“Because it trains my mind”

Assessing the Cognitive and Scholastic Effects of Chess Instruction in Primary Schools of the Soweto Township, South Africa

Master Thesis

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ANA	Annual National Assessment
CAPS	Curriculum Assessment Policy Statements
CfA	Chess for Africa
CHESSA	South African Chess Foundation
DoBE	Department of Basic Education
DoE	Department of Education
EFA	Education for All
FAL	First additional language
FIDE	Fédération Internationale des Èchecs [World Chess Federation]
G	Grade
GATB	General Aptitude Test Battery
GMR	Global Monitoring Report
H	Hypothesis
HL	Home language
IQ	Intelligence quotient
L	Latent [score]
LSO	Life skills/orientation
M	Mathematics
N	Norm [score]
NIE	National Institute of Education
OECD	Organization for Economic Cooperation and Development
PIRLS	Progress in International Reading Literacy Study
R	Raw [score]
RSA	Republic of South Africa
SACMEQ	Southern and Eastern Africa Consortium for Monitoring Educational Quality
SAT	Scholastic Assessment/Aptitude/Achievement Test
SON-R	Snijders-Oomen Non-Verbal Intelligence Test Revised
SPSS	Statistical Package for the Social Sciences
TIMMS	Trends in International Mathematics and Science Study
TONI-3	Test of Non-Verbal Intelligence Third Edition
UNESCO	United Nations Educational, Scientific and Cultural Organization
USCF	United States Chess Foundation
US	United States
WISC	Wechsler Intelligence Scale for Children

1 Introduction

"Education is the most powerful weapon we can use to change the world" (Mandela 2003) and by many considered to be a human right. Prominently, it has been engraved in the Universal Declaration of Human Rights (United Nations 1948: Art. 26) and in many national constitutions, such as the one of South Africa (Republic of South Africa 1996: Art. 29).

Respectively, promoting education has ranged high on the agenda of national governments, organizations, and international initiatives for many decades. In the final year of the initiative, the Global Monitoring Report (GMR) Team, monitoring progress towards the Education for All (EFA) agenda, drew up a sobering balance: On the positive side, the number of out-of-school children has been cut almost in half since 2000. Additionally, much progress has been made in the area of gender parity, mostly in primary education. However, major challenges persist: 58 million children remain out of school, inequalities in the access to education have increased, and conflict is playing a gradually larger role as a barrier to education (EFA-GMR Team 2015a: if).

One finding seems particularly discouraging: In 2014, 130 million children had not mastered basic skills, such as reading or fundamental math, despite having spent at least four years in school (EFA-GMR Team 2015a: 189). This draws attention to the fact that despite the considerable emphasis placed on ensuring access to education, safeguarding its quality has been attended to too a much lesser extent. Thereby neglecting "how much and how well children learn and the extent to which their education translates into a range of personal, social and developmental benefits" (EFA-GMR Team 2004a: 4).

Whilst some children leave school not having mastered basic skills, even more lack soft skills essential for their everyday and particularly their working life in the future. Complaints voiced by different sectors of the working world highlight that many graduates lack those skills crucial to finding one's way in the job market. Ideally, the teaching of these skills falls just as much into the mandate of scholastic education. Schools should function not merely as transmitters of knowledge but are also essential agents in the teaching of core competencies (Bönsch-Kauke 2008: 242).

Considering the disparity of progress in the area of education, it becomes immanent that education is a complex phenomenon that cannot solely be measured in quantitative terms, such as enrollment ratios or performance on international standardized tests. Particularly when investigating education's impact on such a multifaceted phenomenon like development, it is important to reflect upon local context, conceptualization of education, respective limits to measurement, as well as mediating variables to education's impact.

This is necessary in order to guarantee in-depth understanding of the factors at play in the educational sector and to avoid idealizing education as a panacea to solve every problem existing in today's world, particularly in developing countries (Siqueira 2012: 69).

1.1 Education's role in development

Alike to international development discourse, a general consensus can be found in academia: Education has a significant impact both on the personal and societal level. With regard to development, disagreement persists on whether this effect can be considered universal or rather context-bound, requiring certain perquisites in order for its effects to become tangible. Moreover, the impact investigated varies strongly with the conceptualization of education, namely functionalist perspectives emphasizing linear, direct relationships, and relationalist ones, which stress the reciprocal impact education has on relationships within a society. Whether impacts are tangible also depends on the study's emphasis on the micro or macro level (Langthaler 2013: 1, 6f, 12).

The impact of education on development becomes tangible in a variety of ways: Areas in which studies were able to demonstrate a positive effect include economic development (in aspects such as income, growth, and poverty reduction), human development (inter alia social cohesion, health, early childhood development, and nutrition), governance (regarding the development of democracy, and the prevalence of conflict), as well as gender relations (particularly regarding the empowerment of women).[1]

Early research on the topic had focused on Human Capital theory and conceptualized education as a means to increase skills, productivity, and eventually earnings. In this regard, an increased number of years of schooling directly translated into higher earnings of the individual and the respective household. Yet, the returns of education were found to be dependent on the poverty status of the household and community, which was traced back to lower quality education in poorer areas. The level of educational attainment was, furthermore, found to be relevant. Traditional research had determined that an additional year of schooling results in an approximate 10% increase in earning; the effect being strongest for individuals leaving school early, and backing up development cooperation's focus on primary schooling. However, more current research shows a shift: Wage returns for primary education have been on a steep decline since the mid-1990s, compared to both absolute and relative wage returns for secondary and, even more so, tertiary

[1] Limited by the scope of this paper, only key findings of current literature will be pointed out. Outlining the discourse on education and its impact on development in its totality would be sufficient for a master thesis in itself. The same holds true for quality aspects of education elaborated on in chapter 1.2. For the individual studies, please refer to the extensive bibliography of studies listed in meta-analyses such as Langthaler (2013) and Riddell (2008).

schooling. Considering that educational expansion overtook the rate of job creation, the dependency of education's impact on labor market demands is highlighted (Colclough 2012: 154ff). Transferring this positive economic impact onto the macro level, fails to produce an equally consistent effect. Without a conducive environment, investments in education are not able to guarantee economic growth. Other educational indicators such as educational quality (see 1.2) serve better to explain economic development than traditional yardsticks such as years of schooling. The institutional environment as well as political and macroeconomic stability is found to play a major mediating role in the relationship. With regards to distributional effects, impact is twofold: Whilst education can ameliorate the income gap, educational inequality (manifest in unequal access, unevenly distributed quality, or unequal value on the labor market) can perpetuate and even amplify inequality (Langthaler 2013: 14ff). The disproportionate occupation with statistical averages might conceal these distributional, but also regional, disparities (Colclough 2012: 165).

Following a more social perspective, education is assumed to alter the behavior of people, translating into changes in the dimension of human development. Direct positive effects were found for health indicators for both the individual and his/her children. Closely associated with an increased autonomy and knowledge of women through education, a decrease in fertility rates and infant mortality, as well as improved health and child nutrition was observed (Colclough 2012: 159f). Here, education's impact on gender follows two lines of argumentation. Functionalist perspectives highlight the direct positive effects mentioned before, whereas relationalists focus on the impact education has on gender roles and empowerment. Much more difficult to measure and assumed to be rather indirect, such effects are harder to detect. Yet, reference is made to increased self-determination for women and opportunities for participation. In this regard, prevailing social and cultural norms continue to have a strong mediating effect (Langthaler 2013: 18f; Colclough 2012: 157, 167).

With regards to governance, some studies are able to find a positive relationship with democratic attitudes and, albeit weak, political participation, as well as with the ability to form critical opinions and evaluate current processes in politics. Nonetheless, education does not seem to be directly related to more democratic attitudes (Langthaler 2013: 17).

Despite the fact that some of the relationships mentioned seem to be non-context bound, the majority of research emphasizes the importance of other elements that can hinder, lessen, or promote education's impact on development. Most central to this research, educational quality as a determining factor will be elaborated upon below.

1.2 The quality imperative of education

Despite its commonsense appeal, uncontested statements on the effect of and on educational quality are even more problematic to make. This is not due to a lack of research, but rather to the large volume of discordant findings. Riddell (2008: 40), for example, points out: “Ironically, we seem to know too much and not enough.” Particularly regarding determinants of quality in schooling, “no general theory [...] has been validated by empirical research” (EFA-GMR Team 2004b: 228).

Heneveld (1994: 6) provides a useful framework for organizing factors determining school effectiveness by allocating them to “supporting inputs”, “enabling conditions”, “school climate”, and “teaching and learning process”. These are mediated by both “children’s characteristics” and “contextual factors”, such as political climate and social norms, and result in a variety of “student outcomes”, measured not only in academic achievement, but also regarding participation in school, social skills, or economic success after graduation (see A1). As research has become immensely compartmentalized, Riddell (2008: 48) assigns all variables under examination in her extensive review into this framework:[2]

<table>
<tr><th>Supporting inputs</th><th colspan="2">Enabling conditions</th><th>School climate</th><th>Teaching/ learning process</th></tr>
<tr><td>Textbooks and other instructional materials</td><td rowspan="8">Teachers</td><td>Subject knowledge</td><td>Community</td><td>Time on task</td></tr>
<tr><td>Class size</td><td>Verbal ability</td><td>Teachers’ presence, commitment, incentives, status</td><td>Pedagogy (direct instruction, active teaching</td></tr>
<tr><td>Distance to learners</td><td>Language</td><td>Order, discipline</td><td>Maternal language</td></tr>
<tr><td>Classroom and school amenities</td><td>Pre-service and in-service education</td><td>Goals, improvement</td><td>Reading</td></tr>
<tr><td>Pre-school</td><td>Pedagogical repertoire</td><td>Curriculum</td><td>Homework</td></tr>
<tr><td>Children’s health and nutrition</td><td>Experience</td><td>Standards, expectations</td><td>Assessment and feedback</td></tr>
<tr><td>Parental involvement</td><td>Proximity to school</td><td rowspan="6"></td><td>Multi-grades</td></tr>
<tr><td>Community involvement</td><td>Gender</td><td>Ability grouping</td></tr>
<tr><td>Teacher supervision and development</td><td rowspan="3">Head teachers</td><td>Leadership</td><td>Repetition</td></tr>
<tr><td>Standards, institutional guidelines</td><td>Supervision</td><td rowspan="3"></td></tr>
<tr><td rowspan="2"></td><td>Training</td></tr>
<tr><td colspan="2">Time</td></tr>
</table>

Table 1: Variables inquiring further investigation and contextualization (own illustration, Riddell 2008: 48).

The multitude and relevance of these factors need to be considered in the light of their respective origin. Whilst researchers associated with the “policy mechanics” and

[2] As mentioned before, it is not possible to analyze the impact of each of these factors in detail. Factors concerning the research focus of this study relating to the learning and teaching process will be considered paramount.

supporting the "quality movement" tend to focus on aspects to be easily measured and implemented (as it is required for politics and management issues), those referred to as "classroom culturalists" strive to contribute to the "quality debate" and center on pedagogy and less tangible effects (Riddell 2008: 13f; Soudien 2012: 99).

Crucially, it is pointed out that "success [of interventions] depends greatly upon the political context of a country's education system and the institutional history of education in a given country" (Boissiere 2004: 26). Finding the appropriate mixture between quality-determining factors will, therefore, always require "experimentation, hypothesizing, and evaluation" in the respective context (Riddell 2008: 39).

In addition to the disagreements in academic discourse, many developing country's monitoring systems fall short of adequately capturing data on educational outcomes, both, regarding timeliness and data quality.[3] Along with the inconclusiveness of empirical findings, this lack of progress analysis prohibits an effective tailoring of appropriate and effective policies to the respective country context (Global Partnership for Education 2014: XIX).

In this thesis, quality of education is defined as the attainment of the following objectives: firstly, facilitating the learner's cognitive development, and secondly, promoting commonly shared values and supporting the creative and emotional development of the student (EFA-GMR Team 2004b: 5). The emphasis in this research is thus placed on the cognitive abilities of children, going beyond standardized measurements, and only secondly on skills becoming immanent in academic performance. The focus on the teaching and learning process, hereafter, adapted in this research represents only one intervention area for ameliorating education quality.

Concerning the regional relevance of this study, countries in SubSahara Africa are particularly affected by the problematic of low educational outputs (EFA-GMR Team 2015b: 7f). Despite major advances in access to education, South Africa – case study country to this research – also falls into this category.

1.3 Reform and quality in the South African schooling system

Post-Apartheid, the newly elected government faced the major challenge of having to, address the issues of access, equity, and quality in education at once (EFA-GMR Team 2004b: 54). In interpretation, struggles in transforming the education system can never be

[3] Instead they often rely on international standardized tests as a measure for performance. Reducing education to learning, and learning, thereafter, to performance on these tests "contributes to fostering the commodification, sterilization, and standardization of knowledge". Instead of considering country context, "a best performer education reform agenda from a distinct social and cultural milieu" is imposed (Siqueira 2012: 79f).

completely disconnected from overcoming the legacy of racial segregation (RSA, DoBE 2013a: 5). Mandela (2003) described it as follows:

> "South Africa inherited a highly dysfunctional educational system from the Apartheid era. It is our one of our major tasks of reconstruction to build an educational system that provides quality opportunities for all our people."

Accordingly, the first ten years after 1994 were characterized by a variety of initiatives to improve access, equity, quality, and democracy of the schooling system, constituting a systemic approach to transform the totality of the educational structure. With regards to quality improvement, attention was shifted to an outcome-based teaching system, teacher education, a teacher redistribution and deployment scheme, introducing school specific financing schemes (i.e. school fees) to lessen the strain on the national budget, as well as to a holistic curriculum reform. These initiatives were intended to set the stage for consequent improvement (Chisholm 2004: 2ff, 20).

In 2001, significant improvements were reported on infrastructural issues such as the provision of basic facilities (e.g. sanitation, telecommunications, water provision, power supply, or access for learners with disabilities). Yet, little impact was tangible with regard to learner performance (Chisholm 2004: 5f, 9), forcing the Department of Education (DoE) to admit "that quality of education in South African schools is worryingly low relative to what South Africa spends on schooling" (RSA, DoE 2003: 107).

Furthermore, unintended effects accompanied the reform process. Whilst the redistribution scheme aimed at balancing the teaching staff between privileged and under-resourced schools, it failed at removing teachers from better-equipped schools. Instead, a significant number of new teachers was hired in the poorer provinces, resulting in an alarmingly high ratio of un- and underqualified teaching staff in these areas (22% in 2000). In contrast, the introduction of school fees enabled schools in well-endowed areas to hire additional teachers to maintain and advance educational quality, increasing the disparity between schools. Inequalities continued to exist between provinces, between urban and rural contexts, as well as in between formal and informal schooling settings, and held true for both structural issues as well as qualitative indicators. These "contours of quality differences by and large continue[d] to reflect historical legacies and differences" (Chisholm 2004: 6f, 9f). Focus was shifted to systemic improvements that take local specificities into consideration, namely enhancing the capacity of the decentralized education districts, paying attention to appropriate language for learning and instruction, further teacher qualification, and improved presence, control, and use of learning resources (Chisholm 2004: 16f, 20).

Another major component of reform was the continuous refinement of the curriculum.[4] Mostly, the (first) new curriculum (Curriculum 2005) emphasized a departure from rote to activity-based learning and learning outcomes that are measured against the “kind of citizen the education and training system should aim to create”. Shortly after its introduction in 1997, it was heavily criticized for its complexity and inapplicability for schools with less qualified teachers who were increasingly overwhelmed by the task to design their own curricula and learning materials. Its reform to be implemented in 2004 was more straightforward and identified goals, expectations, and learning outcomes as well as assessment standards, while leaving considerable room for teacher creativity. Yet, learners continued to score frighteningly low, both in international comparison (e.g. in grade 6 math proficiency they scored ahead of Namibia and Lesotho, but behind any other country in the Southern African region) and well below the expectations of their own curricula (Chisholm 2004: 11-15).

Another century later, and despite major public investments in education,[5] learning outcomes have remained comparatively low, giving indication of the extent of the remaining challenge. It was concluded that South Africa’s education problem could be attributed to the insufficiency of basic skills (such as literacy or numeracy) acquired at the primary level (RSA, DoBE 2013a: 44). Having participated in three major international performance assessments[6], results have been disappointing as South Africa, firstly, scored low compared to other countries, and secondly, desired improvements could not be realized. Yet for the first time, the 2011 TIMSS showed a statistically significant improvement in math and science of grade 9 learners despite their low base line performance. This represented the “first unambiguous improvement pattern” in international testing. Considering the slowness of reform, it was suggested that these improvements can be traced back to a ripple effect of the Foundations for Learning campaign in 2008 which provided grade R-6 learners with improved teaching materials and trained teachers (RSA, DoBE 2013b: 3, 10ff). Moreover, increased equity can be

[4] A more detailed account on the most current curriculum reform, its contents and relevance for the upcoming research is given in chapter 3.4.

[5] In 2013 for example, the education sector received the largest proportion of the national budget (namely R232.5 billion of R1.06 trillion). Yet, the country ranked lower in measures of learner performance and teachers’ subject knowledge on international comparative tests administered than those countries in the region with similar or less spending on education (RSA, DoBE 2014a: 10). In 2014, government’s expenditure on education comprised 6.6% of the country’s GDP and 19.11% of total government spending

[6] Namely the Trends in International Mathematics and Science Study (TIMSS) (participation in 1995, 1999, 2002, and 2007), assessments by the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) (2000 and 2007), and the Progress in International Reading Literacy Study (PIRLS) (2006 and 2011) (RSA, DoBE 2013a: 10).

observed as the TIMSS results show starker improvements in the lower-performing sections of the school system (RSA, DoBE 2013a: 77).[7]

Yet, shortcomings continue to exists, particularly with regard to "weak" input indicators such as curriculum coverage and teacher qualification. Even though some form of learning is taking place in every school, the range of topics covered varies immensely: For example in grade 6 mathematics, 20% of schools completed four or less exercises of the curriculum, whereas the highest-scoring quintile managed to complete ten or more exercises within the same timeframe. This is bound to translate into unalike learning outcomes. With regard to teacher qualification, an increase of qualified teaching staff (at least three years of training after completion of grade 12) has occurred to an average of 97% in 2012. This represents the highest proportion of teachers with a degree in the SubSahara African region and the second highest average years of training. However, teachers' subject knowledge ranged below those countries with similar or less teacher training, raising the question of the quality of teachers' pre-service and in-service training (RSA, DoBE 2013a: 59, 62f).

Considering the perspectives of learners and their parents, a general household survey focusing on schooling investigated self-perceived issues with the system in 2012. When inquiring about reasons for not attending school, 11.3% of the eight- to 18-year-olds reported that the education they were receiving was "useless or not interesting" and another 7.8% alleged that they were "unable to perform at school". From those attending school, the ratio of self-perceived problems with the learner's education has decreased over the past decade. Nevertheless, 2.2% consider poor teaching to be a problem in their school, other issues include a lack of teachers (3.0%), large classes (4.7%), but mostly a lack of books (6.6%) (RSA, DoBE 2014b: 17f, 21-24).

Most current reforms of the DoBE are yet another curriculum reform ("National Curriculum Statement Grades R-12" in 2011) and a detailed sector action plan ("Action Plan to 2019: Towards the Realisation of Schooling 2030" in 2015).

This most current reform and the supplementary Curriculum and Assessment Policy Statements (CAPS) represent a shift towards a much prescribed curriculum. The CAPS outline for every teaching phase and subject what is to be taught, how it is assessed, how lesson plans should be prepared, and how teaching should take place. Accompanying measures are the massive distribution of standardized teaching materials and the

[7] As pointed out in 1.2, educational quality measured solely in terms of these tests should be interpreted with caution. A national assessment system, introduced 2011, will be outlined later on.

introduction of the Annual National Assessments (ANA), a nation-wide annual assessment of learners' performance (RSA, DoBE 2014a: 33).

Until the introduction of ANA in 2011, assessment on educational outputs was made against international testing standards. The only national testing was conducted through the matric exam at the end of the schooling career, but not on more fundamental levels (RSA, DoBE 2013a: 44). The new assessment system provides an opportunity for a contextualized and disaggregated form of educational testing against local standards. Improvements in test design and marking are still necessary in order for the ANA to become a reliable testing tool that can facilitate comparison across regions and different time frames (RSA, DoBE 2013b: 12).[8]

The Action Plan to 2019 outlines 27 goals from which 13 focus on educational output (meeting minimum standards, improving average performance, compulsory schooling, access to early childhood education, and improving grade attainment) while the other 14 seek to deal with how to improve schooling (inter alia teacher capacity and professionalism, curriculum coverage, and school management).[9] Particularly in the latter goals, emphasis on educational quality becomes immanent. Yet, quality is still merely assessed through operationalizing standardized testing and pass rates, contributing to the lack of data on quality such as cognitive development of the learner beyond academic success (RSA, DoBE 2015: 1ff). Up until 2030, the action plan encompasses a rather large time frame and acknowledges that:

> "Whilst we do need to accelerate change, it must be remembered that certain changes in education systems tend to be slow. The key thing, as indicated in the vision of the previous section, is to ensure that there is continuous improvement and that changes are as large as can be expected. In the end, a large improvement is the accumulation of many smaller changes." (RSA, DoBE 2015: 10)

This inherent inertia of system reform must always be taken into consideration when evaluating progress. Furthermore, in 2015, South Africa's schooling system entered an "era of unprecedented stability". For once, no grade had to realize provisions made under a new curriculum reform and were free from yet another reform looming. A nation-wide curriculum and universal assessment standards were the result (RSA, DoBE 2015: 10, 13). Whether this signals the end to a two-decade long development process remains to be determined.

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[8] During the course of the research, the 2015 ANA was scheduled but cancelled on a Friday afternoon before the tests were supposed to begin the following Monday. A repetition date is yet to be set. This incidence further highlights the difficulties in obtaining high-quality, timely data on performance indicators.

[9] For a complete overview of goals and priorities see A2f.

Most current data, yet limited to standardized testing, stems from the Report on the ANA 2014. Still, it shows alarming low learning outputs. After grade 3, 44.4% of the students score below the acceptable achievement mark of 50% in math and 43.4% in their home language. Rates are even more distressing at later stages. Despite finishing grade 9, the majority of students do not achieve acceptable levels of performance: 52.2% in home language, 85% in their first foreign language, and 97.1% in math. Big disparities between provinces continue to pose an additional challenge (RSA, DoBE 2014c: 65, 68f, 73-85). So far, policies have not yet achieved their intended impact.

1.4 Chess as a means to enhance educational outcomes

Internationally, "traditional" policies for better learning have focused on enlarging the teacher workforce, improved teacher training, extending class time, moving towards more child-centered pedagogy, first language instruction, better-quality teaching materials, renovating facilities, and decentralizing and ameliorating school governance (EFA-GMR Team 2004a: 3). As illustrated in the previous section, the Republic of South Africa follows this trend aiming at a systemic improvement of the entire education system. In their Action Plan 2019, the DoBE (2015: 10) pointed out that realizing their objectives needs to be considered a time-intensive process.

Against the backdrop of low educational quality and inertia of systems reform, alternatives need to be identified that – in the meantime – are able to ameliorate the learning situation in a timely and effective manner. Since the 1970s, chess teachers and masters have claimed that methodical chess lessons might be an apt choice to increase learning outcomes.[10]

"Chess is the touchstone of the human intellect" was supposedly already voiced by Johann Wolfgang von Goethe. Chess, the game of kings, has fascinated humankind for centuries and has been subject to research for more than a hundred years. But only in the late 1960s, the question was started to be asked whether playing chess had an effect on cognitive development (Bönsch-Kauke 2008: 26, 198). If one considers the underlying rationale of the origin of chess, it does not seem far-fetched that playing the game on a regular basis might entail personal benefits. Legend has it that an Indian ruler had requested several wise men to develop a teaching tool for the children of the royal family. He, thereby, hoped to make his children better thinkers and better strategists on the battlefield. The result of this exercise was *chaturanga*, an early version of the game of chess dating back more than 1500 years (Meyers 2004: 9).

[10] For a comprehensive overview, see Ferguson Jr. (1995) or McDonald (2004).

In an ever more complex world, the ability to analyze situations strategically and to arrive at sound decisions is as relevant as it was back then. With easy access to and unprecedented amounts of information that is brought about by the digital revolution and rapid globalization, being able to choose from a variety of options has proven crucial for personal, scholastic, and professional success. The processes of information gathering and processing that are employed while playing chess teach valuable life skills, particularly when taught to children in early years (Bönsch-Kauke 2008; Dauvergne 2000). Hence, Dauvergne (2000: 6) concludes: “The case, then, is exceptionally strong for using chess to develop our children’s minds and help them cope with the growing complexities and demands of a globalising [sic] world.”

Neither the notion of integrating chess into school curricula nor research on its educational benefits is particularly new. A major bulk of research has been conducted in between 1970 and the mid-1990s and, after a short dry spell, since the mid-2000s. To various extents, the methodologically diverse studies arrive at an almost unanimous conclusion: Chess, methodically taught, has the potential to enhance the cognitive abilities of children (such as problem-solving, creativity, and thinking ahead) and thereby also their academic performance. Ferguson Jr. (n.d.: 9) summarizes:

> “Chess is a new way of solving the old problem of poor education. From the streets of Harlem to Venezuela's public schools the sport of kings has been implemented as an effective tool for teaching students to utilize their higher order thinking skills and to strive to overcome personal problems to reach their full potential.”

Despite the large body of existing research, chess lessons within the framework of developing countries’ education systems have been largely neglected.[11]

1.5 Study design

Recalling the crucial importance of context for effective interventions, an equally positive effect of chess instruction in developing countries’ schools cannot be simply assumed. To fill this gap, this master thesis aims to investigate a well-researched phenomenon in a different context; hereby trying to answer the research question whether the introduction of methodical chess lessons positively influences the cognitive abilities and learning outcomes of primary school children in township schools in South Africa.

The project “Chess for Africa” (CfA) served as a case study for this purpose. The project trains interested teachers, educators, and social workers to teach methodical chess lessons

[11] Exceptions include Albert Frank’s Zaire experiment “Chess and Aptitudes” (1973-74), the large-scale social “Learning to Think” experiment in Venezuela (1980-84), as well as smaller current studies such as that of Kazemi, Yektayar & Abad in Iran (2012). For elaboration on these studies see 2.2 and 2.3.

in their corresponding schools. Due to the fact that the project has worked mainly in the Johannesburg and Soweto area in South Africa, three local primary schools were sampled. In terms of methodology, the study followed a mixed-method approach: Alongside with non-verbal testing procedures to assess the children's cognitive development and scholastic records that were analyzed quantitatively, qualitative interviews were conducted with the learners' chess instructors to elaborate on possible explanation mechanisms for their development.

1.6 Paper overview

Backing up the claim of many chess players and masters that chess hails educational benefits, selected studies dealing with different aspects of cognitive development through chess and its effect on academic performance will be examined in chapter 2. In addition, studies with particular developmental relevance will be scrutinized in more detail (2.3) and critical literature will be reflected upon (2.4). The theoretical framework (3) will draw upon Robert Mills Gagné's theories on "The Conditions of Learning" and "Principles of Instructional Design", reinforcing the idea that incorporating problem-solving exercises such as chess into the curricula will eventually result in enhanced cognitive development and better learning outcomes. They will be related to both thinking in chess (3.3.1) and chess instruction (3.3.2), as well as to their relevance for the South African context (3.4). Chapter 4 on the methodological approach will outline the specific aspects of the field research such as the case study (4.1), field access and sampling procedure (4.2), as well as methods of data collection (4.3) and analysis (4.4). Limitations to the study will be continuously reflected upon. The results chapter (5) will present the quantitative and qualitative empirical findings of the field research period and will relate these to the theoretical framework. The conclusion (6) will summarize this thesis' key findings, evaluate them, and sketch possible implications of the research outcomes.

2 Literature review on the educational benefits of chess

Prior to turning onto the scholastic benefits of chess, it is important to understand the genesis of chess research and its rootedness in experimental psychology. One of the first to systematically examine the relationship between chess and cognitive processes was the Dutch psychologist Adriaan de Groot in the 1940s. In his book "Thought and Choice in Chess" he found fault with the large body of research on chess:

> "The chess literature is for the most part of a purely technical nature. It deals with the play and not with the player and his way of thinking; it treats the problem and not the problem solver." (Groot 1978)

Hitherto, studies existed that inspected the mental capacities needed for chess and case studies on chess players from a medical stance (Christiaen 1981: 9; Bönsch-Kauke 2008: 317). De Groot therefore set out to "carry out an experimentally based psychological analysis of chess thinking". In his early experiments with chess players, he sought explaining variables for chess skill through systematical psychometric tests (Christiaen 1981: 13).

The reverted question on how chess influences the cognitive abilities of those who play it, was not asked until the 1970s. Much scientific, anecdotal, and populist literature has emerged since then. Extensive collections of literature by the United States Chess Federation (USCF) and similar organizations show that chess masters and chess teachers are certain about the educational benefits that chess lessons entail (Gobet & Campitelli 2006: 1). Amongst others, they propose that methodical chess lessons have the potential to improve academic performance, creativity, problem-solving skills, memory, self-esteem, concentration, sportsmanship, communication, intuition, as well as to reduce aggression. Together with the argument that chess lessons are easily (and cheaply) implemented, inclusive, and appropriate for school-children of all ages, the claim is voiced that chess instruction should be integrated into schools.

The body of proof used to strengthen this claim is vast and multifaceted, but only some of the studies, reports and statements have been published and/or peer-reviewed.[12] The following chapter will outline the major findings of chess literature on education in the period from 1970-1995 and since the start of the new millennium, highlight studies with a particular developmental relevance, and examine critical voices both with regard to content and methodology of previous studies.[13]

2.1 Les échecs en vogue: Research from the 1970s to the mid-1990s

Chess lessons in schools are by no means a new phenomenon. Ströbeck in Germany claims to be the first town in history that introduced obligatory chess lessons, namely in 1823, and has cultivated this tradition ever since. In the former Soviet republics, chess was taught in "children and youth chess schools" on a voluntarily basis in the afternoon. Reports on first trials on the effect of these lessons on school grades in Moscow's 464th school date back to 1957 (Bönsch-Kauke 2008).

[12] This refers particularly to studies from the period 1970-1995, more recent studies (described in 2.2) have been increasingly published in peer-reviewed journals.

[13] Apart from the studies selected for this review, a large body of research on chess and its cognitive effects and precedents exists using adults as test subjects. As this study concerns itself with the instruction of chess in schools, only research on children and in the scholar context is considered.

Nevertheless, systematic research on chess in schools began only in the 1970s. Albert Frank's doctoral dissertation on chess and aptitudes in Kisangani, Zaire from 1973-74, can be considered the first impetus for a wide variety of experimental field studies on the topic. Due to its particular developmental and geographical relevance, the study, its design and results will be examined in more detail in chapter 2.4.

Another stepping stone to establishing the research field was presented by Johan Christiaen's doctoral dissertation on chess and cognitive development, 1975-76 in Belgium. Christiaen used a posttest-only design with randomized groups to assess whether an enriched environment, such as chess lessons, would accelerate the transition within the stages of cognitive development as postulated by Piaget; and whether it would increase school performance and general measures of intelligence. When comparing intervention and control group, he could observe that the chess group scored significantly higher when it came to their scholastic results and the nation annual ability test. The Piaget-tests did not heed a sufficiently significant results in terms of chess players having advanced further in Piaget's cognitive stages (Christiaen 1981: i, 21-24, 49-57).

Afterwards, many studies specifically targeted the relationship between chess and certain abilities such as critical thinking, creativity, memory, math, or reading skills. To avoid going beyond the scope of this paper, only those studies that focus on aspects congruent to this thesis' research interest, namely cognitive abilities immanent in skills such as (creative) problem-solving and their translation into academic performance, will be dealt with.

Ferguson conducted several studies with different foci in the time period between 1979 and 1988. In his first four-year study, Ferguson compared 15 chess-playing gifted students with talented students undertaking various other after-school activities (e.g. computer-based problem-solving, creative writing, or games such as dungeons and dragons). When tested for their skills in critical thinking and creativity, he found that the students from the chess group improved their performance in critical thinking on the Watson-Glaser Critical Thinking Appraisal annually by 10.5%, realizing an average percentile gain of 17.3% vis-à-vis the national norm. Moreover, those gains were significantly higher than those of non-chess playing students. The same held true for the chess students' gains on the Torrance Test of Creative Thinking[14], namely in verbal fluency, flexibility and originality (Ferguson Jr. 1986a: 2f, 6).

[14] The Torrance Test of Creative Thinking measures the general mental abilities fluency, originality, flexibility and elaboration that are "regarded as indicators of creative potential that increase the likelihood of creative behavior" (Runco et al. 2010: 361f).

In a two-month follow-up study, Ferguson used a larger sample to compare gains made by chess-playing students and gains made by gifted students taking a college test (SAT) preparation class in their respective areas. Since the chess-playing learners realized much larger short-term percentage gains than the SAT group; particularly those classified as "non-gifted" increased their achievement by 27.1%. Ferguson (1986b: 4) concluded that "chess may enhance and expand [...] thinking concepts at a faster rate". The direct comparison of gains in different areas and a group of gifted students with a mixed group should nevertheless be interpreted with caution (Ferguson Jr. 1986b: 4).

Gaudreau (1992) worked with a much larger sample from 1989 to 1992 in New Brunswick, Canada. Following Robert Mills Gagné's learning theory that skills obtained through problem-solving exercises were easier transferable and more resilient against being forgotten, she divided 437 students in to three groups: Group A received the traditional curriculum of math (control group); group B received one year of "regular" classes and thereafter math classes that were complemented with chess and instruction on problem-solving (enriched classes); and the third group C started with enriched classes in year one. A standardized math test at the end of the study showed no significant differences in the sections requiring basic calculation, but both group B and C scored significantly higher than the control group A on the problem-solving and comprehension sections. It is reported that the project gained that much attention that participation in the provincial grade school chess championship increased from 120 to 19,290 learners within only three years (Ferguson Jr. 1995: 11; Bönsch-Kauke 2008: 228)!

Moreover, in a study investigating the possibility of inter-domain transfer, Rifner found that transfer of problem-solving skills was possible when that transfer was made an explicit "instructional goal" of teaching (Ferguson Jr. 1995: 11f).

Although they had been specifically targeted in studies, such as those of Ferguson, it was found that chess does not only enhance intellectual resources of particularly gifted students. In contrast, chess lessons were also able to bring latent abilities of disadvantaged school-children[15] to the forefront (Bönsch-Kauke 2008: 225). The New York City School Chess Program which started in 1986 demonstrated this in over 100 schools from poor, high-risk city districts. The "Palm Report" on the project cites many positive effects such as increases in cognitive skills, self-confidence, communication skills, scholastic performance, and values of hard work, concentration, and commitment, as well as an

[15] Bönsch-Kauke (2008: 225) mentions in particular hyper active, shy, suicidal, mentally handicapped, aggressive, criminal, drug addicted students, and those who refuse to actively participate in school.

improved understanding of gender equality (Ferguson Jr. 1995: 9f).[16] A quasi-experimental assessment of the effects of the program can be found in a study conducted by Margulies from 1990 to 1991 in the Bronx of New York. In addition to chess instruction in the first year, students had the opportunity to enhance their playing with chess software and long-distance matches in the second year. Comparing the pre- and post-scores of the Degree of Reading Power Test, Margulies found that while the control group performed below the national average, most chess players outperformed the average (Margulies 1991: 4, 6f, 9).

Teachers' anecdotal material (Coudert 1989; Russo 1997; MacEnulty 2010) reinforces the results that playing chess had kept students at risk or with problem behavior "in school and away from gangs, drugs, and other difficulties" (Storey 2000: 46).

2.2 La renaissance: Recent research

Literature from the current century mostly confirms the "classic" studies. Other than the rather scattered and unpublished findings outlined in the previous chapter, most of the following studies have been published in peer-reviewed journals.

In Spain, Aciego, García and Betancort (2012) compared children in an extracurricular chess group with those taking part in other after-school activities such as soccer or basketball by measuring their performance in an IQ test as well as through a self-report and third-party assessment by their teachers. After one year of instruction, chess students had improved their performance in tasks requiring attention, focus, perceptive organization, speed, planning and foresight significantly when compared to the control group. In addition, their teachers reported them to be better adapted to and more satisfied with school, and that they had better problem-solving and coping strategies. Hence, the authors conclude that chess is "a valuable educational tool". As a limiting factor to their research, they draw attention to the fact that if chess is offered as a voluntary activity, it tends to attract those students already better adapted to school. In order to attract those students it could be particularly beneficial for (namely less adapted students), increased efforts and more research are needed (Aciego, García & Betancort 2012: 558f).

Paying particular attention to those students at risk[17], Hong and Bart (2007) could find no significant difference in cognitive abilities when comparing students who had received 12 chess lessons and those who regularly attended alternative extracurricular activities

[16] It needs to be noted that the report relies primarily on records of academic performance and anecdotal evidence (Ferguson Jr. 1995: 10).

[17] Students at risk are defined by Hong & Bart (2007: 89) as those students „who are one or more years behind their age or grade in mathematics or reading skills".

when comparing their performance on three different cognitive tests: the Korean Basic Skill Test, the Raven's Progressive Matrices test, as well as the Test of Non-Verbal Intelligence Third Edition (TONI-3).[18] Then again, when controlling for pretest results on the TONI-3, chess skill ratings proved to be a key predictor for TONI-3 posttest scores. Meaning that students at risk could increase their cognitive skills by improving their chess performance. Therefore, the authors discuss the possibility that 12 hours of instruction might have been too limited, and that a particular threshold of chess skills need to be attained for the transfer to come into effect. In line with Aciego, García and Betancort, they call for increased research with regard to the target group of children at risk and for customization of chess pedagogy (Hong & Bart 2007: 92ff).

In further recent studies, the relationship between chess instruction and math skills received particular attention and it was found conclusively that methodical chess lessons improved performance in mathematics. In 2000, Smith and Cage found improved math skills and non-verbal cognitive abilities of students in the rural south of the US after 120 hours of chess instruction (Bart 2014). Similarly, Kazemi, Yektayar and Abad (2012) reported significantly higher math scores and meta-cognitive abilities in a sample of 180 randomly assigned Iranian students after teaching 86 of them chess for six months (Kazemi, Yektayar & Abad 2012: 374ff). Using a very elaborate Solomon 4-group experimental design[19] and a large sample of 568 children, Trinchero (2013) was able to demonstrate that the chess groups improved their performance on the OECD-Pisa math items significantly more than the control group. Thereby, the duration of chess instruction and chess skill had a significant positive impact on posttest scores. At least 14 hours of chess instruction were necessary for subgroups to significantly perform better (Trinchero 2013: 4f, 10).

A call for more research on the topic dominates the discussion section of recent literature (see 2.5).

[18] While the Korean Basic Skill Test of the Korean Ministry of Education and Human Resource Development and the Korean Institute of Curriculum and Evaluation measures students' skills in mathematics, reading and writing, the Raven's Progressive Matrices test is designed to measure non-verbal intelligence such as performance in logical thinking, analogical reasoning, and spatial abilities. Similarly, the TONI-3 measures cognitive capabilities in terms of non-verbal intelligence such as problem-solving skills and reasoning (Hong & Bart 2007: 90f).

[19] A Solomon 4-group experimental design can be used to rule out the possibility that a treatment effect can be traced back to an interaction between stimulus (intervention) and the existence of a pretest. Therefore two further groups are added to the standard experimental setting where an intervention group and a control group are measured on both a pre- and a posttest: yet another group receiving the treatment/intervention and a control group which have both not undergone a pretest and are merely assessed post-intervention (Schnell, Hill & Esser 2008: 224f).

2.3 Studies with particular developmental relevance

Before becoming popular in Europe during the time of the Crusades, the game of chess had already travelled and fascinated players from all over the world. From its early conceptualization in India in approximately 570 AD, the game had travelled from India to Iran and to China, from Iran into the Arab world, and into Northern Africa. Only due to the Arabic conquests, the game of kings also spread throughout the European kingdoms. With this in mind, chess can be considered much more rooted in those countries nowadays considered as developing countries (Frank 1978: 2). Yet, research is strongly biased towards the effects of chess in European, Anglo-American, or formerly Soviet settings. This chapter will therefore highlight two very influential experiments undertaken in developing countries.

Despite being the first systematic study on the effects of chess on cognitive abilities, Frank's doctoral dissertation represents simultaneously the only study conducted in the African context. In line with former research on chess skill and abilities, Frank firstly sought to determine which aptitudes in students function together to create chess playing skills. The novelty of his work became immanent in his second hypothesis that postulated an additional, opposite causality: "Learning chess is a procedure which can influence the development of aptitudes […]" (Frank 1978: 12). Furthermore, he had already considered the possibility that, if that was the case, chess might be an enriching supplement to the school curriculum (Frank 1978: 12).

In a Kisangani school, 92 students between the age of 16 and 18 years[20] were distributed randomly into two groups. Whilst the intervention group was instructed in chess, the control group was not given any alternative treatment. Both groups were examined using a battery of psychometric tests[21] in both a pre- and a posttest. To test his hypotheses, Frank correlated the intervention group's pretest results with their chess proficiency after the instruction (H1) and compared trial and control group's posttests at the end of the study (H2) (Frank 1978: 12ff).

At the end of the experiment, Frank (1978: 70) concluded: Due to the overall positive correlations between chess skill and the aptitudes measured, "chess playing is related to the possession of a large number of abilities, some greater than others, but all effectively

[20] It is to be noted that the age group Frank chose is significantly older than the students in most other studies.

[21] The tests given included the Primary Mental Abilities test to measure verbal meaning, spatial aptitude, reasoning, numerical aptitude, and verbal fluency; parts of the Differential Aptitude Test (numerical aptitude, abstract reasoning, spatial aptitudes, mechanical reasoning, clerical speed and accuracy); in parts the General Aptitude Test Battery (GATB) (comparison of names, calculation, three-dimensional figures, vocabulary, comparison of instruments, arithmetic reasoning, comparison of forms); the D_2 test to measure visual attention and concentration; and lastly the Rorschach test for personality analysis (Frank 1978: 15-18).

participating in playing the game."[22] With regard to his second hypothesis, he found that chess instruction improved both numerical aptitude and verbal abilities at a significant level. All other tests rendered insignificant results (Frank 1978: 74f).

Frank's study draws attention to the fact that the method and level of difficulty of chess instruction matters. His is the only study reporting that students openly showed aversion to the chess lessons.[23] He already reflected that the tests chosen might be highly criticized for being inappropriately used in other cultural settings (Frank 1978: 13) which has proven true later (see 2.4).

Another striking experiment was conducted in a developmental setting: the "Learning to Think" project initiated by the Venezuelan government in 1980 and supported by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Chess Federation (Fédération Internationale des Échecs (FIDE)). Trying to prove that chess can be used as a "tool of learning and as a mechanism of transfer of intelligence" (Tudela 1982: 2) a pilot project was initiated at a randomly selected school in Caracas with 4266 subjects. Within five and a half months, the project team was able to produce a significant increase in the intelligence quotient as measured by the Wechsler Intelligence Scale[24] that could be attributed to methodical chess lessons (Tudela 1982: 2). The results held true for both boys and girls regardless of socio-economic background (Bönsch-Kauke 2008: 213).

By 1981, 100,000 teachers had been trained the methodology and 42,000 of them had started to teach approximately 1,200,000 children (Tudela 1982: 1). Most remarkably, the results led to the introduction of chess lessons in all Venezuelan schools starting with the 1988-89 school term (Ferguson Jr. 1995: 8).[25] Due to striking social inequalities and a

[22] Specifically, he found visualization, numerical aptitude, administrative abilities and skills like precision in perception, visual memory, and speed to be significantly correlated with better chess skills (Frank 1978: 70).

[23] During the course of the study, Frank (1978: 26) had to admit to the fact that after initial curiosity "the lack of the interest in the chess course was striking". As possible reasons he lists the compulsory nature of the course, its level of difficulty, a fear of failing as well as discouraging elements of the game for beginners. In contrast, most authors highlighted the popularity of the chess program such as Palm (1990), Gaudreau (1992), or Trinchero (2013). Also, CfA reported almost solely positive responses to the project (Becker & Becker 2015). Furthermore, overall scores were very low, which he traced back to the same causes, but also to the very complex and lengthy testing procedures (Frank 1978: 13).

[24] The Wechsler Intelligence Scale for Children (WISC) sets out to not only measure an overall intelligence quotient by answering verbal items but instead incorporates multiple practical tests to calculate subscales that can be used to analyze strengths and weaknesses of a child. It draws on Wechsler's intelligence concept that intelligence should not be seen as a specific asset but rather as an agglomeration of various skills. Since its introduction in 1949, the WISC has undergone multiple revisions and adaptations into different languages (Petermann & Macha 2005: 101f).

[25] Furthermore, international responses to the experiment were overwhelming: Tudela (1982: 1) cites the President of the Soviet Union's Academy of Science, Anatoly Alexandrov, as considering the results as a "a matter of great significance not only for Venezuela but also for all of Mankind [sic]" as well as the contemporary psychologist Bee Skinner: "There is no doubt that this project in its total form will be considered as one of the greatest social experiments of this century." Plans for scaling-up the results were voiced amongst others by the World Union of Psychologists and the Chinese government.

continuous extrusion of public education by a growing privatization of schooling, the positive effects of the project could not be upheld (Bönsch-Kauke 2008: 215).

2.4 Critical voices on chess in education

After having examined the supporting (and partly even enthusiastic) literature on the scholastic benefits of chess, it is essential to turn towards the work which takes a more critical stance on chess instruction's assets. This includes methodological criticism on prior studies as much as contradictory evidence. Critics raise the question whether "[…] chess players [have] been blinded by their love of the game into thinking that it offers instructional advantages" (Gobet & Campitelli 2006: 1).

Replicating and building on de Groot's work, Chase's and Simon's investigation (1973) has possibly had the largest consequences. In "The Mind's Eye in Chess", they concluded that practice was the overriding factor in explaining chess skills. Apart from that, they were not able to identify non-chess tasks (e.g. general memorizing) that can be used to explain chess skill, but only chess-related tasks (such as remembering positions of figures on the chess board) (Chase & Simon 1973: 278f).

It was mainly due to their research that the National Institute of Education (NIE)[26] advised against incorporation of chess into US schools. They added that psychological studies conferred that transfer of skills was minimal and that schools should therefore focus on training the specific tasks at hand. Furthermore, time studying chess would only divert attention from other intellectual activities (NIE 1977).

The NIE letter did provoke considerable attention. In a memorandum, de Groot argues that the relevance of the study conducted by Chase and Simon was rather limited when it came to the topic of chess in schools: They had worked with adult chess players and were concerned with high levels of proficiency. This could and should not be transferred to the learning effects of children after basic instruction:

> "Since we are not concerned here with the development of chess mastership or expertise – let alone with raising child prodigies […] – but rather with much simpler goals, the research outcomes in question do not speak against the introduction of chess instruction in school. Rather do they not 'speak' at all – neither pro nor con." (Groot 1981: 3).

He points out that educational research projects such as those conducted by Frank or Christiaen were of much higher relevance. Teaching chess would not divert from other

[26] The National Institute of Education has been formed by US Congress in 1972. It states its role as the following: "To provide leadership in the conduct and support of scientific inquiry into the educational process, to provide more dependable knowledge about educational quality, to improve education […]" (Lyman 1981: iii). The NIE was abolished in 1985 (National Archives 2015).

tasks but instead teach “low-level gains” such as patience and internalizing moral lessons (e.g. accepting defeat) and “high-level gains” such as learning to distinguish alternatives and thinking ahead. In his view, rather issues of specificity or transferability should be addressed. The gain in cognitive abilities might be brought about by other stimulating, playful or learning-by-doing activities. The issue of the difficult transfer of skills from one area to another should in his opinion be solved by appropriate modes of instruction (Groot 1981: 6f, 8). De Groot does not consider chess to be a panacea, but in the end he subsumes: “[…] although I am not a ‘believer’ in the blessings the game of chess, of all things, can bring to mankind, I am satisfied that, in our time, the arguments in favor of chess instruction in school are rather strong” (Groot 1981: 9).

Another strand of critique follows up on contradictory findings regarding the chess-intelligence relationship. Bilalić, McLeod and Gobet (2007) draw from their research that “chess does not need intelligence”. In a study with young chess players, they found that it was practice time that had the most influence on chess skill, measures of intelligence had only a minor effect. In a subsample with the best players, intelligence even correlated negatively with chess rating. In a later study, Campitelli and Gobet (2008) investigated practice time and confirmed strong positive correlations with chess skill. In a more specific manner, Waters, Gobet and Leyden (2002) found in their study that visual memory abilities (and thereby visual-spatial intelligence) had no significant influence on chess skill.

With regard to these studies a similar line of argumentation can be adopted as it was the case for Chase and Simon: Improving chess skills is not a major objective of those advocating school chess programs. Their argument does hold true that if chess increases intelligence, chess players (in general) must be more intelligent than the non-chess playing population (Gobet & Campitelli 2006: 5). Fault lies in the assumption that increasing intelligence amongst chess players must necessarily be accompanied by an increase in chess skills. Their sole focus on chess players might have distorted their assumptions. Considering their line of argumentation, their research is rather in line with early works on the subject (e.g. de Groot) postulating a causal direction from intelligence to chess skill, whilst the literature they tend to criticize examines the reverse relationship from chess playing to intelligence.

Lastly, methodological criticism is voiced by authors such as Gobet & Campitelli (2006). By subjecting various studies to a comparison with what they call the “ideal experiment"[27], they highlight strengths and weaknesses of studies such as those conducted by Christiaen, Frank, Liptrap, Ferguson Jr., and Margulies (see table 2).

	Random allocation	Pretest	Posttest	Control group I (placebo)	Control group II (no activity)	Different teacher and tester	Subjects blind to the experiment
Ideal experiment	X	X	X	X	X	X	X
Christiaen	X		X		X	X	X
Frank	X	X	X		X	X	?
Liptrap		X	X		X	X	X
Ferguson I		X	X		X	?	?
Ferguson II		X	X		X	?	?
Margulies		X	X		X	X	X
Fried & Ginsburg	X		X	X	X	X	?

Table 2: Comparison of the experimental design used in the seven studies reviewed in Gobet & Campitelli (2006: 11) (own illustration).

All studies mentioned are criticized for the lack of a second functioning control group, thereby not controlling for a possible placebo effect of any intervention.[28] Moreover, without a pretest, as it was the case for Christiaen, equal distribution of characteristics between experimental and control group cannot be proven. This again could be ameliorated through random assignment of participants. A non-random assignment of the groups on the other hand increases vulnerability to self-selection biases and could have distorted the positive results of Liptrap, Margulies and Ferguson Jr. Furthermore, statistical fallacies are highlighted (no correction measures for statistical tests by Frank; small sample size of Ferguson). Similarly, generalizability seems doubtful for Frank (extremely low scores and overall unsuccessful course) and Ferguson (only assessing gifted students). Further issues include inappropriate tests for the cultural setting (Frank),

[27] Although an ideal execution of an experiment could be impeded by a variety of practical, administrative and ethical concerns, the following requirements should be fulfilled according to Gobet, Campitelli (2006): "random assignment of the participants to the various groups; presence of a pretest to insure that there is no initial difference between the groups; presence of a posttest to measure potential differences due to the treatment; presence of an experimental group and of two control groups, one for eliminating the possibility of a placebo effect; provision of different people for carrying out the treatment, the pretest, and posttest; experimenter's and tester's ignorance of the nature of the group assignment; and participants' ignorance of the purpose of the experiment, and even of the fact that they are participating in a study." (ibid.: 8). How the present study fairs against these rigid criteria will be summed up in chapter 6.

[28] In Ferguson's study on critical and creative thinking, the control groups seemed to be very well designed initially. But switching between extracurricular activities occurred quarterly or semi-annually. In addition chess players also took part in other activities (Gobet & Campitelli 2006: 17).

selective reporting (Liptrap) and not considering confounding variables (Margulies)[29] (Gobet & Campitelli 2006: 13-19).

Overall, Gobet and Campitelli draw particular attention to the attribution problem that was not well attended to in most studies.[30] The question of the specificity of chess vis-à-vis other activities remains unanswered in all studies examined. This can be traced back to the fact that commonsense-theories were used to predict results, the use of well-established theory remains the exception. They subsume that there is an evident disparity between the assumptions made by strong advocates in chess literature and the "rather inconclusive findings of a limited number of studies" (Gobet & Campitelli 2006: 22f, 25).

Bönsch-Kauke (2008: 205) agrees that methodology is a major limitation to existing findings: She criticizes many studies for being rather vague on methodological issues or failing to provide information on methodology whatsoever.[31]

Reacting to these critiques (particular to those raising doubts about methodological quality), authors such as Trinchero (2013) and Bart (2014) call for an "increase in quality and quantity of empirical studies" on the topic.

2.5 Summarizing remarks and research gap

When one considers the totality of statements made on the potential beneficial effects of chess instruction in schools, a large (and rather homogeneous) body of chess enthusiasts becomes evident. They claim that chess lessons entail volatile benefits for children's cognitive as well as emotional development such as improved grades, problem-solving skills, critical thinking, creativity, but also sportsmanship and self-worth. In their line of argument, chess' effects surpasses gains made by other activities such as sports, creative writing or counseling, and its effects become tangible very early after only a few months of regular instruction. The game is said to be easily integrated into curricula, inclusive, and appropriate for children of all ages and backgrounds. Not surprisingly, some authors explicitly call for the introduction of chess in schools.

On the opposite side of the spectrum, critical studies are rather sparse. The comprehensive methodological criticism voiced by Gobet & Campitelli (2006) poses an exception. Their

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[29] That computers were used in addition to chess lessons starting in the second year, the authors consider to be confounding (Gobet & Campitelli 2006: 19). This claim can be challenged as the computers were introduced and used to use chess software or play matches against distant opponents. This should be considered as an extension of chess instruction rather than a contending variable.

[30] E.g. could a higher intelligent quotient be solely attributed to playing chess? Might it be that more intelligent children play chess? Or could a mediating variable such as coping capacity with time pressure influence both at once (spurious causality) (Gobet & Campitelli 2006: 8)?

[31] Consequently, it was not always immanent to her how variables were explicitly measured; which hypotheses were tested; whether experimental and control groups were homogeneous and randomized; whether methods were tested on validity, reliability and objectivity; how qualified and interested students and instructors were; whether the sample was representative; and whether the findings were examined in a replicated study (Bönsch-Kauke 2008: 205f).

critique is justified: More research and particularly well-designed field experiments are needed to close the gap between strong claims and their fairly inconclusive scientific base. This would include more peer-reviewed studies, which need to include an exhaustive documentation of procedures and a comprehensive presentation of results, and use scientific rather than commonsense-theory as a base for their line of argumentation. Studies such as those by Christiaen and Gaudreau constitute an exception by drawing on established psychological theories (Piaget and Gagné respectively). Also, the issue of specificity of chess instruction vis-à-vis other pedagogical options needs to be attended to in future research. A research gap is thus evident in various regards: lack of theory-led research, insufficient transparency of studies with regard to providing appropriate information about methodology, as well as the deficient coverage of regions outside the Anglo-European or (post-)Soviet sphere.

In the setting of development countries, where many governments struggle with low educational quality, the potential of chess as a means to ameliorate outcomes becomes particularly interesting. Given the postulated effect of chess on cognitive abilities and consequently learning output, an introduction of methodical chess lessons could serve as an effective interim solution and/or addition to the systemic reform of education structures. As illustrated in chapter 1.3 holistic reform processes are characterized by gradual, but slow progress in which outcomes might only become tangible with a time lag of several years. Chess instruction on the other hand has proven to reach significant results within a few months or even weeks of training. Furthermore, its cost-efficiency makes it attractive for schools with a limited amount of funds or resources. Its appropriateness to also realize improvements with disadvantaged or at-risk learners adds to the argument of being of particular interest for developing countries.

South Africa represents a “prime” country in this regard (see 1.3): Reforms have yet failed to translate into majorly improved learning outcomes. The regional and rural-urban disparity in schooling, high drop-out and repetition rates at the end of secondary school, as well as a continuous problem of teen pregnancy signal a significant portion of students to be at-risk of not completing their education (RSA, DoBE 2013a: 34-43). Moreover, a large portion of schools can be considered under-resourced, particularly those in rural, informal, or township settings. Against the backdrop of particularly poor performance in education that is the reality in South Africa and many other developing countries, more case studies are needed in a developmental context.

The forthcoming study is an answer to the call for more case studies on the topic and seeks to tackle multiple of the deficiencies voiced by critics. It will provide a throughout description of methodology, make use of a case study conducted in a developing country where learning outcomes are particularly low, and utilize an established theoretical framework provided by Robert Mills Gagné's theories of learning and instruction. The following chapter will elaborate on this theoretical foundation.

3 Theoretical framework

As it has been highlighted in the previous chapter, theory-led investigations pose the exception in research exploring the effect of chess instruction on education. The following chapter will therefore aim to consolidate classic theory of learning and instruction with chess instruction in schools. Two appropriate models by Robert Mills Gagné have been selected from a vast array of learning theories.

3.1 Learning theory

In development studies, the term development is mainly used to refer to societies, nation states, and other entities on the macro level. The development of the individual on the other hand lies at the core of developmental psychology. Every human being undergoes a life-long development process along with a continuous modification of his/her behavioral repertoire. Learning is hereby key to the ability to constant development. Whilst learning itself is difficult to observe directly, it becomes immanent in the change of behavior. Since the late 18th century, different strands of psychology have attempted to explain this progress (Baumgart 2007: 11f). Anthropological perspectives accentuate a predominantly biologically prescribed course of development. Whereas early psychoanalysts like Freud emphasize psychosexual and later psychosocial development that centers on finding one's own identity (Baumgart 2007: 25f, 58). In contrast, behaviorists consider external stimuli to be the driving force of learning: Individuals react to stimuli through which they adapt to their environment. In this case, learning refers to continuously establishing new stimulus-reaction connections that alter the behavior permanently (Baumgart 2007: 109). More subjectively, gestalt psychologists interpret behavioral change (and learning) as the individual's interpretation and resulting reaction to external stimuli and focus more on internal psychological processes (Baumgart 2007: 167). Last but not least, cognitive psychology as practiced by Piaget can be considered as an epistemological approach to development: From childhood, through adolescence, into adulthood, humans traverse distinctive steps of development that are characterized by different cognitive faculty (Baumgart 2007: 204).

Being aware of this broad range of approaches to (individual) human development and consequently learning, two models of the behaviorist tradition have been opted for in this research. They are suitable for the context specificity that is at core of the international development discourse and similarly for investigating the context-bound effects of education.

3.2 Gagné's classic models of learning and instruction

Within the framework of developmental psychology's strands, the subsequent theories follow a classic behaviorist approach. Robert Mills Gagné's theory on "The Conditions of Learning" (1965) will be related to the psychological stimulus-reaction mechanisms at work when playing (and learning to play) chess. Moreover, his theory on the "Principles of Instructional Design" (1974) will be used to illustrate the advantages of practical chess instruction when aiming to increase cognitive skills and provide a framework for designing effective lessons in chess.

3.2.1 The "Conditions of Learning"

Prior to the publication of Gagné's ground-breaking book "The Conditions of Learning" in 1965, it was commonly assumed that any kind of knowledge was learned in the same manner (Gagné, Yekovich & Yekovich 1993: 115). Gagné, in contrast, made the case for distinguishing eight types of human learning, each of which occurs within the framework of certain learning conditions (Gagné 1975: 26).
The instance of "learning" becomes tangible in the difference of a person's performance before and after the subjection to a "learning situation". Hence, learning cannot be measured solely as the successful accomplishment of a task, but as a shift in performance (Gagné 1975: 27).
Requirements for learning are thereby both of internal and external nature. Those of internal nature refer to already existing capabilities of the learner. Whether he/she will be able to learn depends therefore mainly on whether he/she has mastered preceding skills. For example learning to correctly formulate a sentence requires prior understanding of the words used in it. Then again, external conditions under which learning takes place are equally relevant. Not every condition will prove to be fruitful for effective learning. While the repetition of word pairs will enable the learner to learn a word in another language, repeating two numbers that need to be multiplied will not arrive at a successful learning outcome (ibid.: 28). Gagné (1971: 24) subsumes: "Each type of learning starts from a different 'point' of internal capability, and is likely also to demand a different external situation in order to take place effectively."

If learning depends to such a large extent on external conditions, educational implications are inevitable for instructors, both in the process of planning and managing learning. Choice of teaching format and material will need to be based on instructional goals and their respective conditions for learning in order to effectively facilitate it (Gagné 1975: 33). Therefrom resulting implications for instructional design and the curriculum will be elaborated on in the following subchapter (see 3.2.2 and 3.4 respectively). In this regard, rethinking the purpose of education is strictly necessary: "Education should be concerned not simply with the acquisition of knowledge, but more importantly with the use and generalization of knowledge in novel situations" (Gagné 1971: 29).

When one examines learning, three aspects of the process are to be considered: the input (a stimulus situation), the output (a reaction), as well as the inferred connection between those two poles (Gagné 1975: 35f). In his original theory from 1965, Gagné distinguishes the following eight types of learning:

1. <u>Signal learning</u>: The learner establishes a prompt physical response to a stimulus. Those responses are of a "general [nature], diffuse, and emotional", for example the emotion "fear".
2. <u>Stimulus-response learning</u>: The individual acquires a precise motor response to a distinctive stimuli, a connection is learned, e.g. learning to shake hands. Other than in type 1, repetition might be necessary for internalization.
3. <u>Chaining</u>: The learner combines two or more stimulus-response reactions into a sequence, e.g. a child asking for a specific object by name.
4. <u>Verbal association</u>: Closely associated with chaining, the learning subject establishes labels for previously learned responses to stimuli. Verbal terms are learned. These short chains are easily learned, but also more likely to be forgotten (e.g. vocabulary).
5. <u>Discrimination learning</u>: The individual learns to develop different responses to stimuli resembling each other to a more or lesser extent. He/she learns to distinguish an object from others first broadly (e.g. a car from a bus) and later more precisely (one model of car from another).
6. <u>Concept learning</u>: The learner develops one reaction to a class of stimuli, although these stimuli vary in appearance. He/she learns to classify them into concepts. While the learner starts with identifying object properties (e.g. shape or color) and thereby recognizes parts of a concept (concrete concept learning), she/he can later classify concepts on a more abstract basis (e.g. considering a brother as the male

offspring of the same parents). He/she is then able to use definitions for a concept (defined concept learning).

7. Rule learning: Drawing on two concepts A and B understood in the previous phase, the learner establishes a rule, such as "If (concept) A, then (concept) B" (e.g. if a German noun is feminine, it takes the article "die"). Rule learning can draw onto verbal statements (something is explained), but is more resistant against forgetting if discovered by the learner oneself. This phase should not be confused with the solely verbal rule "If A, then B" established in type 4.
8. Problem-solving: The learner combines two previously established rules into a higher-order rule. New knowledge is acquired that "multiplies the applicability of rules already learned" (Gagné 1971: 62), capabilities for further thinking are developed. Thus, problem-solving represents the most complex form of learning. (Gagné 1975: 37-58; Gagné 1971: 36-62; Gagné 1964: 312; Gagné & Briggs 1974: 40f)

The hierarchical structure points out that in order to effectively learn by problem-solving, capabilities developed in the prior seven types of learning must be available.

In the particular process of problem-solving, an individual departs from a "given situation" in order to arrive at a "desired situation" (Gagné 1964: 302). The ultimate result of this process is not only the successful solution to the problem identified by the learner, but even more fundamental: Through the learning process, his/her performance capacity has increased substantially compared to the initial situation. This enhanced capability is more or less durable depending on the type of learning (Gagné 1975: 171). In the case of problem-solving, the learned skill is of superordinate nature and is not altered through repetition. Skills attained in this manner are thus very unlikely to be forgotten. Furthermore, these skills can be applied to a variety of stimuli belonging to a similar category, they are generalizable and can be transferred. Also, due to the fact that the learner is required to develop the higher-order rule autonomously without much external support, he/she arrives at an idiosyncratic solution with a high relevance for him-/herself (Gagné 1975: 177f). Thereby, new skills can be applied even easier to new situations.

In addition to his theoretical postulation, Gagné moreover proved empirically that better abilities to perform basic skills increase performance in problem-solving tasks significantly[32] (Gagné, Yekovich & Yekovich 1993: 389f). Hence, it can be claimed that

[32] In 1970, Gagné and his colleague Okey first analyzed the prerequisite skills necessary for high-school students in introductory chemistry to solve the question whether the mixture of two chemicals would form a solid matter. After an instructional program teaching both prerequisite skills (such as determining the molar mass of a molecule or how to divide/multiply numbers expressed in exponential equations) and the final skill on how to predict the correct

learning prerequisite skills, as mentioned in the learning hierarchy, is not only a necessary condition of learning how to solve problems, but that they are also an important determinant of the degree of success in problem-solving and thus higher-order thinking.

3.2.2 "Principles of Instructional Design"

In addition to the internal capability (mastery of prerequisite skills) necessary for successful learning, Gagné considers the external conditions under which learning takes place as equally relevant. This includes to a large extent providing pedagogical instruction in such a manner that "the external conditions of learning [are arranged] in such a way as to insure that learning will occur" (Gagné & Briggs 1974: 147). Therefore, in "Principles of Instructional Design" (in collaboration with Leslie J. Briggs) he translates his conditions of learning into a theory of instruction sequences and enumerates effective learning conditions to attain the learning outcome desired.

For understanding his theory, one must keep in mind what Gagné considers the function of learning in schools to be: creating adult individuals who function in and contribute to society. Effective education is therefore measured with regard to the adjustment to the demands of modern life, enacted responsibilities as citizens, as well as an ability to fulfil one's interests both professionally and in one's personal life (Gagné & Briggs 1974: 4)[33]:

> "Learning must be planned, rather than haphazard, so that each person will come closer to the goals of optimal use of his talents, enjoyment of life, and integration with his physical and social environment. Naturally, this does not mean that the planning of instruction will have the effect of making different individuals more alike. To the contrary, diversity among individuals will be enhanced. Planned instruction has the purpose of helping each person to develop as fully as possible, in his own individual directions." (Gagné & Briggs 1974: 4)

Hence, educational goals should be matched with societal needs and should not be merely based on the subject structure of "traditional" curricula (Gagné & Briggs 1974: 31).

Gagné's classical behaviorist approach focuses on the outcomes of training, namely behavior. From his learning hierarchy, he derives five major categories of learning outcomes or capabilities: motor skills, verbal information (names, events, or facts), attitudes, intellectual skills, and cognitive strategies. These capabilities must be distinguished from performance per se; instead, they can be considered to mediate

answer, students were tested on their mastery of the necessary skills and confronted with new prediction problems (criterion test) (Gagné, Yekovich & Yekovich 1993: 389f).

[33] Whilst the idealistic appeal of this theory might have universal coverage, it must be kept in mind that in the context of developing countries especially the fulfilment of the latter two criteria is subject to many more restrictions than instruction in schools. But as the fulfilment of potential lies at the core of many development theories, most prominently Amartya Sen's capability approach (inter alia Sen 1993, 1999), this theory is despite its eurocentristic formulation still deemed relevant here.

performance. Their conceptualization is nevertheless relevant, as they refer to different goals of a course or even to education in general. Each, furthermore, requires a different set of learning conditions in order to be achieved (Gagné & Briggs 1974: 23ff, 30).
More specifically[34], intellectual skills function as a basis for further learning and include Discriminations (type 5 learning), Concrete and Defined Concepts (type 6), Rules (type 7), and Higher Order Rules (i.e. problem-solving, type 8). In most curricula, particular emphasis is placed on rule learning. Successful performance can be observed when an intellectual operation is carried out in a specific setting. Cognitive strategies on the other hand "[govern] individual's own learning, remembering and thinking behavior" and can be considered the cornerstone of creative problem-solving[35] and self-management. Performance is judged against the ability to employ efficient means to solve a variety of practical problems (Gagné & Briggs 1974: 24ff).
Instructional design finds its prime application in lesson and, on a larger scale, course design. According to Gagné and Briggs (1974: 139f), lesson planning for a sound lesson, adheres to the following steps: The entire course needs to be organized into major themes and units. The lesson objective is justified by contributing to achieve these larger objectives. Based on the desired learning outcome (verbal information, intellectual skill etc.), an instructional level/goal needs to be defined. By analyzing the task/skill foreseen to be learned, the prerequisite skills (internal capabilities) needed to perform the new task have to be identified. These are systemized into a learning hierarchy that specifies all required basic skills and how they relate to the new skill to be acquired[36]. Based on this, a teaching sequence is designed.[37] The specific types of prior capabilities have to be identified (discrimination, concept, rules etc.). One target capability is singled out as a lesson objective. The teaching plan for each objective must consider instructional events and effective learning conditions necessary for each learning outcome. After the selection of instructional events for each objective, a medium and materials for this event need to be selected and/or developed. Upon completion of the lessons, evaluating student performance is crucial before continuing with further objectives. Possible forms of assessment include testing (both formal and informal) after the respective lesson, about groups of lessons, or about the topic in its totality.

[34] With respect to the research questions and their emphasis on higher-order thinking and academic performance, emphasis is placed on the learning outcomes of "intellectual skills" and "cognitive strategies".
[35] Problem-solving as acquired in type 8 of the learning hierarchy (learning of higher-order rules) is not to be confused with creative problem-solving that is referred to in cognitive strategies and encompasses a set of skills.
[36] Illustrative examples for learning hierarchies for skills such as subtraction, categorizing agricultural products, or solving a science problem can be found in Gagné & Briggs (1974: 9, 114-119). For an example, see A4.
[37] How to plan sequences for intellectual skills and cognitive strategies in particular will be elaborated on below in more detail.

With regard to practical teaching, the instructor is supposed to structure his/her lesson by nine instructional events. However, this does not imply that all events necessarily have to occur in this exact order or that all events must be employed in every single lesson. The most probable order of teaching events is the following:

1. Gaining attention, e.g. by appealing to the learners' interests or through visual stimuli.
2. Informing the learners about objectives to assure the students know which kind of performance is expected of them.
3. Stimulating recall of prior learning: This aspect is essential as it draws most heavily onto the idea of the necessity of prior capabilities. Component ideas (such as concepts or rules acquired before) are most commonly being elicited by asking recall questions ("Do you remember what happens if...?").
4. Presenting the stimulus material that is involved in the desired learning such as showing letters to be written or demonstrating sounds to be learned. In the latter case, contiguity of the demonstration in combination with the students' response is required; correct responses by the learners need to be reinforced and the process repeated.
5. Providing learner guidance which varies from giving the precise answer (e.g. when introducing a new concept) to merely providing hints to assist the learners in finding a line of thought that will lead to establishing a new rule for themselves. The amount of guidance varies strongly between individual learners.
6. Eliciting performance: To ensure that the desired learning outcome has been achieved, the learners are asked to demonstrate the acquired skills. This does not only serve to assure the instructor, but also the learner, that learning has occurred.
7. Providing feedback, which is in some cases immanent (e.g. having learned a motor skill, such as throwing a ball through a hoop), but needs to be voiced explicitly in others.
8. Assessing performance to assure that "the observation of performance reveals the learned capability in a genuine matter" (Gagné & Briggs 1974: 131) and cannot be due to chance/guessing.
9. Enhancing retention and transfer: Whilst retention refers to systematic review and retrieving of the learned capabilities, transfer concerns motivating the learners to utilize these skills in novel situations.

   (Gagné & Briggs 1974: 123-132).

A planning sequence for intellectual skills could start with a brief review of subordinate skills needed for the one to be learned. A starting point for skills to be acquired is determined based on where mastery of necessary skills can be assumed. The sequence of the lesson is then specified by the learning hierarchy and skills are taught and acquired in order. The mastery of prerequisites is essential before attempting to learn the "final" skill; learners must be able to execute the prior abilities "with perfect confidence". Sequencing instruction in this way also provides opportunities to pinpoint learning difficulties; due to the fact that problems in attaining a skill can be directly traced back to not having mastered a previous skill (if the learning hierarchy is constructed correctly). Upon diagnosis, relearning the lacking capability can be attempted (Gagné & Briggs 1974: 141f). Basic repetition should no longer be seen as a fundamental condition for learning, but rather as a mode of practicing (Gagné & Briggs 1974: 8).

To design a sequence for cognitive strategies cannot be considered as straightforward. Cognitive strategies rely as well on previously learned information and intellectual skills. But in contrast to other learning outcomes, creative problem-solving can be attained by a variety of "right" ways. Hence, instead of providing an ideal teaching sequence for this capability, Gagné & Briggs (1974: 143) suggest to disperse repeated opportunities for problem-solving into instruction for other outcomes over a long period of time. Variety and novelty in problem-solving tasks are of particular importance for developing cognitive strategies (Gagné & Briggs 1974: 132).

Even though Gagné first published his work as early as the 1960s, his theories remain influential up until the present. Posthumous, the (English) fifth edition of "Principles of Instructional Design" was published in 2005 by prior collaborators. According to Richey (2000: 12), Gagné's influence on the field of learning and instruction psychology as well as the resulting practice is unprecedented:

> "Yet much of Gagné's research has not only impacted practice in many settings but it has established the norm during his lifetime. Gagné's work is unique in the extent to which it has actually shaped an entire field. He has influenced theory and practice, teaching and research, school and non-school environments."

3.3 Transferring learning theory to chess thinking and instruction

If one considers the tremendous influence Gagné's work had on the way we perceive learning, and correspondingly, instruction in schools, it seems obvious that his findings can and should also be applied to the learning and teaching of chess. While Gagné's basic theory on the "Conditions of Learning" aims to explain learning in a holistic manner, "Principles of Instructional Design" is very focused on a scholastic/curricular setting.

However, as this study focuses on methodical chess lessons in primary schools, both theories are deemed relevant. In the following subchapter, learning theory will be related to the thinking processes while learning and playing chess, whereas instruction theory will provide a more practical framework for the question how chess instruction can effectively promote learning. For this purpose, the nine instructional events will be illustrated in a chess teaching setting.

3.3.1 The "Conditions of Learning" and thinking in chess

If we return to de Groot's findings on the thinking in chess, we see that he describes the process of learning chess as one in which "the learning of rules and the learning of exceptions alternate with each other, resulting in a constantly more differentiating hierarchically structured system of operation arrangements – a program, a routine, or a subroutine" (Christiaen 1981: 12). This is congruent to how Gagné defines the establishment of a "higher-order rule" that results from the learning of two rules (or congruently a rule and an exception).

Winning a match can be conceptualized as the main goal of each player; thus, the most hierarchical problem to solve in chess playing. On a more disaggregated level, higher-order problems and special subproblems need to be solved beforehand. As an entire game poses too large as an analysis unit, considering individual moves seems more appropriate for further analysis (Groot 1978: 14f, 184). Hence, in a chess match, each turn can be considered a problem-solving activity (the "choice-of-move problem"): From a given situation on the field, the player must reach his/her desired situation by considering rules of movement learned previously. As formulated by de Groot: "The problem for the subject throughout the thought process is to find his next move" and even more specifically to "[play] a good move" (Groot 1978: 185, 144).

Before this kind of problem-solving activity is possible, the player has learned to classify the pieces (concept learning) and the rules on how each chess piece (a prior established concept) moves on the board (rule learning) as well as more elaborated rules (e.g. those present in playing strategies).

When considering separate "choice-of-move problems", solving each problem poses unalike difficulties and therefore requires different prerequisite skills: Is a plan constructed or simply executed? Does the move follow common lines of play (e.g. an opening strategy) or does the player have to devise new strategies? Even the "same" problems are continuously re-investigated resulting in differences in problem perception and possibly in the development of new strategies (Groot 1978: 16f, 169).

Moreover, through continuous playing and, hence, learning-by-doing, the chess player develops autonomous solutions to problems. Learning to play chess can therefore be considered a "non-reproductive" (Gagné 1964: 311) learning process.

3.3.2 The "Principles of Instructional Design" and chess instruction

The last section was able to demonstrate fundamental similarities between the sequence of learning events in acquiring chess skills and Gagné's learning hierarchy as specified in the "Conditions of Learning" as well as to conceptualize playing chess as a continuous problem-solving activity where problems vary with each move. Apart from this fit based on thinking processes, a pedagogical perspective can reinforce the relevance of Gagné's work for chess instruction. As learning processes are comparable, internal and external conditions for learning, appropriate teaching sequences, and the nine instructional events used for designing lessons apply just as much to chess instruction as they do to "classic" subject instruction in schools.

Teaching the game of chess needs to be broken down into several topics and subtopics, such as introducing the board and the pieces (concrete concepts: black vs. white, fields on the board; defined concepts: chess pieces), teaching the rules of the game (how does each piece move, specific rules like "castling"), as well as specific strategies (e.g. for opening a game). Setting and achieving an objective for each lesson also requires to assure that all prerequisite skills are available to the learner. For example, a learner will not learn how to capture the opponent's piece with his piece, if he has not internalized the rules of how both pieces move.

Furthermore, the nine instructional events, as specified by Gagné and Briggs, can (and should) be transferred to methodical chess instruction. The following example of a lesson teaching to capture the king using two rooks serves to highlight how the "Principles of Instruction" can be employed practically in chess teaching.[38]

Instructional event	**Example from a chess lesson**
Gaining attention	Not necessary[39]
Informing the learner of objectives	Telling the learners that they will learn to capture the king using the two rooks.
Stimulating recall of prior learning	Having the learners repeat the rules of how the king and the rooks are allowed to move on the board, how to use the chess notation to indicate a move to a specific field.

[38] The table is based on the author's own observation during field research when visiting an extracurricular chess lesson in one of the sample schools.

[39] The first instructional event of gaining attention proved to be unnecessary, as the students were eager to start as soon as the instructor reached the blackboard.

Presenting the stimulus material	Demonstrating the initial situation on the demonstration board, while the students are requested to replicate the set-up on their chess boards.
Providing "learner guidance"	Simulating a game on the demonstration board by playing the king oneself and the students playing the rooks; for the first few moves indicating whether it was a "good move" to corner the king more or whether it gave him more leeway by demonstrating possible moves by the king; successively giving less hints when students make the right moves.
Eliciting performance	Playing the king oneself, having the students suggest the moves of the rooks until the king is captured.
Providing feedback	Feedback is immanent in whether the students are successful in capturing the king or not.
Assessing performance	Having two students (or two sets of students) play against each other with one side representing the fleeing king and the other trying to capture him with the rooks.
Enhancing retention and transfer	Successively introducing more pieces to the situation, after they have been introduced in a similar manner.

Table 3: The nine instructional events of Gagné & Briggs' "Principles of Instructional Design" transferred into a chess lesson (own illustration, based on an observation of instruction at one of the sample schools).

Continuous instruction (and its translation to playing) and thereby the attainment of more higher-order rules (e.g. opening strategies, defensive vs. offensive playing etc.) will lead to long-term formation and refinement of cognitive strategies, i.e. the ability to deal with novel situations, and eventually to continuous improvement in the game of chess. This superordinate development of the learner's own thought processes (learning to think) can in return be utilized for a variety of novel problems (Gagné & Briggs 1974: 48f); and can therefore also be translated into academic capabilities.

3.4 Relevance for curriculum design in South Africa

As mentioned in 1.3, South Africa has been undergoing a continuous process of curriculum reform since 1997. 2015 represents the first year, where no grade is implementing a national policy with regard to curriculum change. Following each reform, curriculum design has moved from many liberties and responsibilities for teachers to a gradually more prescribed style of content and teaching methodology.

The National Curriculum Statement Grades R-12 is stated to first serve to

> "[equip] learners, irrespective of their socio-economic background, race, gender, physical ability or intellectual ability, with the knowledge, skills and values necessary for self-fulfilment, and meaningful participation in society as citizens of a free country" (RSA, DoBE 2011: 4)

To achieve this, emphasis is inter alia placed on

> "identify[ing] and solv[ing] problems and mak[ing] decisions using critical and creative thinking; [...] organis[ing] and manag[ing] themselves and their activities responsibly and effectively; [and] collect[ing], analys[ing], organis[ing] and critically evaluat[ing] information." (RSA, DoBE 2011: 5)

The accompanying Curriculum and Assessment Policy Statements (CAPS), specify the provisions per education phase[40] and subject in extensive detail, including aims, time allocation, content, and teaching plans.

As already evident in the purpose statement, the South African curriculum envisions the purpose of learning in schools similarly to Gagné, namely in producing individuals well-equipped to deal with society. Also, emphasis is placed on the attainment of values apart from skills and knowledge. Its availability in all 11 official languages acknowledges the context specificity of teaching, considering an appropriate language of learning and instruction (building upon previously attained skills). The abilities envisioned to be learnt through instruction following CAPS, highlight capabilities classified by Gagné as higher-order thinking skills and cognitive strategies.

Its prescribed nature makes it appropriate for the inclusion of teaching principles, or teaching learning sequences as suggested by Gagné (or, more generally, educational psychology and pedagogy). Moreover, the subject specificity of the CAPS would allow for a specific statement for chess instruction, without implications for other CAPS.

3.5 Research hypotheses

Considering the fundamental similarity between thinking in chess as postulated by de Groot and Gagné's conceptualization of problem-solving, it is assumed that the learning of chess will equally increase problem-solving abilities. Prior learning capabilities – namely concept and rule learning skills – should, correspondingly, be enhanced in chess players. Methodical chess instruction in schools can help train these abilities even more if executed in a well-planned manner, following principles of instructional design.

To examine this relationship, the upcoming research will seek to determine whether chess instruction enhances higher-level cognitive skills (abstract thinking and problem-solving capacities). Abstract thinking capacity is thereby conceptualized as the ability of children to classify objects and establish concepts (concept learning) as well as their capacity to identify rules and apply them (rule learning). Problem-solving capability is defined congruent to Gagné as transferring an initial situation to a desired one by applying previously learned rules and thereby resolving complex situations correctly. Due to their indistinct nature, cognitive strategies cannot be operationalized directly. As it is postulated that the attainment of these strategies is transferrable to other (novel) situations, academic performance will serve as a proxy-indicator for having acquired transferrable thought strategies.

[40] Foundation phase: grade 1-3; intermediate phase: grade 4-6; senior phase: grade 7-9.

The following research hypotheses (H) will be tested:

H1: Students learning and practicing chess possess and utilize higher-level cognitive skills than their non-chess playing counterparts.

H1.1: Students learning and practicing chess score higher on classifying tests.

H1.2: Students learning and practicing chess score higher on tests where they need to identify and apply rules.

H1.3: Students learning and practicing chess score higher on problem-solving tasks.

To scrutinize whether these improved skills translate into better performance in school, the following hypothesis will be tested as well:

H2: Students learning and practicing chess show better academic performance than their non-chess playing counterparts.

Considering the fundamental necessity of ameliorating learning outcomes in South Africa and the applicability of Gagné's learning and instruction theory to the curriculum as postulated in CAPS, these hypotheses will be tested in the context of South African township schools. The project "Chess for Africa" will serve as a case study to test whether the introduction of methodological chess lessons in South African primary schools enhances cognitive skills and performance of the students.

4 Methodological approach

The field research of this study followed a mixed-method approach. Due to the timing of the research, a longitudinal study could not be realized. Conclusions had to be drawn using a posttest-only quasi-experimental design. To mitigate the attribution gap, a multitude of methods was used: non-verbal psychometric tests, a statistical analysis of academic performance, and qualitative semi-structured interviews.

4.1 Case study

Resting on the assumption that through chess children will acquire a wide variety of cognitive skills[41] and will thus improve their performance and grade point average at school (Deutsche Schachstiftung 2012: 4), the German Chess Foundation initiated the project "Chess for Africa" (CfA) in 2012.

In the greater Johannesburg area, where the research was conducted, 50 teachers, educators, and social workers have so far been trained to teach chess in their schools,

[41] These skills include the abilities "to focus their attention and to maintain a high degree of concentration, to mentally visualize positions and sequences of moves, to create strategies, to train their memory, to think ahead and plan their activities in advance, to re-evaluate a situation which has changed, to develop patience, thoughtfulness and originality, to weigh options, to assess the results of their actions, and to develop stamina, determination and social skills" (Deutsche Schachstiftung 2012: 4).

either integrated into subjects such as life orientation, life skills, or sports as well as by offering chess as an extracurricular activity (Becker & Becker 2015).

To ensure local presence and continuous monitoring, a full-time project manager is employed and based in Johannesburg. He represented a focal person during the course of this research, particularly with regards to field access.

4.2 Sampling procedure

Originally, a two-step sampling procedure was planned: firstly, a stratified sampling of the schools to adequately cover all characteristics[42] of the schools participating in the project (assure sample heterogeneity). For that purpose, an ex-ante inquiry was foreseen to collect the relevant characteristics (quantitative data on the school and chess course, such as the duration and frequency of the class and to be distributed using established channels of the Sports Office of the Johannesburg Central District branch, a local office of the Gauteng DoE that facilitates communication between the project and the schools. Within the strata of the schools, an equal number of students per school and sample group was supposed to be randomly selected.

After an initial meeting with the Sports Office, it became immanent that this procedure could not be upheld as security concerns would prevent equal access to all school. Thus, sample schools were selected in tandem with the office as well as the CfA project manager. Three schools with similar framework characteristics (public township schools allocated in the nation's third quintile[43]), but varying duration and modes of chess instruction were selected in a purposive, homogeneous sampling procedure.[44]

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[42] As the project schools differ largely in relevant characteristics such as equipment as well as duration and mode of chess instruction, a random sample might have yielded biased results. For instance, it would have been possible that all randomly sampled schools were administered privately, which would not allow for an extrapolation on public schools.

[43] Quintile hereby refers to the schools allocation within a national ranking based on the degree of poverty within the community the school is located in, as well as on infrastructural endowment. Quintile 1 represents the poorest 20% of the nation's population and quintile 5 the most affluent 20%. Schools in quintile 1-3 have been declared non-fee schools. In the research province Gauteng, more than 50% of the region's population are allocated to quintile 4 and 5. In considering quintile 3 schools, particular attention is given to lesser-resourced schools (Western Cape Government Education 2013).

[44] Hereby, it was less relevant whether schools had participated in CfA trainings as opposed to their socio-demographic characteristics.

	School 1	School 2	School 3
Sector	Public	Public	Public
Grades	1 – 4	1 – 7	1 – 7
No. of students	192	395	978
Quintile	3	3	3
Home language	Zulu	Venda	English
First additional language	English	English	Tsonga
Extracurriculars offered	chess, soccer, athletics, netball, poetry, music, public speaking	chess, soccer, athletics, netball	chess, soccer, athletics, netball, squash, volleyball
CfA	Yes	No	Yes
Start of chess instruction	03/2015	2006	03/2010
Curricular status of chess	extracurricular	extracurricular	extracurricular <u>and</u> 3 months obligatory for grade 6 (in sports in term 3)
Frequency of instruction	3 times per week, 1 hour each	1 time per week, 2 hours each	(extracurricular) varying, mostly 3 times per week, 1 – 1.5 hours each (compulsory) 1 time per week, 0.5 hours each
No. of chess students	43 – 46	40 – 50	(extracurricular) 20 (compulsory 2015) 118
Materials available	self-made chess boards, classic chess boards (borrowed), self-made demonstration board for chalk board, chalk board	classic chess boards, chalk board	classic chess boards, demonstration board for chalk board

Figure 1: School profiles of the selected sample schools (own illustration, interview material).

Within the schools, students to be tested were randomly selected to allow for the use of probability statistics in subsequent data processing. Learners were sampled using numbered lists for the chess classes, lists of participants of other extracurricular activities, as well as from the overall class lists[45]. The sample was drawn using a random number generator (Android application "Random Number"). They were initially sampled into three groups: Group 1 referred to the intervention group; those students taking part in chess lessons after school. Group 2 was formed to control for a placebo-effect and consisted of students who take part in extracurricular activities other than chess. Group 3 involved students not receiving additional lessons apart from the regular curriculum.

[45] The learners appearing in the extracurricular lists were omitted from the overall class lists before the selection of the "no activity" group. Moreover, learners taking part in both the chess class and other after-school activities were not considered for selection.

Subsamples of ten students in each group and school were used to obtain an overall sample size of 90 children.

As the documentation of participation in after-school activities turned out to be not exhaustive, several students had to be manually excluded after the testing session, because it became immanent in their follow-up interview that they participated in both the chess class and other activities. If this was the case for learners originally sampled for the "no activity" group, they were not excluded but manually assigned to the respective group which shifted the original 30-30-30 design slightly (see figure 2). Another sampling difficulty appeared, as I was informed in my final interview with a chess instructor that chess instruction was mandatory in her respective school and was taught to grade 6 learners in the subject sports every year in term 3 (July to September). Therefore, two further groups were created and grade 6 learners[46] of the school in question redistributed: "chess as mandatory subject" and "chess both mandatory and extracurricular" (and excluded if allocation conflicts arose). Since both of these groups consisted of very small n, they were subsumed with the chess class participants into "general chess instruction" and contrasted with students doing "extracurricular activities" and "no chess, no extracurricular activities". These three groups represent the final sampling structure.

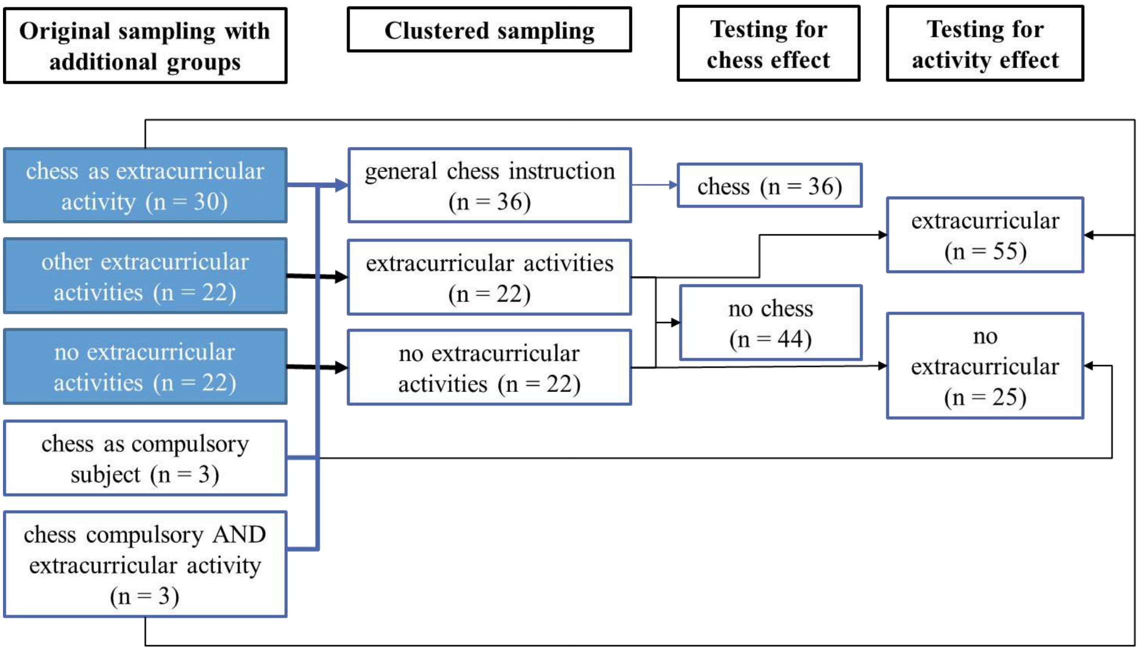

Figure 2: Sampling structure using different group allocations (own illustration, A75f)

The final overall sample size included N = 80 learners. For further explanations about the regrouping for analysis purposes see chapter 4.4.1.

[46] Grade 7 learners were kept in their respective category because of the study's focus on current chess instruction.

4.3 Data collection

In order to arrive at a comprehensive picture of the students' development since the introduction of chess in their schools, data needed to be obtained from three sources: from the children in terms of their current performance, from the schools concerning their prior performance, and from their teachers to gather information about the development process. Expert interviews with South African key stakeholders in chess were supposed to round the picture off.

4.3.1 Psychometric testing

A short side note on the cultural specificity of intelligence testing

Before we continue on the specificities of the psychometric tests used in this research, it is necessary to consider that these tests – initially designed for and normed to a Western-European population – are undertaken in a very unalike setting and the potential biases that could consequently arise.

If we follow the assumption that intelligence tests measure learning, we need to take into account that all learning (both verbal and non-verbal) takes place in a cultural context. Hence, all tests are "culturally-loaded" (Ford 2005). In reality, developers of standardized tests have for the longest time failed to acknowledge this, although first considerations of cultural biases date back as far as the 1920s (Schölmerich et al. 2008: 188).[47]

Schölmerich et al. (2008: 189) point out three sources that give rise to distortions when testing children from different cultural backgrounds: method bias, construct bias, and item bias. The method bias refers to the different extent to which a child is familiar with a testing environment, its motivational context as well as to which behaviors the child considers to be appropriate in such a context. Furthermore, constructs that are used have different relevance for different populations. An illustrative example: It has been shown that children from Asian decent grouped objects based on their relationships to each other (e.g. a car and its driver), whilst European Americans used categories to group objects (motorized vehicles). Lastly, an item bias needs to be considered. Items used in a test should always consider the respective reality of everyday life. To determine an item bias particular attention should be paid to item scores instead of only cumulative scores (Schölmerich & Leyendecker 2009: 432f; Schölmerich et al. 2008: 189).

Language has been shown to be a major obstacle to validity in testing. Even when translated and administered by bilingual examiners, test results were still heavily biased.

[47] The issue of cultural specificity has mainly been raised in the context of assessing migrant or minority children or adolescents (e.g. Schölmerich et al. 2008), but can also be transferred to the inappropriateness of making use of standardized tests developed in certain cultures to other cultural settings they were not designed for.

For that reason, non-verbal and “culturally fair” tests have been drawn up to ameliorate these effects. Although they are able to lessen the impact of some biases (e.g. by breaking down language barriers), biases such as unfamiliarity with the testing situation persist (Schölmerich & Leyendecker 2009: 434f).
In any case, insights gained by standardized tests (which should only be regarded as “illustrative samples of behavior”) always need to be accompanied by further collateral information on the child to actually arrive at a “comprehensive picture” (Ford 2005). This includes “a clear idea of the group of reference and the context of development of each child”. If interpreted with caution and detailed analysis, many standardized instruments can be legitimately used in other cultural contexts (Schölmerich et al. 2008: 192).

The Specifics of the SON-R 5½-17

Keeping these considerations in mind, a test has been selected that seeks to minimize distortions through language and cultural bias and is accompanied by a broad collection of collateral variables. The possibility of construct and item biases is considered and made subject of analysis in 5.5.2.
The psychometric tests selected formed the “heart” of the field research. Each student was tested and interviewed individually using non-verbal testing procedures from the Snijders-Oomen Non-Verbal Intelligence Test Revised for the age group five and a half to 17 (SON-R 5½-17). Originally designed for deaf children, the SON-R 5½-17 (in the following only referred to as SON-R) was chosen due to its immanent advantages in testing children from different cultural backgrounds and varying native languages: Both the instruction and the solution of the tasks can be presented without the use of words. Furthermore, reading and writing is not necessary which makes it appropriate for young children of elementary age and avoids biases that can arise from lacking literacy skills (Petermann & Macha 2005: 6). The test developers themselves consider the test to be suitable for international and intercultural testing, but emphasize the fact that intelligence testing can never be fully free from either language nor cultural bias (Snijders, Tellegen & Laros 2005: 13).
The sample children were tested in the Categories, Analogies, and Situations subtests. Whilst the former two are designed to measure abstract thinking, the latter assesses concrete thinking capacities (Petermann & Macha 2005: 125). Congruent with Snijders, Tellegen & Laros’ (2005: 65) suggestion, the Categories subtest was administered first, followed by the Situations, and lastly the Analogies subtest.

Test taker and test conductor were seated at a table opposite from each other. The booklet for the respective test[48] was placed in front of the learner, so that pictures were faced towards him, meanwhile the numbering of items was legible for the test conductor. The researcher was not aware of the group allocation of the tested learner; this information was added upon completion of the session.

Each test composed out of two to three example items and subsequently three testing series (a- to c-series) with an equal number of testing items. Specific to this intelligence test is the feedback given after every item, indicating whether it had been solved correctly or not. When working on the examples, the correct answer was specifically pointed out.[49] On the actual test items, only "right" or "wrong" was indicated.

The testing series of each subtest follow progressive difficulty, whilst the same numbered items (i.e. A1, B1, and C1) are designed to be equally difficult. To assure this, a specific "theory of difficulty" underlies each test which will be outlined when considering the subtests in detail. Taking this into account, the testing session followed an adaptive testing process to reduce overall testing time, the number of items too difficult or too easy for the respective learner and thus test frustration, as well as to limit the number of items where guessing is necessary and, consequently, random distortions. Hence, specific termination and starting rules were applied: After two incorrect answers in a given series, work on that series was terminated and continued on the subsequent series. The starting item was hereby determined by the number of correctly solved items minus one (Snijders, Tellegen & Laros 2005: 27f, 101ff). Figure 3 demonstrates the application of these rules through a filled out subtest excerpt:

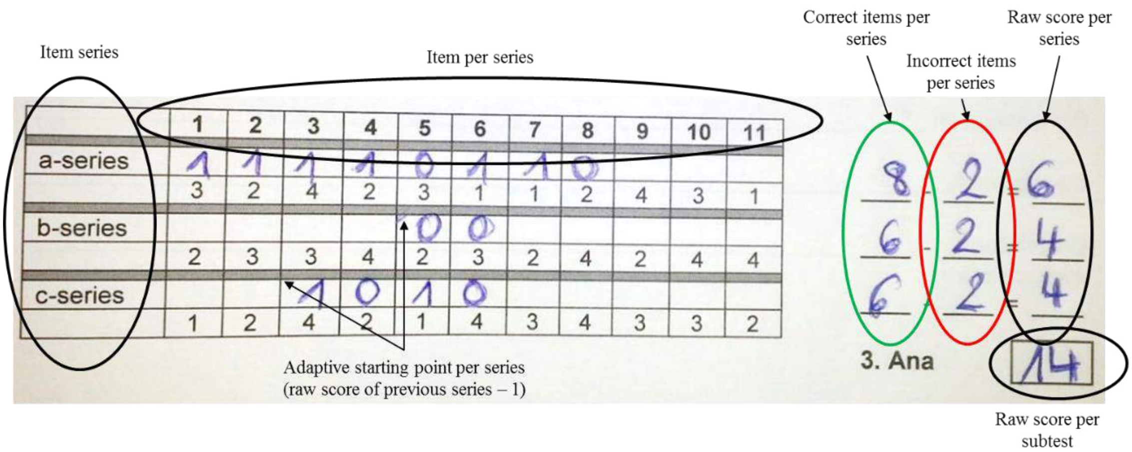

Figure 3: Explaining the adaptive testing procedure using an example from a filled out score sheet (own illustration, test sheet Phaka3006).

[48] The full booklets for the SON subtests used are provided electronically. Illustrative item examples will be elaborated upon below.

[49] I.e. "No, this is not right [*pointing at the given answer, shaking the head no*]. Look, this picture is right [*pointing at the correct answer and nodding*]!"

The number of correctly solved items on the overall subtest (right hand column) represents the raw test score (R). How this score is further processed will be outlined after presenting the individual subtests.

Instruction for the tests was standardized and presented both verbally in English and non-verbally through the use of gestures (for the detailed instruction see footnotes 50ff). In case the learner seemed to not understand the instructions and failed to answer any of the example items correctly, a teacher was summoned to translate the instructions verbatim into the learner's home language. Particular emphasis was placed on the instruction not give any additional cues while translating.

In the Categories subtest, the child is presented pictures that exhibit similarities. The learner is asked to assign two pictures from the right-hand side that match the category of the left-hand side (Petermann & Macha 2005: 125).[50] Items become increasingly difficult in two regards: On the one hand, the degree of abstraction underlying the clustering of the first three items increases gradually.

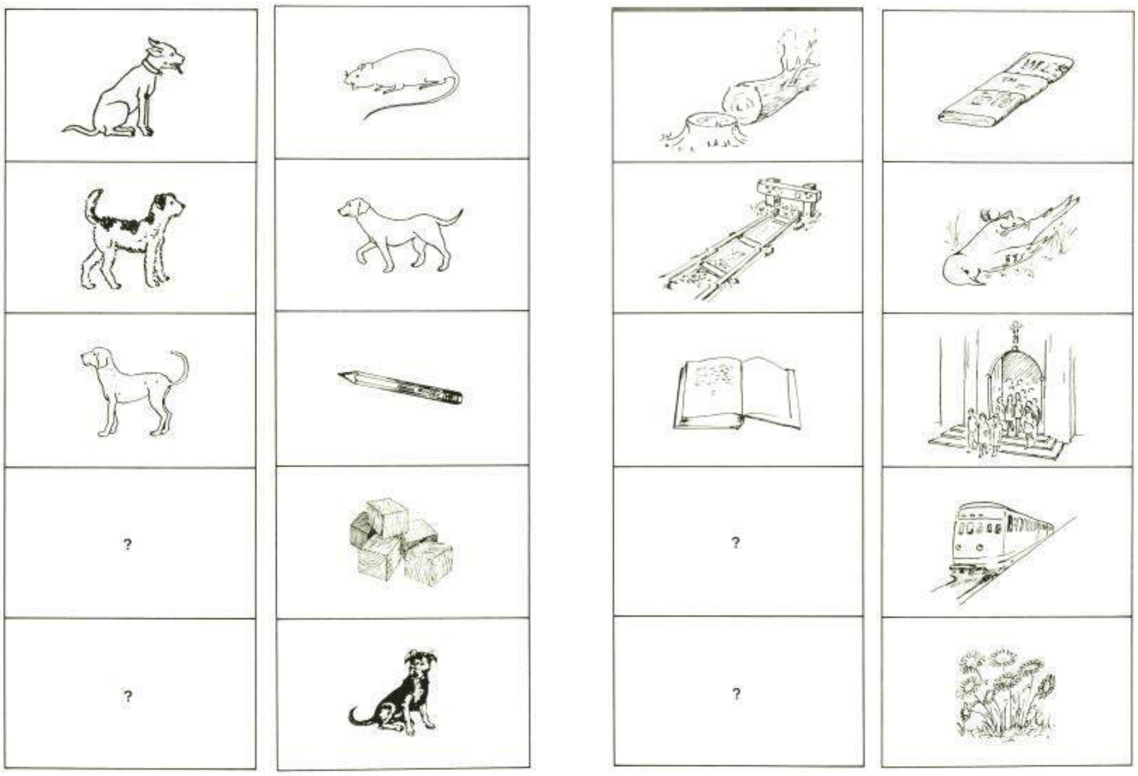

Figure 4: Item examples from the Categories subtest (Ex1 and A7) illustrating starting level and advanced classifying tasks (Snijders et al. 2005b).

[50] Each learner was given the following standardized instruction: "Here you see three pictures that belong together [*pointing at the three pictures on the (child's) left-hand side*] and two of them are missing [*pointing at the two empty boxes below*]. From this side [*pointing at the five pictures on the right-hand side*], two [*holding up two fingers*] need to go to the other side [*pointing at the empty boxes again*]. Can you show me which ones?" After successful completion of a few items, the instruction was shortened: "From here [*pointing at the five pictures on the right*], two [*holding up two fingers*] need to go to the other side [*pointing at the empty boxes*]. Can you show me which ones?" and subsequently suspended (Snijders, Tellegen & Laros 2005: 106ff).

As illustrated in figure 4, the classifying concept for Ex1 is dogs. The more abstract item A7 requires the test taker to identify the theme "end" as a classifying factor. In addition, the degree to which wrong answers seem to be acceptable (i.e. potential answers exhibiting stronger similarities) increases with progressive item difficulty (Snijders, Tellegen & Laros 2005: 21f). The Categories subtest is therefore used to test the ability of the child to classify (formulated in H1.1).

For the Situations subtest, a child is provided with incomplete pictures where either one or several pieces are missing. It is asked to complete them with provided options to render them logical (Petermann & Macha 2005: 126).[51] Here, various aspects contribute to progressive item difficulty: the amount of missing pieces and in return the amount of possible answers, the degree of similarity between right and wrong answers, as well as the complexity of the situation (Snijders, Tellegen & Laros 2005: 23f).

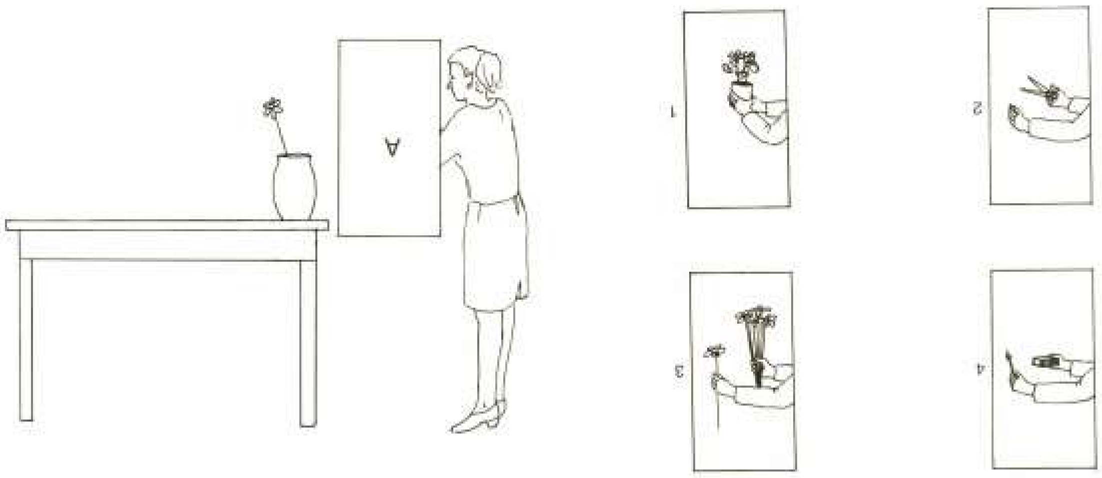

Figure 5: Item example from the Situations subtest (A2) showing a starting level problem-solving task (Snijders et al. 2005c).

Figure 5 shows a situation (A2), in which only one option seems logically feasible, namely adding further flowers into a vase already containing one flower. The alternative of lighting the flower on fire or cutting it with scissors deviate strongly from this option. The example presented in figure 6 (B8) possesses potential solutions that only vary in minor characteristics, such as whether an apple is next to the vase or the sequence in which the flowers are arranged. Appealing to logical thinking, the Situations subtest aims at assessing the child's problem-solving power (H1.3).

[51] Each learner was given the following standardized instructions: "Here you see a big picture [*circling the totality of the presented situation*] and a little piece is missing [*circling the part where the picture fragment was missing*]. From these small pictures [*pointing at the available options*] one [*holding up one finger*] has to go in here [*pointing at the missing fragment again*]. Can you show me which one? Look carefully at all the pictures, before you decide!" During the course of the test, the instruction was shortened to: "Which of the little pictures [*pointing at the options*] has to go in here [*pointing at the missing fragment*]?" Whenever more missing fragments were introduced, this was specifically pointed out: "Watch out, now X [*holding up the respective number of fingers*] pieces are missing [*pointing out all missing sections*]! You now need to choose X [*holding up fingers again*]." (Snijders, Tellegen & Laros 2005: 122ff).

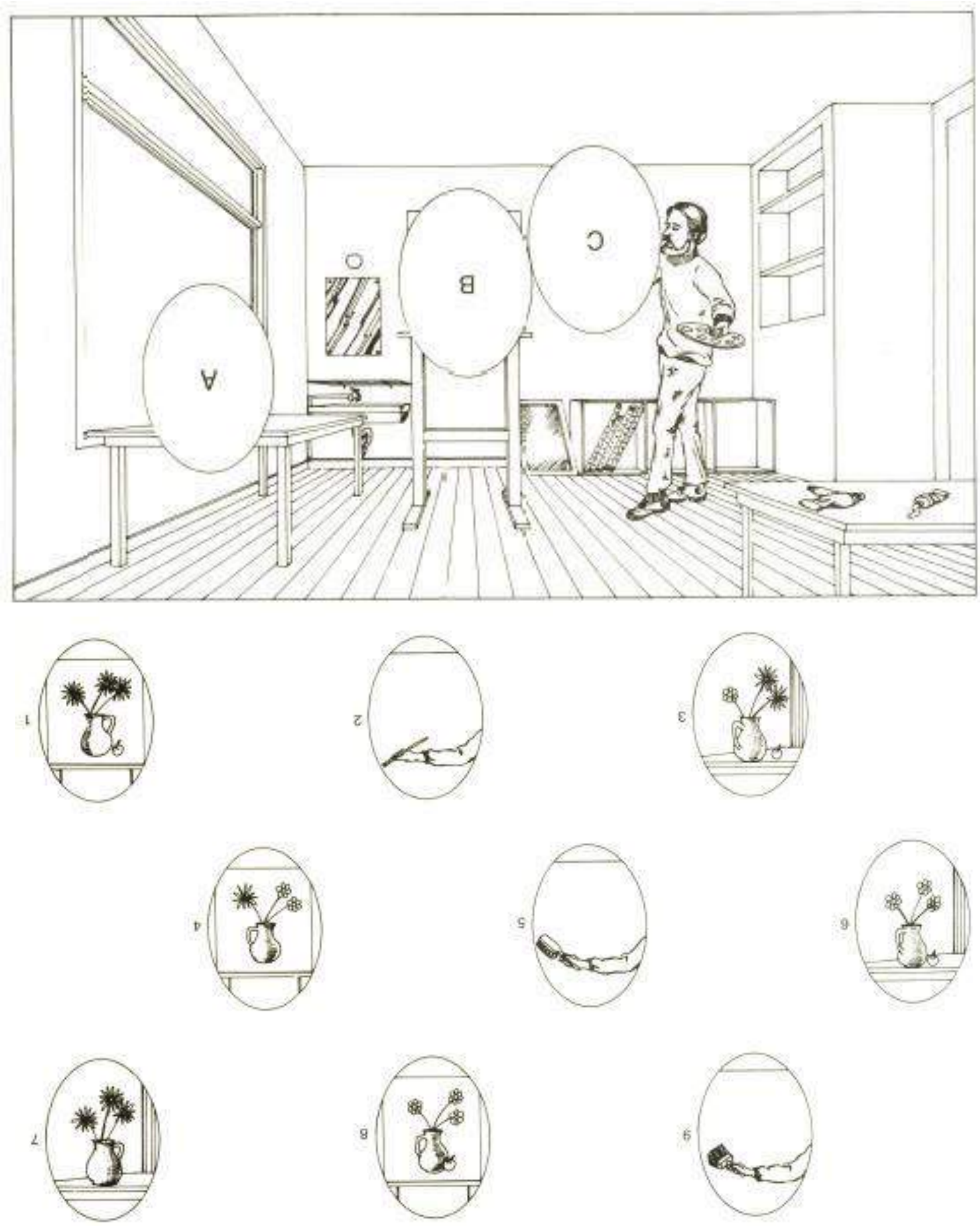

Figure 6: Item example from the Situations subtest (B8) illustrating a more complex problem-solving task (Snijders et al. 2005c).

Lastly, the Analogies subtest tests a child's ability to recognize patterns and to act accordingly, i.e. to identify and apply rules. Here, the child is shown a transformation of a geometric object. The child has to analyze the transformation and apply the same transformation to another object presented below (Petermann & Macha 2005: 126).[52]

[52] Each learner was given the following standardized instruction: "Look, this picture changes [*pointing at the upper left picture*] and it becomes this one [*pointing at the upper right picture*]. This one [*pointing at the lower left picture*] has to change in the same way. What does it look like after it has changed [*pointing at the lower right question mark*]? One of the pictures down here [*pointing at the possible answers*] has to go here [*pointing at the question mark*

Transformations include changing size, movement, removing or adding elements, halving the object, mirroring, rotation, and color changes. Difficulty increases with growing complexity of the first object that is transformed, the amount of transformations used, and the number of basic elements present in the first object. Moreover, the less similar example item and item to be transformed by the learner are, the more difficult is the item rated (Snijders, Tellegen & Laros 2005: 24).
Figure 7 contrasts two items with very dissimilar difficulty levels: A1 uses a single basic element and one transformation (color-blocking the frame). Example and task to be solved are rather similar with regards to shape. In contrast, A10's example item consists out of three basic elements where two independent transformations take place (mirroring of the two center objects, reducing size of the framing object). Other than the same combination of basic elements (two identical center elements with a framing one), no visual similarity is evident between example and task.

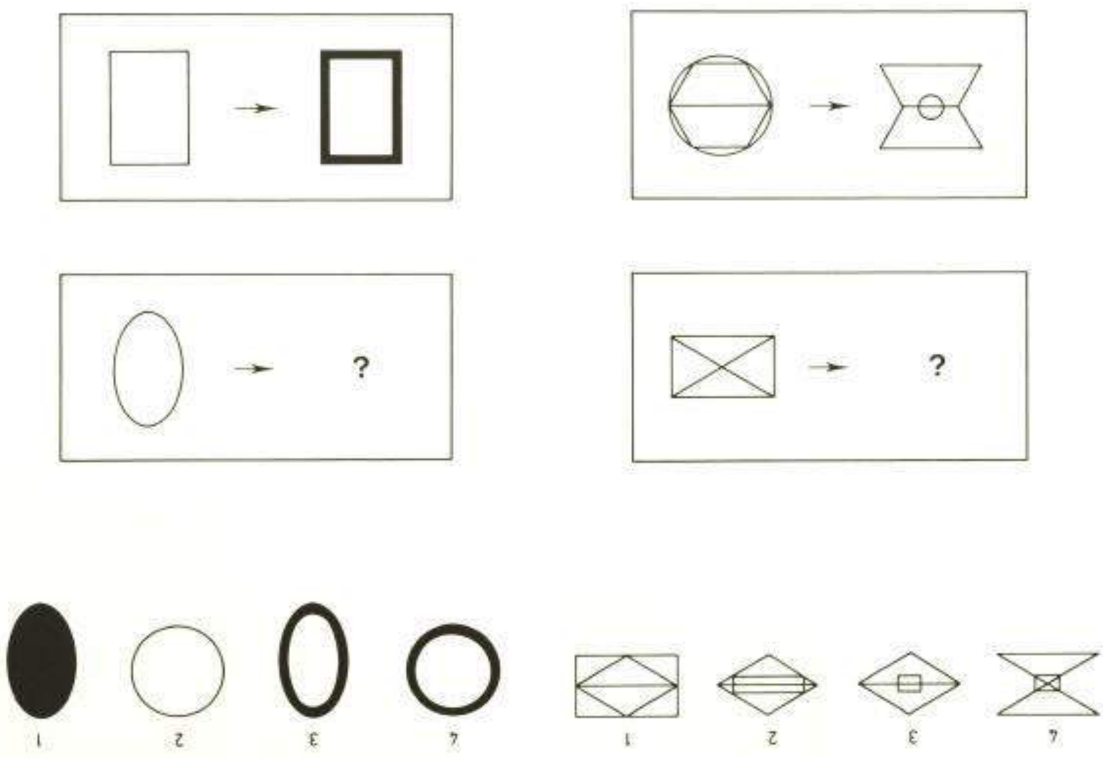

Figure 7: Item examples from the Analogies subtest (A1 and A10) to exemplary illustrate the rising level of difficulty within the a-series (Snijders et al. 2005a).

The Analogies subtest is used to operationalize the child's progress in rule learning (H1.2).

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again]. Can you show me which one? Look carefully, only one [*holding up one finger*] is right!" Later on this was shortened to: "If this pictures changes [*pointing at the upper left picture*] and becomes this one [*pointing at the upper right picture*], this picture [*pointing at the lower left picture*] has to change and become which one?" If necessary, the long version of the introduction was repeated upon start of a new series (Snijders, Tellegen & Laros 2005: 123f).

Due to the diverse age structure of the sample (and more generally the raw test scores' dependency on age), observed scores cannot be compared directly. Hence, they were converted into norm scores (N) using the software package Snijders-Oomen Non-Verbal Test of Intelligence (Version 4.1 from 28/01/2010). They were computed using raw test scores, sex, as well as birth and test date of the learner.[53]

It needs to be noted that the test version available to the researcher did not represent the most current version of the SON-R. The potential distorting effect of obsolescence of time-specific items and the potential shift in norm values, reliability and validity caused by changes in the population need to and will be reflected upon (Snijders, Tellegen & Laros 2005: 10).

Additional information gathered

As pointed out before, behavioral insights from psychometric tests need to be complemented with collateral variables (Ford 2005; Schölmerich et al. 2008: 192). For this reason, the testing session was followed up by a brief interview (A8ff). Firstly, this served the purpose to collect information on control variables (e.g. socio-economic characteristics, prior knowledge of chess by the student and his/her social group). Secondly, open questions were posed about motivation and self-perception of development to make the children feel more actively included in the testing process and to investigate a possible (self-)selection effect[54]. A question about their favorite subject at school tried to control for variance in the chess group by investigating the popular claim that particularly children with an affinity for logical thinking opt for playing chess.

Special attention in the interview was given to child-oriented wording. In cases where language posed a barrier to posing or answering these questions, I was assisted by an available school teacher in translating. Due to the simplicity of these questions, distortions should be minimal.

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[53] Classical test theory (or true score theory) assumes that in psychometric testing, an observed score results out of the test taker's true score (reliable component) and some measuring error (unreliable component). Measurements in testing are hence referred to estimated true scores from a norm population. Underlying the transformation of this test is a norm group assessment of 1350 Dutch children from 1984/85. Using their results, normalization procedures were undertaken standardizing true score distributions into normal distributions with equal means (100) and standard deviations (15) per subtest and age group. Based on this normalization, true scores of an individual test taker or the distribution of true scores within a population can be estimated using the observed scores. N scores hence represent one of two estimates of the standardized true score attained. Other than the estimate of the latent value (L) used to estimate the individual's true score, the N score is better suited for group settings and hypothesis testing and was thus opted for. This is based on the assumption, that true scores are better suited for comparison purposes than estimated true scores using regression analysis as it is the case for L values. Following classical test theory, the average of norm values is equal to the true score average added by the average measurement error. With increasing sample size, error scores cancel each other out resulting in the norm value mean approaching the average true score (Snijders, Tellegen & Laros 2005: 33ff, 54–59).

[54] I.e. did the student only join the chess class because their teacher (or another person of reference) suggested it based on his/her academic performance? Did only students with previously better performance opt for the chess class?

Before the start of the data collection, written consent was obtained from the sampled learners' parents. In total, only three guardians refused participation of their child. A re-sampling was used to assure adherence to the overall sample size.
The timing of testing sessions was determined in tandem with the respective school management and teachers. On average, one testing session took 18 minutes.

4.3.2 Academic performance

Due to the lack of a pretest, inferences on the improvement in cognitive skills as measured by the SON-R 5½-17 could not be drawn. It was assumed that records on academic performance (i.e. marks), on the other hand, were readily available for previous points in time and could thus serve as both a measurement of prior performance and as an alternative measurement for current performance. Unfortunately due to a state-wide reform of reporting standards,[55] in all schools, the administration was only able to provide so-called schedules (i.e. mark reports) from the research year. This included both marks and attained levels[56] from the first three school terms (namely in March, June, and September) as well as numbers of days absent and further demographic information on the learners. For the sample students, information from the schedules was matched with the test data in one SPSS file.

4.3.3 Qualitative interviews

Due to the fact that theory-led studies on the influence of chess on education are rarely found, possible explanation mechanisms have been largely neglected or have been simply assumed. Therefore, qualitative interviews with the respective chess instructors were conducted to supplement the quantitative performance data obtained. In the semi-structured interviews, they were asked to describe the (chess) students' development over time as well as to voice their perceptions on the interplay between chess and education, particularly in the context of South African schools (A13f). Open-ended questions were followed up by targeted questions providing the framework for later analysis (see 4.4.2). Consecutively, teachers were asked closed questions from a structured questionnaire on general characteristics of their school and chess class (originally designed as the ex-ante inquiry) to collect relevant framework data (A15f).

[55] Furthermore, several break-ins in all schools, and as a result the theft of computers used in administration, made a full reconstruction of reports following old reporting standards impossible.
[56] In the South African schooling system, marks are recorded in percentage points, by which an average score above 50% represents a pass into the next grade. Furthermore, reports indicate levels for each subject that cluster performance into seven categories: 0-29% not achieved, 30-39% elementary achievement, 40-49% moderate achievement, 50-59% adequate achievement, 60-69% substantial achievement, 70-79% meritorious achievement, 80-100% outstanding achievement. For an (anonymized) exemplary schedule see A13.

The expert interviews with key stakeholders in South African chess (A17f)[57], that were foreseen to elaborate on the South African specificities of chess instruction and to identify possible implications of (positive) research findings, had to be postponed due to timing issues. They were scheduled to take place via Skype after the return from field research, but did not materialize as some interview partners were not reachable any longer. Future research should seek to incorporate these local perspectives to determine implications of research findings.

4.4 Data processing

Due to its different nature, the data obtained had to be analyzed both quantitatively and qualitatively. While the quantitative data was processed with IBM SPSS (Version 22)[58] using both descriptive and probability statistics, information gathered from the qualitative interviews was coded manually and used to complement the analysis on selected issues.

4.4.1 Quantitative data processing

To enhance understanding of the sample studied, the sample population was characterized using descriptive statistics. Important aspects included age structure, gender balance, as well as the frequency distribution across groups, schools, and grades. Attention was also paid to testing characteristics such as test duration and language used.

Before beginning to analyze causal relationships, the interrelations between the different measures of performance were examined through correlation analysis. Overall test scores[59] and current grades were related to inspect how closely the two measurements of current performance are associated. Furthermore, the relationship between subtest scores and the individual subject marks[60] was investigated to pin-point connections between the two performance measures in more detail. In addition, subtest scores were correlated amongst each other to study whether these measure sufficiently different aspects of thinking abilities. Correlating prior and current grades and calculating the resulting determination coefficient r^2, served to examine how much of the current performance can be explained by previous success. Dealing with metric data, the Bravais-Pearson

[57] Interview partners approached include the vice president of the South African Chess Foundation CHESSA, Shanks Naidoo, Kgaugelo Mosetlhe, representative of South Africa in FIDE's Chess in Schools Commission, Jabulani Banda, local project manager of CfA, and a representative of ChessKids, a non-governmental organization promoting chess in schools (e.g. through tournaments) and based in Soweto.
[58] Using the SPSS output, selected figures and tables were designed in Microsoft Excel 2013.
[59] Unless mentioned otherwise, SON-R test scores refer to the respective N scores. These are independent of age and can be compared across the entire sample.
[60] Only four subjects were taken into deeper consideration: home language, first additional language, mathematics, and life skills/orientation. The latter was combined out of the life skills mark for learners in grade 1-6 and life orientation for grade 7 learners. Other subjects such as natural sciences, technology, social sciences, economic and management sciences, and creative arts were disregarded as they are only taught starting in the intermediate phase (G4-6) or senior phase (G7-9) and, therefore, do not apply for 35 out of 80 learners tested (A77).

correlation coefficient (r) was used wherever both variables' data was normally distributed. For those variables not exhibiting a normal or at least close-to-normal distribution, the non-parametric Spearman correlation coefficient (ρ) was opted for (Davies & Hughes 2014: 146f).

During the course of analysis, a variety of group compositions was studied to pin-point the group contrast with the best explanatory power. For that reason, various recodings were necessary. The steps of analysis outlined below were each performed using the following group allocations:

1. Using the original three subsamples: "general chess instruction", "other extracurricular activities", and "no chess or extracurricular activities" and respectively the
    a. Recoded dummy variable: "chess instruction" vs. "no chess instruction"
    b. Recoded dummy variable: "extracurricular activities" vs. "no extracurricular activities"
2. Using the recoded dummy variable: "knowledge of chess" vs. "no knowledge of chess" (as queried in the follow-up interview of those not participating in chess)
3. Using the recoded dummy variable: "practicing chess at home" vs. "not playing chess at home (or at all)" (as queried in the follow-up interview)
4. As well as repeating the analysis only considering students to be chess students if they had received more than a term of instruction[61] and their respective
    a. Recoded dummy variable: "chess instruction" vs. "no chess instruction"
    b. Recoded dummy variable: "extracurricular activities" vs. "no extracurricular activities"

Most importantly, the subsamples were compared with regard to their mean performance in the testing session (both overall and with respect to subtest scores) and in class. After testing for normality of the variable distributions (Kolmogorov-Smirnov- and Shapiro-Wilk-test), the difference in means was tested for significance using the appropriate procedure: When comparing the more than two groups, the One-Way-ANOVA test statistic was used with subsequent post-hoc comparisons[62]; when binary combinations were tested, the Independent samples T-test was used for normally distributed variables

[61] I.e. recoding those who receive mandatory instruction during one term in grade 6 into their originally sampled groups as well as transferring learners who recently joined the chess class into the no activity category.

[62] The analysis was accompanied by a Levene's test to test for equality of variances. If the sample sizes were equal as well as the variances, the REGQWA post-hoc test was opted for. With slightly different sample sizes and equal variances, the Gabriel test was interpreted; with starker varying sample sizes Hochberg's GT2. The Games-Howell test was included in any case to be interpreted, if the Levene's test exhibited unequal variances (Field 2013: 458).

and the Mann-Whitney U-test statistic for those that do not follow a normal distribution (Davies & Hughes 2014: 140f; Field 2013: 219, 388).

As measures for pre-intervention performance were not available, development of students was analyzed with regard to their average improvement (or rather development) in between term 1 and term 3. Beforehand, a Dependent samples T-test was run to scrutinize whether the average scores between the two measurement times differed significantly, as well as two Wilcoxon Signed-Rank tests (one for marks, one for performance levels). The latter represents a non-parametric hypothesis test for repeated measurements of the same sample to test whether there are significant changes in ranking (Field 2013: 228ff). Including the Wilcoxon Signed-Rank test was deemed relevant because means could appear stable despite significant change in the ranks of cases. Afterwards, mean improvement between groups was tested for significance using the One-Way-ANOVA test statistic for multiple groups and the Independent samples T-test for the dummy groups (after ensuring the condition of normal distribution).

To determine the direction of influence, several regression analyses were performed after a respective Levene's test to assure variance homogeneity of the variables. Firstly, bivariate (linear) regressions each tested the influence of having received chess instruction and practicing chess at home (independent variables) on test scores and academic performance (dependent variables). Secondly, a multivariate (linear) regression was modelled to combine these aspects and to include other explanatory variables such as socio-demographic data such as gender and age.

The relationship between duration of instruction and performance of chess students was examined using the Spearman correlation coefficient, as length of instruction had to be recoded into ordinal scaled categories.

It is important to note that possible biases had to be controlled for. As mentioned, controlling for previous performance was not possible due to the unavailability of marks prior to 2015. In return, this gave way to an attribution problem: Have those receiving chess lessons become academically superior or did only those with previously stronger academic performance opt for the chess class or were referred there because of their performance ((self-)selection effect)? Here, answers from the open-ended question "Why did you join the chess class" were analyzed distinguishing internal and external reasons for joining the course. With regards to a self-selection effect stemming from an affinity for abstract thinking, the answers to the question "Which is your favorite subject in school?" in the follow-up interview were used to descriptively compare the preferences of the sample students in each group.

Lastly, upon consideration of the cultural limits of intelligence testing mentioned in chapter 4.3.1, validity and reliability of the psychometric tests were called into question. Whilst these biases weigh less when comparing learners from a homogeneous environment (as it is the case in this research) as opposed to comparing minority groups with the norm population, limitations to the methodology used need to be reflected upon, nonetheless. Here, the sample population's performance distribution was descriptively compared to the norm distribution underlying the SON-R score calculations, in particular regarding their measures of central tendency. Upon detecting a large shift in the distribution, the solution rates of the Categories and Situations subtests' items were contrasted and examined in more detail to detect possible construct and item biases. Lastly, the reliability of the different subtests was compared using a test specific formula for internal consistency of each subtest.[63]

4.4.2 Qualitative data processing

The content of the semi-structured interviews with the chess instructors was transcribed verbatim from digital recordings.[64] Due to the relatively small amount of data, no software was used for analysis and codes were assigned manually.

Albeit never free of interpretation, the approach chosen is of a mainly descriptive and less interpretative nature. As the qualitative information gathered predominantly functions to supplement the qualitative analysis, focus was placed on manifest content and inferences were mostly drawn from the text itself. Hence, reporting will center on common issues mentioned in the data (Mayring 2000: 3; Vaismoradi, Turunen & Bondas 2013: 399f). In this line of reasoning, a qualitative content analysis was opted for, more specifically a directed content analysis. Following this directed, deductive approach, the data was analyzed within the framework of the chosen theory and the deriving research hypotheses. The open questions posed in the interviews served to establish main categories such as learning/development of students, instruction, and country relevance. Categories (e.g. learning types and learning outcomes, or events of instruction), and subcategories (e.g. concept learning, intellectual skills, cognitive strategies) were derived prior to the coding procedure operationalizing main aspects of Gagné's learning and instruction theories.[65]

[63] The reliability of a subtest cannot be considered a constant property of the respective test. Instead, it depends upon the distribution of norm values within the specific group tested. Common measures of reliability such as Cronbach's α are rendered inappropriate by the adaptive testing procedure. By applying termination rules, the sequence of item processing becomes relevant and items interdependent. A reliability study showed that common measures naively exaggerate reliability of adaptively administered subtests. Based on the results of this study, an adapted equation for estimating internal consistency was developed based on the variance of the norm scores N and their respective error score (measurement error) E: $\alpha' = [Var(N) - Var(E)] / Var(N)$ (Snijders, Tellegen & Laros 2005: 44f, 57f).

[64] Punctuation (particularly commas) was used to indicate pauses of speech rather than for orthographical reasons.

[65] For the full coding agenda in accordance with Mayring (2000) and Elo & Kyngäs (2008) see A19-22.

Using a structured coding matrix, categories were focused on the research question and guided analysis (Elo & Kyngäs 2008: 111; Hsieh & Shannon 2005: 1278, 1281; Vaismoradi, Turunen & Bondas 2013: 401; Mayring 2000: 5). Hence, information not central for answering the research questions (e.g. ice-breaker questions) has been neglected in analysis. No particular attention was paid to the quantification of data due to the small number of interviews.

In the transcripts, questions referring to a main category were color-coded, categories (and, where applicable, subcategories) were indicated in the right-hand column (A23-51). References to the transcriptions are made citing interviewee code and the respective line number.

5 Results

The following chapter will illustrate the key results derived from the data collected during field research. After a general introduction into the structure of the sample and the relationship between key variables, the major focus will be placed on comparing chess students to their non-chess playing counterparts with regards to their current performance and their performance development over time. Moreover, possible explanation mechanisms and potential biases to the results will be elaborated upon. In a concluding section, results will be summarized and related to the research hypotheses and theoretical framework given in chapter 3.

5.1 The sample studied: Descriptives

Overall, 90 students were tested using selected subtests from the Snijders-Oomen Non-Verbal Intelligence Test for the age groups five and a half to 17 (SON-R 5½-17), namely the Categories, Situations, and Analogies subtest.

For the major part of the analysis, only 80 learners will be considered, as some cases had to be excluded due to their ambiguous group assignment (e.g. participating in both sports and chess as determined in the follow-up interview). From these 80, 36 students received methodical chess lessons at school, 22 participated in other extracurricular activities, while 22 did not partake in any after-school activities. 28, 27 and 25 learners from three different schools are respectively included in the main analysis (A75ff).

Students were tested at the primary level (grade 1-7). Despite the random sample, dispersal across grades was rather well-distributed: 13 students from grade 1 (G1), 15 from G2, seven from G3, 11 from G4, seven from G5, 13 from G6, and 14 from G7. Hence, the average age of nine years and 11 months is located rather centrally between the youngest learner tested at age of six years and three months and the oldest tested with 13 years and five months. Gender proportions were balanced (40 girls, 40 boys) (A76f). On average, it took the students 18 minutes to complete both the tests and the short follow-up interview. Hereby, 72.6% (56 learners) were able to complete the test and interview using non-verbal and English instructions. In three cases (3.9%), translation was necessary for all subtests, in five cases (6.5%) only for selected tests. 13 learners required translation when it came to answering the follow-up questionnaire (A75,77).

5.2 Preliminary remarks

Before examining the relationship between the predictive variable of interest (namely chess) and the two measures of current performance (namely "average test score on the SON-R subtests" and "average mark in the current term, i.e. term 3 2015"), attention should be paid to the interrelations of these variables and their components.[66]

When looking at the correlation between the two main measures of current performance, a moderate positive relationship ($r = 0.281$) can be observed that is significant at the 5% significance level ($p = 0.012$) (A78). While this can be interpreted as both measures capturing a similar concept, it even more accentuates the fact that marks do not necessarily portray cognitive abilities (or even the much discussed concept of "intelligence") as accurately as it is often claimed.

Amongst each other, the different subtests are moderately correlated (Situations-Categories $\rho = 0.283$, $p = 0.011$; Situations-Analogies $\rho = 0.363$, $p = 0.001$; Categories-Analogies $\rho = 0.383$, $p = 0.000$).[67] All relationships are positive and statistically significant (A79). This indicates that better abilities in one area (such as classifying, recognizing and applying rules, and problem-solving) are accompanied by better abilities in the other two, but it is still safe to assume that the tests are sufficiently different to measure diverse abilities. Hereby, the Analogies subtest exhibits the strongest relationships with both other variables ($\rho = 0.383$ and 0.363). If one considers the operationalization of the Analogies subtest as a measure of rule learning that serves as the link between concept learning (as operationalized as performance in the Categories subtest) and problem-solving (as operationalized as performance in the Situations subtest), this stronger relationship strengthens the theoretical base that different learning levels follow each other in a specific order.

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[66] In interpreting strength of association, the following rules of thumb were adhered to in line with Kühnel & Krebs (2010: 404f): < |0.05| : negligible; |0.05| - |0.2| : weak; |0.2| - |0.5| : moderate; |0.5| - |0.7| : strong; |0.7| - |1| : very strong.

[67] As data for the Situations subtest was not normally distributed, Spearman's ρ was opted for as a non-parametric measure of association, despite the variable's metric scale level (Davies & Hughes 2014: 146f).

Whilst the average performance considering all subtests is equally moderately correlated with all individual subjects (home language (HL) $\rho = 0.244$, $p = 0.030$; first additional language (FAL) $\rho = 0.253$, $p = 0.024$; mathematics (M) $\rho = 0.231$, $p = 0.040$; life skills/orientation (LOS) $\rho = 0.240$, $p = 0.032$), analyzing the correlations between more specific fields reveals discrepancies in relationships. Neither the Categories, nor the Situations subtest correlate significantly with individual subjects or the average mark in term 3. The Analogies subtest on the other hand exhibits positive, significant correlations with all individual marks (HL $\rho = 0.361$, $p = 0.001$; FAL $\rho = 0.375$, $p = 0.001$; M $\rho = 0.346$, $p = 0.002$; LOS $\rho = 0.264$, $p = 0.018$) (A80f). Thus, the Analogies subtest seems to be the closest measurement for the same abilities recorded in academic marks. Key to the acquisition of intellectual skills (see 3.2.2), rule-learning is emphasized in the reality of most teaching settings (Gagné & Briggs 1974: 24). This focus might explain the closer relationship of the Analogies subtest with academic performance. Alternatively, both the Categories and the Situations subtest might be biased in their measurement as they rely more heavily on culturally specific interpretation of items. This possible bias will be more elaborated on in 5.5.2.

With regards to the marks used as a performance indicator, prior and current marks are strongly positively correlated ($r = 0.877$) and significant at the 1% level ($p = 0.000$). This indicates that 76.9% of the variation in current performance can be explained by previous academic achievements ($r^2 = 0.769$) (A82f). With 23.1% of variation left unexplained, the result indicates that current performance cannot solely be explained by earlier performance; other variables must also influence the development of academic success.

5.3 Comparison between groups

When comparing performance, a variety of group compositions was studied. With regards to the restructured final sample, the groups “chess instruction”, “extracurricular activities”, and “no chess, no extracurricular activities” were examined, as well as their respective binary cases “chess vs. no chess” and “extracurricular activities vs. no extracurricular activities”. This analysis also included contrasting students with knowledge of the game of chess with those claiming not to know anything about the game and those claiming to play chess at home vis-à-vis those not doing so. In a second run, the analysis was repeated only considering learners as chess students if they had received chess lessons for a longer period than one term (i.e. three months).

5.3.1 Performance comparison

When illustrating the performance scores of the three sample groups graphically (see figure 8&9), a trend becomes evident: With regard to the SON-R test, in most cases, chess students score the highest on average, followed by those students taking part in extracurricular activities, and lastly those not partaking in either activity. This holds true for the Categories and Situations subtests as well as the overall SON-R score. In the Analogies subtest no activity students score slightly higher than those doing extracurricular activities (77.73 vs. 77.5) but behind chess playing students (A84).

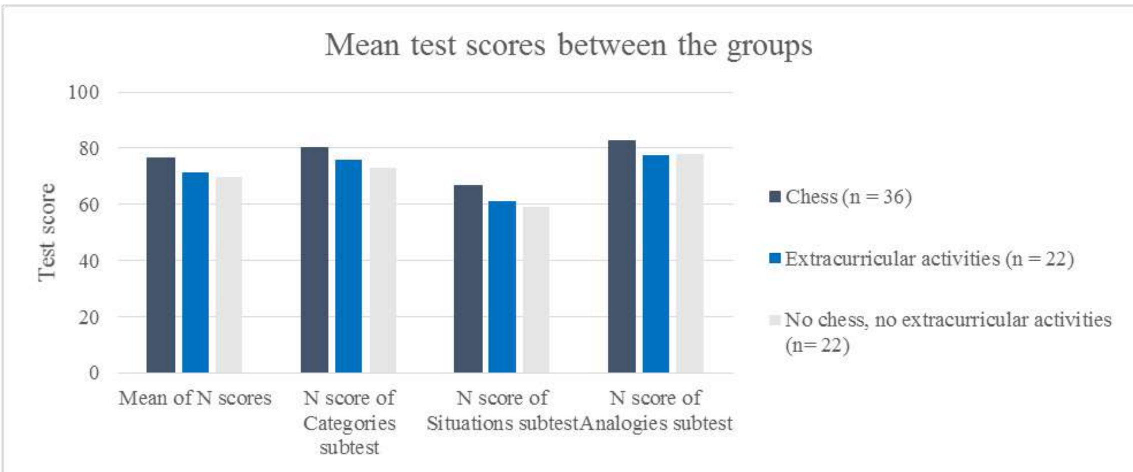

Figure 8: Comparison of mean group performance in the Categories, Situations, and Analogies subtest of the Snijders-Oomen Non-Verbal Intelligence Test, as well as the test mean score (own illustration, A84).

A similar picture presents itself with respect to the other performance dimension: academic results. With the exception of math, where "no activity" learners score after chess but in front of extracurricular students, the same trend can be observed: chess playing students obtain the highest scores, followed by learners partaking in extracurricular activities, and lastly those participating neither in chess, nor in other extracurricular activities (A84f).

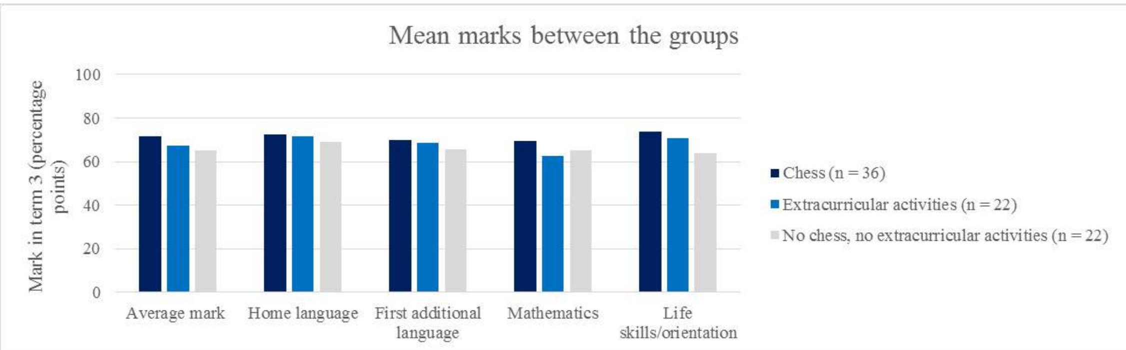

Figure 9: Comparison of mean group academic performance in term 3 2015 (own illustration, A84f).

If broken down into two groups, the chess students (n = 36) score higher in every category when compared to their non-chess playing counterparts (n = 44) (A86;89f). The same holds true for students participating in other extracurricular activities (n = 55) vs. those only receiving the prescribed curriculum (n= 25) (A87, 91f).

When not using chess instruction as the grouping variable but self-reported knowledge of chess, the results become more balanced. Differences between the groups became less stark, but the students not reporting chess knowledge scored higher in the Situations and Analogies subtest, overall on the SON-R, as well as in every subject (A88,92f). Here, it is important to note that 53 of the 80 students (66.3%) were either participating in extracurricular chess or answered the question "Do you know how to play chess?" with "yes" (A94f). The level of expertise was not investigated upon. Mere knowledge of chess, without having received methodical instruction, seems to relate differently to performance.

Contrasting those who claim to play the game outside of school with those that only play it at school or not at all, again paints a different picture. Learners practicing at home score higher on all SON-R tests, in life skills/orientation, and overall marks, while those not playing chess outside of school show better performance in home language, their first additional language, and mathematics (A88f,93f).

Which group scored higher in which chess-contrast is illustrated in the following table:

Operationa-lization of chess		SON-R N scores				Marks in term 3 2015 (percentage points)				
		Mean	Categories subtest	Situations subtest	Analogies subtest	Average	HL	FAL	M	LOS
Chess instruction	yes (n = 36)	76,44	80,17	66,72	82,61	71,78	72,64	70,06	69,56	73,97
	no (n = 44)	70,70	74,41	60,20	77,61	66,25	70,19	67,00	63,84	67,14
Chess know-ledge (self-reported)	yes (n = 53)	73,66	77,79	63,47	80,00	68,08	70,13	67,45	65,08	70,13
	no (n = 16)	73,69	75,94	64,31	81,06	71,06	77,19	70,38	69,50	72,44
Chess practice at home (self-reported)	yes (n = 39)	76,41	80,69	66,77	82,13	69,10	70,41	68,15	66,18	72,41
	no (n = 41)	70,32	73,49	59,68	77,71	68,39	72,18	68,59	66,63	68,12

Table 4: Comparison of means using different operationalizations of chess (own illustration, A86-94)

This highlights how chess, when operationalized in different ways (as instruction, knowledge or continuous practice), yields very different results. As the focus of this study is on the introduction of methodical chess lessons in schools, the first comparison contrasting those receiving chess instruction with all others is considered paramount.[68] The other two contrasts, furthermore, rely on self-reporting; due to which they might be subject to a social desirability bias, particularly because young children were interviewed. This makes the comparison between "instruction" and "no instruction" a more reliable operationalization of chess.

After testing for normality, not all performance variables displayed a normal or at least close-to-normal distribution.[69] Therefore, both parametric and non-parametric tests were used to determine whether the difference in means between the groups, as illustrated before, can be deemed statistically significant (see table 5).

As before, results are strongly dependent on group composition. When comparing the three sample groups, the One-Way ANOVA did not indicate any significance in the difference of means at the 5% level. Correspondingly, the performed post-hoc test (Gabriel)[70] did not render any significant results at this level either (A119-125).

For the binary groups, the Independent samples T-test deems the difference in means between the group receiving methodical chess instruction and the group not receiving it significant, both regarding their mean performance on the selected SON-R tests ($p = 0.037$) and academically ($p = 0.04$). In contrast, means do not differ significantly for subtest scores or individual subject marks. Even more significant is the difference in means of average SON-R performance between the group practicing chess at home and those not playing chess outside of school (or at all) ($p = 0.026$). In this case, the difference in average academic performance is not significant ($p = 0.793$), but illustrative for the sample studied. For the groups "chess knowledge" vs. "no chess knowledge" and "extracurricular activities" vs. "no extracurricular activities", the difference in means was not significant in any case (A126-132). Hence, it seems as if students receiving chess instruction at school perform better in both indicators measuring current performance. Furthermore, students playing chess at home on a regular basis demonstrate higher abstract and concrete thinking skills as measured by the SON-R test. Yet, these do not necessarily translate into better academic performance.

[68] The positive results of at-home-practice should be considered as a useful recommendation for instruction (see chapter 6).

[69] Both the Kolmogorov-Smirnov and the Shapiro-Wilk test were executed in SPSS, sometimes with varying results (A95-118). In the case that one test deemed the distribution to be normal and the other did not, the results of the Shapiro-Wilk test were used as the decisive statistical value due to its higher test power (inter alia lower sensitivity to extreme values) (Ghasemi & Zahediasl 2012; Field 2013: 188). To ease the comparison, the Mann-Whitney U-test was also used on the data following a normal distribution.

[70] This post-hoc test was chosen due to the homogeneity of variances (as measured by the Levene's test) displayed by all test variables and the rather small difference in the groups' n (Field 2013: 459).

Variable		One-Way ANOVA	Independent samples T-test				Mann-Whitney U-test			
		3 groups	chess instruction vs. no chess instruction	chess knowledge vs. no chess knowledge	chess practice at home vs. no practice at home	extracurricular activites vs. no extracurricular activities	chess instruction vs. no chess instruction	chess knowledge vs. no chess knowledge	chess practice at home vs. no practice at home	extracurricular activites vs. no extracurricular activities
SON-R N scores	**Average**	x p = 0.104	* p = 0.037	x p = 0.994	* p = 0.026	x p = 0.176	* p = 0.044	x p = 0.870	* p = 0.042	x p = 0.230
	Categories subtest	x p = 0.253	x p = 0.122	x p = 0.689	x p = 0.051	x p = 0.296	x p = 0.156	x p = 0.864	x p = 0.055	x p = 0.324
	Situations subtest	n.a.	n.a.	n.a.	n.a.	n.a.	x p = 0.103	x p = 0.770	* p = 0.037	x p = 0.382
	Analogies subtest	x p = 0.355	x p = 0.149	x p = 0.816	x p = 0.200	x p = 0.292	x p = 0.153	x p = 0.926	x p = 0.218	x p = 0.241
Marks in term 3 2015 (percentage points)	**Average**	x p = 0.108	* p = 0.040	x p = 0.390	x p = 0.793	x p = 0.197	x p = 0.059	x p = 0.309	x p = 0.784	x p = 0.205
	Home language	x p = 0.580	x p = 0.405	x p = 0.051	x p = 0.548	x p = 0.230	x p = 0.431	* p = 0.050	x p = 0.596	x p = 0.195
	First additional language	n.a.	n.a.	n.a.	n.a.	n.a.	x p = 0.331	x p = 0.545	x p = 0.946	x p = 0.311
	Mathematics	n.a.	n.a.	n.a.	n.a.	n.a.	x p = 0.128	x p = 0.306	x p = 0.919	x p = 0.720
	Life skills/ orientation	n.a.	n.a.	n.a.	n.a.	n.a.	* p = 0.049	x p = 0.302	x p = 0.307	x p = 0.140

Table 5: Comparing tests of significance on all performance levels using different group allocations (own illustration, A119-136)

When including the variables that do not follow a normal distribution[71] by performing the non-parametric Mann-Whitney U-test, several more significant differences could be detected: distinguishing between "instruction" and "no instruction" shows that the two groups' means differ significantly ($p = 0.049$) in their performance in life skills/orientation; the contrast groups "knowledge" vs. "no knowledge" moreover in home language ($p = 0.05$); and the "practice at home" and "no practice at home" groups' means differ in the Situations subtest ($p = 0.037$) (A133-136).
Repeating the previous analysis, only considering those learners as chess students, if they had received chess instruction for longer than three months (i.e. one term), does not alter the general trend of the means comparison (see figure 8&9): When comparing the three groups, chess students score highest in all categories of the SON-R and academic performance, usually followed by learners doing extracurricular activities, and lastly those not partaking in any after-school activities. Again, in the Analogies subtest and in mathematics, no-activity students score slightly higher than extracurricular students but after chess students (A137f,140f). Chess students continue to score higher in every category, while the contrast "extracurricular – no extracurricular" shows better scores for every category with the exception of mathematics (A138f,141ff). With regard to significance, the Oneway-ANOVA could not detect any significant difference between means of the three groups. Furthermore using the Independent samples T-test, the significant mean difference previously found for both performance categories between "chess instruction" and "no chess instruction" disappears (mean of subtest scores: $p = 0.052$, average academic performance $p = 0.090$), if those learners with less than three months instruction are allocated to the respective other groups (see 4.4.1). Merely, the significant difference in mean performance in life skills/orientation between the chess instruction group and the non-chess playing group is upheld ($p = 0.047$) (A168-180). Allocating those learners having only received chess instruction for three months or less to the other groups has resulted in a loss of significance in means comparison. For one, this could indicate that even short-term benefits of instruction had become tangible and are now masked through the artificial recoding. Therefore, interest rises in considering the length of instruction as an explanatory variable for current performance (see 5.4).
The results of this comparison in favor of the research hypotheses should be considered in the light of the study's cross-sectional design! Due to the unavailability of previous performance indicators, a pre-post comparison could not be performed. It cannot be ruled

[71] This includes the Situations subtest and the individual marks for first additional language, mathematics, and life skills/orientation.

out that those students with higher cognitive abilities and better academic performance either opted for chess class or were even referred there because of their performance. This highlights the difficulty of attributing the effect observed to the intervention alone. Even though the effect cannot be controlled for completely, chapter 5.5.1 investigates the explanation gap and enumerates control factors mitigating the assumption of a selection-bias.

5.3.2 Development comparison

Shifting attention from a cross-sectional focus on current performance towards the students' development over time,[72] different tests become necessary. Operationalizing mark development as the difference between term 3 and term 1 marks, it was, first, tested whether the means between term 1 and term 3 marks differed significantly, second, whether ranks in marks shifted significantly; and third, whether there is a significant difference in the improvements of the groups. Having established that term 1 averages, term 3 averages, as well as the improvement of averages from term 1 to term 3 are normally distributed as measured by the Shapiro-Wilk test (A181-187), parametric test statistics were opted for.

On average, students improved by 3.5 percentage points over the course of the year, but vary between a minimum of losing 10 points to a maximum of gaining 19 points (A181), which calls for further analysis to explain this disparity.

The Paired samples T-test shows us that despite being strongly correlated ($r = 0.877$), the difference in means between term 1 and term 3 averages is highly significant ($p = 0.000$) (A188). With regards to the entire sample, a significant development has taken place. If we now consider the individual sample students, the Wilcoxon-Signed-Ranks test was able to point out that not only the whole sample improved/deteriorated, but also that the ranking of students within the sample changed significantly, meaning the rank order between cases differs significantly in between term 1 and term 3 ($p = 0.000$). With regard to marks in percentage points, 19 learners scored worse at the end of the year, 51 learners improved, and three maintained their average over the school year. Repeating the test with more robust categories, namely the ordinal-scaled performance levels, rank change becomes less stark (11 students deteriorated in their level, 27 improved, while 41 stayed within their initial level), but remains highly significant ($p = 0.008$) (A189f).

[72] Again, it was not possible to compare development pre- vis-à-vis post-intervention as marks were only available for 2015. That is why, it was focused on the "speed" of progress in the current year.

Having established the significance in progress over the school year, means tests were employed to compare how the groups' development is to be distinguished (see table 6).

Grouping variable		Mean improvement (% points)	Significance tests for means' difference
3 sample groups	chess (n = 35)	1,81	* p = 0.049
	extracurricular activities (n = 22)	4,86	
	no chess, no extracurricular activities (n = 16)	5,38	
Chess instruction	yes (n = 35)	1,81	* p = 0.014
	no (n = 38)	5,08	
Chess knowledge (self-reported)	yes (n = 50)	2,77	x p = 0.386
	no (n = 15)	4,20	
Chess practice at home (self-reported)	yes (n = 37)	3,01	x p = 0.454
	no (n = 36)	4,03	
Extracurricular activities	yes (n = 54)	3,29	x p = 0.573
	no (n = 19)	4,16	

Table 6: Mean improvement in average mark from term 1 to term 3 by group and significance of mean difference (own illustration, A190-196).

Noticeably, regardless of grouping, chess students show lower progress than their non-chess playing counterparts; this furthermore holds true for extracurricular vis-à-vis non-extracurricular students. An Oneway-ANOVA test statistic for the three group comparison and the Independent samples T-tests for binary groupings rendered the difference in means significant for group distinction based on "instruction" (for all groups p = 0.049; binary p = 0.014), but not the group distinction based on "self-reported knowledge" (p = 0.386), "chess practice at home" (p = 0.454) or for contrasting extracurricular activities in general (p = 0.573). Yet, the post-hoc tests following the ANOVA could not pinpoint a significant difference between two of the three groups. The group contrast "chess" and "no chess, no extracurricular activity" was closest to a 5% significance level (GT2 Hochberg: p = 0.109); the contrast "chess" and "extracurricular activities" yielded similar results (GT2 Hochberg p = 0.137) (A190-196).

This might suggest that chess playing students, and more generally those taking part in extracurricular activities, do not improve as fast as those only focusing on the traditional curriculum, i.e. that these activities can be seen as a distraction. Nevertheless, the overall scores must be kept in mind (see figure 10). Here, it can be observed that despite the fact that students not participating in any extracurricular activities or chess achieve for the most part, greater improvements in their individual marks, they still score lower in total than students participating in those activities. It must also be considered that the disparity between groups observed might also result from the fact that improvements starting from lower score levels are more easily achievable than gains in already high-performance levels. A longitudinal study would be able to show whether the no-activity students would catch up with higher-scoring students owing to their faster rate of progress, or whether their advancement would slow down at a certain threshold upholding the performance hierarchy.

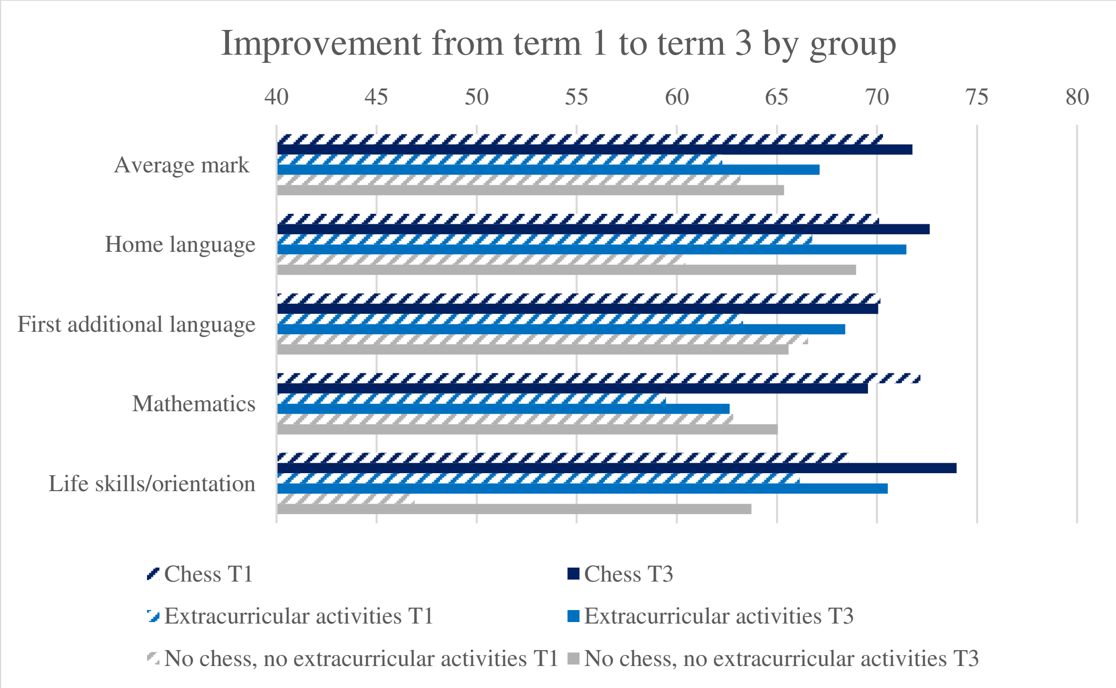

Figure 10: Improvement in marks (percentage points) from term 1 to term 3 by group and subject (own illustration, A197ff).

In addition, when including the duration of instruction as a decisive grouping variable in the analysis, both the Paired samples T-test and the Wilcoxon-Signed-Rank test for mark and level improvement continue to exhibit a significant development overall ($p = 0.000$) and between ranks (marks $p = 0.000$, levels $p = 0.012$) (A206ff). But in contrast to the prior group composition considering all chess students, the difference between the groups' means is no longer considered significant neither for the three groups ($p = 0.759$) nor for the "chess vs. no chess" contrast ($p = 0.458$) (A208-212). This reinforces the findings of 5.3.1 that chess instruction of less than three months might already have a tangible effect on performance.

5.4 Explanation mechanisms

In 5.3, we saw that performance means were significantly different between groups, most notably the average score in the SON-R subtests and the average mark in term 3 between students receiving methodical chess instruction and those who do not. Moreover, there was a significant difference in mean performance on the SON-R between those playing chess at home and those not playing the game at home or at all. To scrutinize how large the influence of the chess variables is on the performance indicators, several regression analyses were performed. The bivariate regression relating receiving chess instruction to performance rendered chess instruction to be moderately positive ($r = 0.234$) and significantly ($p = 0.037$) correlated with the mean performance on the SON-R. Hence, currently receiving chess instruction explains 5.5% ($r^2 = 0.055$) of the variance in the average SON-R score. Similarly, chess instruction and the average mark in term 3 are moderately, positively correlated ($r = 0.231$) with their relation being significant ($p = 0.040$). Here, chess instruction can explain 5.3% ($r^2 = 0.053$) of the variance in current academic performance (A213-216). Regular practice at home (at least once a week) is able to explain the average performance on the SON-R slightly better: With a significant moderate and positive influence on performance ($r = 0.250$, $p = 0.026$), at-home practice can explain 6.2% ($r^2 = 0.062$) of the mean performance. Chess practice's influence on current academic performance is negligible and not significant ($r = 0.030$, $p = 0.786$) (A216-219).

As suggested by the statistical insignificance of means when mere chess knowledge is considered, basic knowledge of the game of chess is not related to either performance dimension ($r = 0.001$ and 0.011 respectively for test and academic scores) (A219-222).

Evidently, neither of these variables serves to explain current performance adequately by itself. A multivariate regression was foreseen to increase explanatory power by including a variety of predictors into the analysis. Regrettably, data quality and availability did not suffice for establishing a complex model. Firstly, the indicator for age did not meet the criteria for being included in the regression analysis by not displaying normal distribution (A222-225). Furthermore, correlation analysis showed no significant relationship between age and either performance category.[73] Also gender was omitted from the analysis, as the difference in means between the performance of boys and girls was not significant.[74] Scores for prior performance of chess students were not available in 12 out of 33 cases, namely for those who started to learn chess prior to 2015 (A228f). That is why the indicator for performance in term 1 of 2015 cannot be considered to aptly display prior performance. In consequence, only chess instruction and chess practice at home could be combined into a model (see figure 11). In their totality, the predictor variables have a moderate positive influence on the dependent variable ($R = 0.282$), determining 7.9% ($r^2 = 0.079$) of the variance in SON-R performance, and leaving 92.1% unexplained. When r^2 is adjusted to the number of predictors, it decreases to 0.056; only slightly above

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[73] For the average performance on the SON-R subtests $\rho = 0.110$, $p = 0.333$; for the average mark in term 3 $\rho = -0.166$, $p = 0.142$ (A225).

[74] As measured by the Independent samples T-test, gender – SON-R score $p = 0.177$, gender – average mark $p = 0.185$ (A226f).

the explanatory power of chess instruction alone, and below that of chess practice. Yet, the model is statistically significant at the 5% level (p = 0.041) (A229f).

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	69,514	1,980		35,100	,000					
	recoded into chess vs. no chess (from restructured groups, all chess)	3,657	3,048	,149	1,200	,234	,234	,135	,131	,774	1,291
	students playing chess at home	4,364	3,034	,179	1,438	,154	,250	,162	,157	,774	1,291

a. Dependent Variable: mean of N scores

Figure 11: Multivariate regression modelling the influence of receiving methodical chess instruction and practicing chess at home on the mean score in the SON-R subtests (own illustration, AX).

Both variables have a similar positive effect on the dependent variable (β = 0.149 and 0.179 respectively), but both effects cannot be considered statistically significant (p = 0.234 and 0.154 respectively). Hence, within the sample both chess variables have a weak positive impact on the performance on the SON-R. But this cannot be generalized onto a greater population. The semi-partial correlation coefficients of both variables indicate that their individual influence remains weak and positive (Part = 0.131 and 0.157 respectively) if corrected for the other predictors' influence. Multicollinearity between variables is not to be expected, as tolerance values score above 0.25 and the variance inflation factor scores below 5 (A231).

When current academic performance is used as the indicator for current performance, repeating the multivariate regression analysis paints a different picture (see figure 12):

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	66,920	1,954		34,242	,000					
	recoded into chess vs. no chess (from restructured groups, all chess)	6,700	3,008	,279	2,227	,029	,231	,246	,246	,774	1,291
	students playing chess at home	-2,455	2,994	-,103	-,820	,415	,030	-,093	-,091	,774	1,291

a. Dependent Variable: average mark in term 3 2015 (percentage points)

Figure 12: Multivariate regression modelling the influence of receiving methodical chess instruction and practicing chess at home on the average mark in term 3 2015 (own illustration, AX).

The model produced by this regression analysis shows a slightly lower explanatory power: with a determination coefficient of $r^2 = 0.061$, it serves to explain 6.1% of the variation in current academic performance (adj. = 0.037). The totality of the variables have a moderate, positive correlation with the dependent variable (R = 0.248). Overall, the model is not significant (p = 0.087), but serves to describe the sample (A232f).

Yet within the model, chess instruction has regained its significant positive influence on performance (β = 0.279, p = 0.029), whilst the influence of practice has become both negative and not significant (β = -0.103, p = 0.415). This result is somewhat lessened but continues, if the correlation coefficients are corrected for the other predictors' influence

(Part = 0.246 and -0.091). Again, medium values for tolerance and low values of the variance inflation factor suggest low risk of multicollinearity (A234).

This reinforces the result of the Independent samples T-tests above that practice only seems to be a relevant explanatory factor when considering cognitive abilities in general, but not with regards to academic performance.

The influence of at-home practice was also made subject of discussion in the qualitative interviews with chess instructors. It is said to accelerate improvement, but requires investment from the parents, e.g. by supplying materials (I01: 318-326; I03: 250-258).

Overall, the explanatory power of the regression analyses is low, in every setting more than 90% of the variation in performance remain unexplained. Thus, it is necessary to turn towards mediating factors that might serve to explain how significant differences in means can come about.

As suggested in 5.3.1, the explanation power of chess instruction might vary with the duration of having received lessons. Whilst length of instruction had been operationalized as a closed question in the follow-up interview with chess students, the data obtained does not suffice to create an adequate metric indicator for the regression analysis.[75] Instead, categories were created to cluster the several starting months and years.[76] When correlating performance with length of chess instruction using the Spearman correlation coefficient, a weak positive relationship becomes evident for both the mean score in the SON-R subtests ($\rho = 0.111$) and for average academic performance ($\rho = 0.170$), indicating that longer duration of instruction is related to better performance within the subsample of chess-playing learners. Yet, both correlations are not significant at the 5% level ($p = 0.538$ and 0.343 respectively). While this means that the result cannot be generalized onto the larger population, it does describe an effect within the sample observed: For this sample, longer instruction has a positive effect on the performance of chess students. Considering the small subsample of 33 learners, repetition of the analysis with a larger sample size might yield significant results and should be attempted in further research.

Further causal explanations of why chess promotes cognitive performance are given in the qualitative interviews: Most prominently, the focus was placed on the attainment of positive attitudes through chess such as discipline and motivation. Participating in the chess course would improve the discipline of the learners (sitting still, not making noise,

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[75] In many cases, learners were only aware of the year in which they started and not the exact month which prohibited translation into a detailed metric indicator using months of instruction. But even when clustering into years, one can observe that 21 out of 33 chess students who reported a starting year/month started in 2015 vis-à-vis seven in 2014, four in 2013, and one in 2011 (A228f). Despite still having a metric scale level, the requirement of normally distributed data for regression analysis is not met.

[76] Cluster categories included starting year 2015, 2014, and before 2014.

listening to their teachers), strengthen their adherence to rules and enable them to sit down and concentrate. These effects were reported to also be tangible outside of the chess class (I01: 160-170, 197-210; I02: 169-174; I03: 310-316). One instructor points out the overarching importance of discipline for the learners' lives: "[...] the chess, it makes them to [...] be aware that one has to, make sure that he abides, he respects, he recognizes the rules, in order for a person to be able to be successful, to have a progress, of what he's intending to do. So the [...] rules, part of it, it has got a a bigger impact in the learner's life" (I01: 89-94). He further reports how this has impacted (and battled) both absenteeism and late-coming of his students (I01: 165-170).

With regards to motivation, it was particularly emphasized how attractive the program was for learners. Those attending the class were eager to do so and those not yet attending most interested in joining[77] (I01: 266-268; I02:155f; I03: 136-139). It was also reported how the pairing with higher-level players and continuous practice increase the self-confidence of the (mostly younger) players (I03: 325-330).

Another major focus is placed on chess' ability to promote cognitive strategies in learners: "Chess opens the mind for the learners, for whoever is playing the chess" (I02: 62f). Reference is made to improved concentration (I03: 118ff, 175-178), thinking ahead (I01: 118-137; I03: 118-124), considering and anticipating consequences (I01: 118-137), and learning to use one's mind (I02: 106-109). Importance and transferability of these strategies are underlined for problem-solving in class (I02: 65-73), for their current everyday life (I03: 330ff), as well as for their role as the future generation of South Africa (I01: 145-148).

5.5 Potential biases

When interpreting the results, limitations to the study design and conduct must be reflected upon. Thus, the following subchapter serves to elaborate on the two major aspects that (might) have influenced the study, considers control mechanism, and gives recommendations for follow-up studies.

5.5.1 (Self-)selection bias

The possible self-selection bias poses the most relevant limitation to this study, because it cannot be ruled out that the effect of better performance by chess students is to be attributed to better-performing students opting for the class. Whilst control mechanisms

[77] During the testing sessions, multiple students reported to be in the chess class, albeit they were not. When cross-validating their statements with the respective chess teachers, it was pointed out that there were many learners who were interested in joining the chess class, but hadn't yet.

were foreseen in the original research design, the unavailability of the total of pre-intervention marks makes controlling for pre-chess performance not possible across the whole sample. Hence, it is of particular importance for further research on the topic to find alternative ways to obtain these marks. Possibilities include approaching the DoBE's District Office directly where marks need to be reported to every term, or inquiring prior reports from the sample students' parents (possibly in tandem with the parental consent forms). For this study, the time frame was too restrictive to follow up with these alternative procedures.

Another control factor for (self-)selection was intended by posing the open question "Why did you join the chess class?" in the follow-up interview to inquire about motivation and whether the student had been referred to the class by an external person. Receiving detailed answers on all open questions proved difficult; in particular with the younger students a language barrier became immanent. Thus, answers for motivation mostly center on liking the game of chess such as "I love chess", "Because I like to play chess", "Because chess is a funny game". Occasionally, references are made to friends, siblings, parents or a teacher (A235ff). This points towards a need for further systemization of questions on motivation.

Apart from the possibility that students with overall better academic performance opt for or are assigned to the chess class, another obvious apprehension is the fact that students with particular interests opt for the chess class, namely those with a liking for abstract thinking and problem-solving. Inquiring about the learners' favorite subject showed salient results:

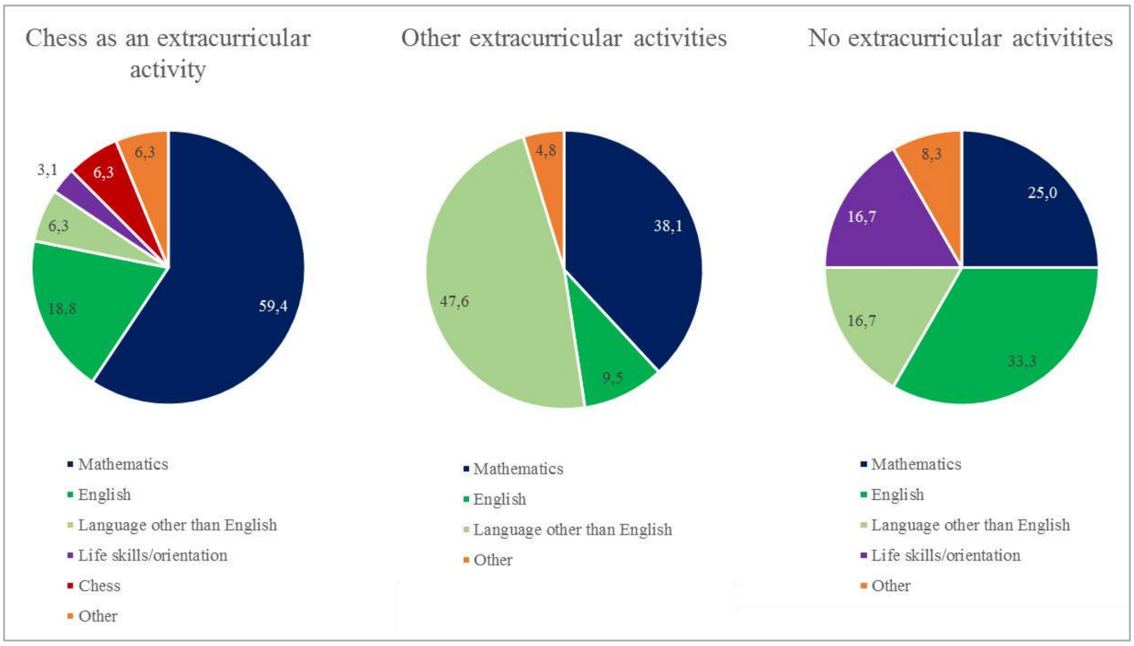

Figure 13: Comparison of favorite subjects split by original sampled groups (own illustration, A237f).

As figure 13 visualizes, preferences vary between groups. Although the chess students report a bigger variety of favorite subjects, most (59.4%) consider mathematics to be their favorite. The most mentioned favorite (47.6%) of learners in other extracurricular activities is a language other than English (Tsonga, Venda, or Zulu), whereas students not taking part in any activity prefer English (33.3%). Overall, the favorite subject is math (42.9%), followed by English and non-English languages (20.8% each) (A237f).[78]

When correlating group membership and favorite subject, the contingency coefficient C = 0.284 and Cramer's V = 0.284, both, signal a moderate, significant (both p = 0.037) relationship between preferring mathematics or a subject other than math and being in one of the originally sampled groups (A238f).[79] Thus, a systematic relationship between preferences for subjects and opting for different extracurricular activities (or none at all) has to be assumed and reflected upon when analyzing the relationship between group allocation, marks of individual subjects, and test scores.

Recalling the results from the means comparison, it must be mentioned that chess playing students do not score significantly higher in mathematics than their non-chess playing counterparts. Hence, self-selection can be rather attributed to preference than to actual performance which lessens the suspicion that higher mark scores can be traced back to higher-scoring students opting for chess class or being referred to chess class.

In further studies, more self-reported variables to control for a (self-)selection effect could be included in the follow-up interview, such as liking to go to school, or more specifically who was the driving force in deciding to join the chess class (the students themselves, parents, or even teachers based on performance). As illustrated by the lack of relevant information obtained in the question of motivation for joining the chess class, most cases (especially young children) would require external assistance for interpreting between learner and researcher. Furthermore, these inquiries might be subjected to a social desirability bias[80] similar to the questions already posed.

Last but not least, qualitative information gathered in the interviews severely lessens the assumption of a self-selection bias. Better scholastic performance of chess players is also highlighted by one interviewee several times (I03: 41f, 198-213). She hereby recognizes

[78] Other than in most analyses described in this chapter, the three contrasted groups base on the original sampling's groups assignment. The restructured sample also considers those students only receiving mandatory chess lessons into the "chess instruction" group. Therefore, the original sample, only considering extracurricular chess where students opt freely, is deemed more relevant for the analysis of self-selection effects.

[79] A correlation analysis was only possible contrasting mathematics vis-à-vis a subject other than mathematics, as in a more stratified cross-tabulation, expected cell counts ranged below five prohibiting the interpretation of the Chi² statistic upon which both C and V are based (Kühnel & Krebs 2010: 355ff).

[80] I.e. the respondent answering in a way he/she assumes the interviewer would want him/her to answer (Schnell, Hill & Esser 2008: 348).

the fact that some "gifted" learners are able to outperform the chess students, but continues to say that unless this is the case, the chess playing students do better in class than their non-chess playing counterparts (I03: 218-224). Moreover, it is pointed out that commitment (attitude) towards chess has a strong influence on the learners and their corresponding development (I02: 183-189; I03: 224-232). Further investigation should thus seek to investigate the mediating influence of the variable "commitment to chess" onto performance in more detail.[81]

Most importantly, the interview partners unanimously described a tangible development process of the learners, indicating an evolution instead of the well-adapted or better-performing students having been in the chess class from the very beginning (I01: 175-178; I02: 167ff, 204ff, 212f; I03: 196ff, 231f). This can be grasped in statements such as "Most of the students, most of them I've just seen [...] much development in their life compared to the previous time when they [...] were not attending the chess class." (I01: 175-178), or "Okay, you know eh what I've realized is, the moment a learner comes into chess class, after some time you see the changes. And even in class [...]" (I03: 196-ff).

Additionally, it was stated that those learners not progressing that well in class were anyway able to show significant improvements in chess playing (I02: 190ff), which also indicates that not only the best-performing students opted for the class.

5.5.2 Cultural testing bias

As Schölmerich & Leyendecker (2009: 434f) mentioned, cultural bias might be somewhat lessened by removing language as one major obstacle to testing, but other important barriers might still persists, such as construct and item bias which refer to the varying relevance of constructs and the lack of match between items and everyday reality of test takers (see 4.3.1).

If one compares the norm distribution underlying the calculation of the SON-R scores with the sample distribution, striking differences come to the forefront. With regards to their measures of central tendency (see table 7), it becomes evident that the whole sample distribution is shifted towards lower scores than the norm population. When cross-

[81] In the follow-up interview, a question was posed that sought to obtain information about the frequency of attending the chess class (never, rarely, sometimes, often, or always). Here, a language bias is suspected, as it appeared very difficult for students to answer this question. Out of 32 replies, 15 learners indicated "always" and 14 "sometimes" (A246f), usually answering before all categories could have been read out. A social desirability bias might also come into play. Correlating frequency of attendance with performance of the chess students shows a very weak negative, but not significant effect (mean N score: $\rho = -0.064$, $p = 0.728$; average mark in term 3: $\rho = -0.035$, $p = 0.849$) (A247).

referencing individual scores with their rank in the cumulative percent of the norm distribution[82], the entire sample can be allocated within the lower 80% of the norm distribution. Disregarding the few high scores, the contrast becomes even sharper: 80% of the sample ranks within the lowest 10% of the norm distribution and 40% in the lowest 1% (A240f)!

Measure of central tendency	Norm distribution	Sample distribution
Mode	100	69, 76
Median	100	73
Mean	100	73.39

Table 7: Comparison of measures of central tendency between the SON-R norm population and the sample population (own illustration, Snijders, Tellegen & Laros 2005: 56 & A239)

If one does not want to assume collectively lower cognitive abilities of South African primary children, attention must shift towards the instrument of testing. To detect a bias that might be based on specific constructs or items, Schölmerich et al. (2008: 189) suggest to also scrutinize scores by item instead of merely focusing on overall scores. Thus, the following tables 8 and 9 point out potentially biased items with corresponding examples. When we recall the composition of the series within a subtest, each series follows a specific theory of difficulty (see 4.3.1) with subsequently more difficult items. In theory, this should entail a rather straight trend of a decreasing rate of right answers and consequently an increasing trend of wrong answers. Equally, the first item of each series should be solved by the most test takers. Yet, the detailed overview of correct and incorrect answers to the Categories and Situations subtests points out outliers to this trend (marked red in table 8&9) (A241-246). Items were considered as problematic, if wrong answers increased by more than 20% with comparison to the previous item and decreased strongly again with the following item, if they deviated majorly from same-level items in the other series, or if the answers to the first item(s) of a series were incorrect more often than correct.

[82] The individual's reference position is provided by the SON software when computing the norm scores (A11).

Categories subtest, a-series		n/N	Percent per item	Categories subtest, b-series		n/N	Percent per item	Categories subtest, c-series		n/N	Percent per item
A1	item not solved	20	23,5%	**B1**	item not solved	16	29,1%	**C1**	item not solved	20	55,6%
	item solved	65	76,5%		item solved	39	70,9%		item solved	16	44,4%
	Total	85	100,0%		Total	55	100,0%		Total	36	100,0%
A2	item not solved	42	49,4%	**B2**	item not solved	32	47,8%	**C2**	item not solved	18	38,3%
	item solved	43	50,6%		item solved	35	52,2%		item solved	29	61,7%
	Total	85	100,0%		Total	67	100,0%		Total	47	100,0%
A3	item not solved	29	42,0%	**B3**	item not solved	35	53,0%	**C3**	item not solved	33	66,0%
	item solved	40	58,0%		item solved	31	47,0%		item solved	17	34,0%
	Total	69	100,0%		Total	66	100,0%		Total	50	100,0%
A4	item not solved	45	83,3%	**B4**	item not solved	15	30,6%	**C4**	item not solved	32	68,1%
	item solved	9	16,7%		item solved	34	69,4%		item solved	15	31,9%
	Total	54	100,0%		Total	49	100,0%		Total	47	100,0%
A5	item not solved	21	72,4%	**B5**	item not solved	22	55,0%	**C5**	item not solved	19	59,4%
	item solved	8	27,6%		item solved	18	45,0%		item solved	13	40,6%
	Total	29	100,0%		Total	40	100,0%		Total	32	100,0%
A6	item not solved	5	50,0%	**B6**	item not solved	22	73,3%	**C6**	item not solved	10	41,7%
	item solved	5	50,0%		item solved	8	26,7%		item solved	14	58,3%
	Total	10	100,0%		Total	30	100,0%		Total	24	100,0%
A7	item not solved	5	100,0%	**B7**	item not solved	12	75,0%	**C7**	item not solved	15	83,3%
	item solved	0	0,0%		item solved	4	25,0%		item solved	3	16,7%
	Total	5	100,0%		Total	16	100,0%		Total	18	100,0%
A8	item not solved	2	66,7%	**B8**	item not solved	5	71,4%	**C8**	item not solved	5	71,4%
	item solved	1	33,3%		item solved	2	28,6%		item solved	2	28,6%
	Total	3	100,0%		Total	7	100,0%		Total	7	100,0%
A9	item not solved	1	100,0%	**B9**	item not solved	2	66,7%	**C9**	item not solved	1	50,0%
	item solved	0	0,0%		item solved	1	33,3%		item solved	1	50,0%
	Total	1	100,0%		Total	3	100,0%		Total	2	100,0%

Table 8: Overview of the number of correct and incorrect answers in the SON-R subtest Categories per item (own illustration, A241ff).

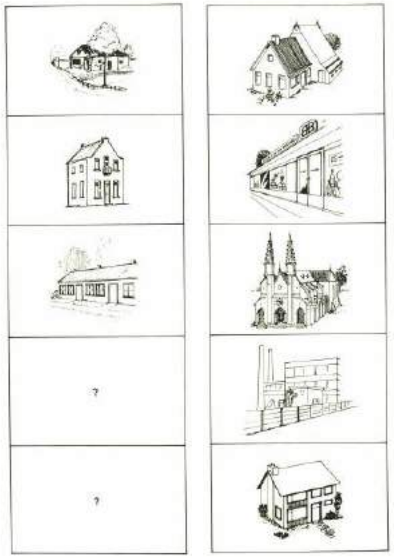

Figure 14: Item example from the Categories subtest (C1) matching small houses (Snijders et al. 2005b).

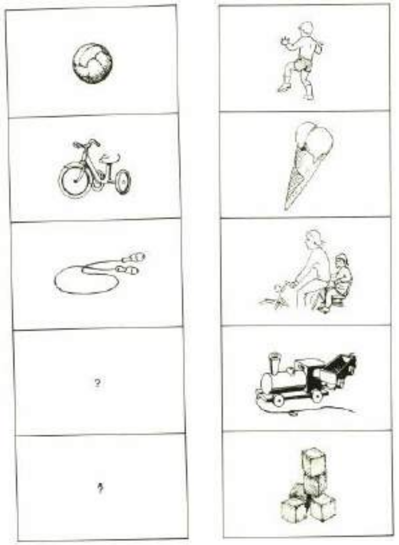

Figure 15: Item example from the Categories subtest (C1) matching children’s toys (Snijders et al. 2005b).

Situations subtest, a-series		n/N	Percent per item	Situations subtest, b-series		n/N	Percent per item	Situations subtest, c-series		n/N	Percent per item
A1	item not solved	20	23,5%	**B1**	item not solved	22	56,4%	**C1**	item not solved	24	63,2%
	item solved	65	76,5%		item solved	17	43,6%		item solved	14	36,8%
	Total	85	100,0%		Total	39	100,0%		Total	38	100,0%
A2	item not solved	25	29,4%	**B2**	item not solved	29	53,7%	**C2**	item not solved	21	40,4%
	item solved	60	70,6%		item solved	25	46,3%		item solved	31	59,6%
	Total	85	100,0%		Total	54	100,0%		Total	52	100,0%
A3	item not solved	28	38,4%	**B3**	item not solved	20	41,7%	**C3**	item not solved	17	34,0%
	item solved	45	61,6%		item solved	28	58,3%		item solved	33	66,0%
	Total	73	100,0%		Total	48	100,0%		Total	50	100,0%
A4	item not solved	36	55,4%	**B4**	item not solved	28	57,1%	**C4**	item not solved	20	43,5%
	item solved	29	44,6%		item solved	21	42,9%		item solved	26	56,5%
	Total	65	100,0%		Total	49	100,0%		Total	46	100,0%
A5	item not solved	34	75,6%	**B5**	item not solved	24	63,2%	**C5**	item not solved	22	47,8%
	item solved	11	24,4%		item solved	14	36,8%		item solved	24	52,2%
	Total	45	100,0%		Total	38	100,0%		Total	46	100,0%
A6	item not solved	8	34,8%	**B6**	item not solved	19	76,0%	**C6**	item not solved	27	81,8%
	item solved	15	65,2%		item solved	6	24,0%		item solved	6	18,2%
	Total	23	100,0%		Total	25	100,0%		Total	33	100,0%
A7	item not solved	13	72,2%	**B7**	item not solved	5	38,5%	**C7**	item not solved	12	60,0%
	item solved	5	27,8%		item solved	8	61,5%		item solved	8	40,0%
	Total	18	100,0%		Total	13	100,0%		Total	20	100,0%
A8	item not solved	3	60,0%	**B8**	item not solved	9	81,8%	**C8**	item not solved	9	81,8%
	item solved	2	40,0%		item solved	2	18,2%		item solved	2	18,2%
	Total	5	100,0%		Total	11	100,0%		Total	11	100,0%
A9	item not solved	1	33,3%	**B9**	item not solved	3	75,0%	**C9**	item not solved	3	60,0%
	item solved	2	66,7%		item solved	1	25,0%		item solved	2	40,0%
	Total	3	100,0%		Total	4	100,0%		Total	5	100,0%
A10	item not solved	0	0,0%	**B10**	item not solved	3	100,0%	**C10**	item not solved	2	100,0%
	item solved	2	100,0%		item solved	0	0,0%		item solved	0	0,0%
	Total	2	100,0%		Total	3	100,0%		Total	2	100,0%
A11	item not solved	2	100,0%	**B11**	item not solved	0	0,0%	**C11**	item not solved	1	100,0%
	item solved	0	0,0%		item solved	0	0,0%		item solved	0	0,0%
	Total	2	100,0%		Total	0	0,0%		Total	1	100,0%

Table 9: Overview of the number of correct and incorrect answers in the SON-R subtest Situation per item (own illustration, A244ff).

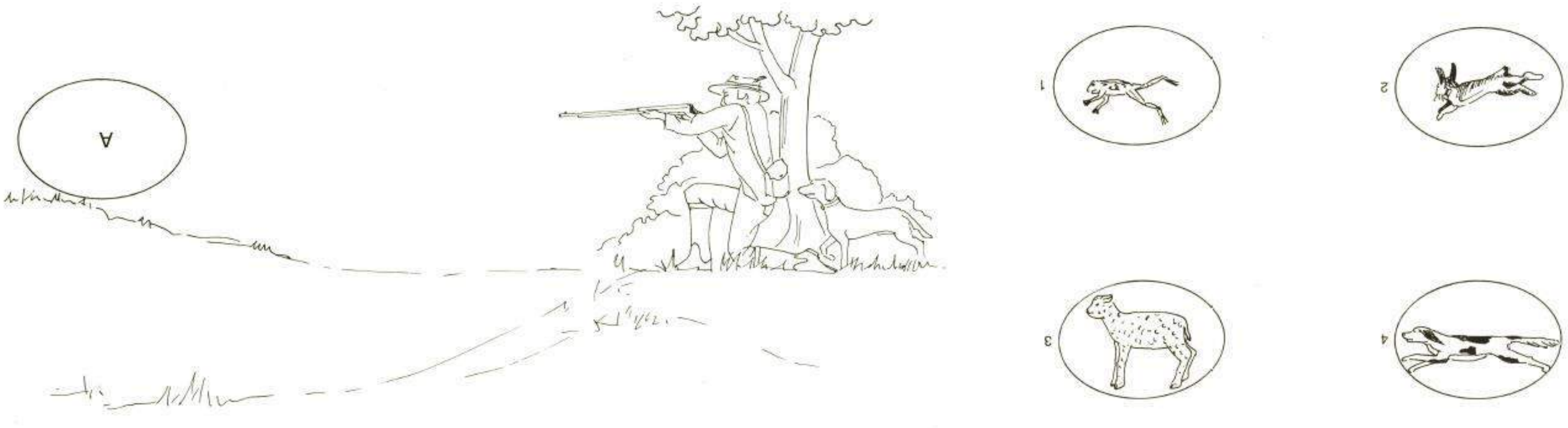

Figure 16: Item example from the Situations subtest (B1), hunter shooting rabbit (Snijders et al. 2005c).

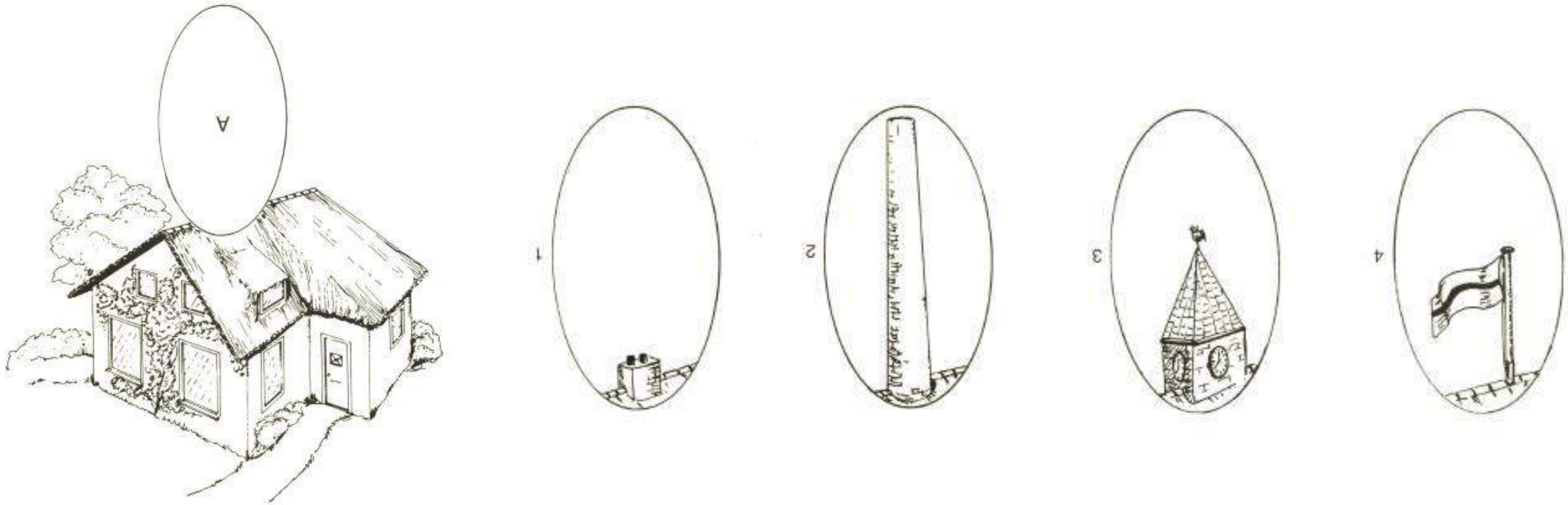

Figure 14: Item example from the Situations subtest (C1), small house with small chimney (Snijders et al. 2005c).

From the Categories subtest, figure 14, where two small houses were supposed to be matched with three other family homes, illustrates a possible item bias. None of the styles illustrated in those pictures represents a common housing style in Soweto (own observation) and does therefore not relate to the learners' everyday reality. In contrast, figure 15 can be used as an example for a possible construct bias. Here, children were supposed to match children's toys with each other. Similar to the example with "car and driver vs. different cars" mentioned in 4.3.1, many test takers matched the three toys with the two children on the opposite page instead of the toy train and building blocks. A relationship was seen paramount to object characteristics.

Item biases also became evident on the Situations subtest as more than half of the learners were not able to solve the first item on the b- and c-series correctly: Figure 16 shows a hunter, dressed in a very European style hunting attire and accompanied by a Dachshund, aiming to shoot a rabbit; whereas in example C1 (figure 17) students were required to match a small chimney, typical for central heating, to a English-style country home. Both scenarios cannot be considered typical for the South African context.

These four items should serve to highlight that wrong answers cannot solely be traced to lower skills in classifying or problem-solving. Eurocentric illustrations might have contributed to a disproportionate number of incorrect solutions. If coupled with the adaptive testing procedure where two wrong answers terminated working on a series, this could have led to undervaluation of the real test score.

This assumption is further strengthened when comparing the reliability of the more abstract Analogies subtest with those subtests that leave more room for interpretation: Both the Categories and the Situations subtest exhibit rather mediocre, but acceptable values of internal consistency (α` = 0.647 and 0.672 respectively). The Analogies subtest on the other hand proves to have an excellent reliability rating (α` = 0.978).

Future research should consider a pre-test to identify potentially precarious items early on. Not available for this study's research, the use of the newest version of the SON-R (namely the SON-R 6-40) should be considered, as items were partially revised both to eliminate outdated illustrations and to reduce cultural bias (Jacobi & Preis 2015).

5.6 Qualitative information on chess instruction and its South African specificities

In a similar fashion to considering potential cultural bias, particular attention should be paid to how chess instruction is handled, to the specific constraints immanent in South African township schools, and the country context in general.

Elements of Gagné's learning and instruction theory can be found in all interviews. Whilst one instructor highlights the importance of concept and rule learning as a necessary step before playing the actual game (I03: 86-101), another points out the importance of learner guidance in chess class (I02: 94ff). One account of a typical chess lesson by one chess instructor points out the applicability of Gagné's instructional events for chess instruction in schools. He describes a teaching sequence including informing the learners of the objective of the lesson, presenting stimulus material, and eliciting performance afterwards (I01: 61-75). This gives reason to believe, that chess instruction is very well suited to be adapted to instructional design principles and, thereby, to help to attain transferable skills in an effective manner.

Nevertheless according to the instructors, effective instruction is hampered by a variety of factors. This includes the lack and loss of resources (I01: 282-300; I03: 77, 296-303), the lack of time allocated for and the priority the class receives, e.g. when scholastic assessments become paramount (I01: 300-307; I03: 303f), the time constraints of teachers assigned to chess classes (I03: 276-289), and the fact that those students using transport after school were excluded from the opportunity of attending chess as an extracurricular activity (I03: 289-296). In order to enhance the chess class' ability to influence the learners' development in a significant way, these issues must be addressed.

To the question what significance chess has for South Africa in particular, a variety of issues was pointed out. One instructor focused on the fact that actions were rarely reflected upon by the South African population (I01: 118-123), whilst another emphasized that South African students struggled particularly with poor concentration and deficiencies in numeracy that could be ameliorated through chess (I02: 156-160, 168-173, 180f). The ability of chess to facilitate international and -cultural dialogue through playing was additionally mentioned (I02: 119ff, 130-139).

5.7 Summary of results and evaluation

Most importantly, the analysis was able to demonstrate that students receiving methodical chess lessons perform significantly better on the SON-R test measuring their abstract and concrete thinking abilities as well as overall in school. Furthermore, those learners practicing chess regularly at home (regardless of receiving additional instruction) also score significantly higher on the non-verbal intelligence test employed. These results back the two main research hypotheses, namely that students learning and practicing chess possess and utilize higher-level cognitive skills than their non-chess playing counterparts (H1), and that students learning and practicing chess show a better academic performance than their non-chess playing counterparts (H2). With regard to the three subhypotheses to the H1, explicitly better performance in classifying tests (H1.1), tests where they need to identify and apply rules (H1.2), and problem-solving (H1.3), higher scores of chess learners were equally evident, but not statistically significant. While the hypotheses can thus be assumed for the sample population, results cannot be generalized onto a larger population. Hence, the explanation mechanism implicit in these hypotheses, modelled after Gagné's hierarchical learning structure of concept learning, rule learning, and problem-solving, does not suffice to adequately explain chess players' superiority in the tested performance dimensions. In consequence, further analysis was conducted to investigate the chess-performance relationship in more detail.

It became evident that performance scores varied with different conceptualizations of chess (namely as receiving instruction, reporting knowledge of the game, or regular practice at home). Not relying on self-reporting, operationalizing chess as methodical chess instruction was considered the most robust and thus paramount. Insignificant results in both the means comparison and the regression analysis of mere chess knowledge indicate that chess' effects might only materialize under the conditions of methodical instruction and continuous practice.

With regards to improvements in academic performance, non-chess playing students and those not participating in any extracurricular activity progressed faster over the course of the academic year studied. Even though this at first suggested extracurricular activities in general to have a distracting effect from academia, "no activity" students started from a lower initial level and still scored lower overall. The difference could thus also be explained by faster progress in lower score segments and should be monitored in a longitudinal study to examine whether catching up would eventually take place, or if progress would slow down at a certain threshold upholding the performance hierarchy.

A major limitation to this study is the existence of an attribution problem. The anticipated control mechanism of using pre-chess performance as a control variable in analysis could not be employed due to unforeseen unavailability of data. Hence, it cannot be ruled out completely that students with higher cognitive abilities and/or better academic performance opted for or were recommended to the chess class. Yet, several analyses were able to mitigate the assumption of this bias. Firstly, while subject preferences are related to opting for chess or extracurricular activities (specifically math), the difference in performance in mathematics is not significant. Hence, self-selection can be assumed with regard to interest but not necessarily regarding better performance. In addition, information from the semi-structured interviews unanimously describes a tangible development of chess learners since they joined the class rather than pointing to the fact that they were previously distinguishable from other students.

With regard to limitations, a possible cultural bias must be given consideration when examining subtest scores. The item and construct bias existent in the Categories and Situations subtest might undervalue performance in the respective categories and thus the mean performance in the SON-R. The subtests' low reliability could explain the strikingly lower score distribution vis-à-vis the norm population and mask significant differences in mean performances as well as the effect of correlations leading to the rejection of the postulated subhypotheses.

Interestingly enough, qualitative accounts focus on spheres of development other than those tested for in the quantitative analysis. The major focus is placed on the students' development of positive attitudes and cognitive strategies that also become tangible outside of chess class. These includes discipline, motivation, concentration, and reflective strategies that consider consequences and possible options for action.

Chess instruction can be considered well-suited for translating learning and instruction theory into practice: This can either occur through the emphasis on gradual concept and rule learning before attempting to continuously train one's mind in the problem-solving activity that is chess; or through applying Gagné's instructional events and thereby setting effective conditions for learning to take place that can be later on transferred to novel situations. Hereby, barriers to effective instruction, enumerated by the teachers (such as lack and loss of resources, insufficient time allocation, and teaching staff) and considered specific to teaching in under-resourced schools, need to be considered as limiting factors to the potential value of chess instruction.

6 Conclusion

For decades, national governments and international organizations have placed major emphasis on the promotion of education. However, the research community is divided about its immanent effect on various components of development. Whereas some studies were able to demonstrate direct positive effects such as higher income or health benefits, many researchers emphasize the importance of factors such as the institutional environment or prevailing inequalities in mediating education's impact. Particularly the quality of education is hereby often said to have large explanatory power. What exactly is meant by quality and what determines it has been subject to much debate. Up until today, no conclusive theory about determining factors has been validated by empirical research. In most literature, learning outcomes, i.e. learners' performance on standardized tests or pass rates, are used as a proxy-indicator for quality of the schooling system. Particularly when only referring to international standardized tests, not adapted to the local context, this measurement falls short on accurately portraying the skill set of the tested learners. Hence, in this research, performance of learners is captured both in terms of their cognitive abilities and in their academic success within the local context.

South Africa – case study to this master thesis – has undergone a two-decade long reform process aiming at restructuring the entire schooling sector to overcome the legacies of Apartheid and ameliorate learning outcomes. Nevertheless, effects have not significantly materialized in terms of learner performance: Students continue to score frighteningly low on the recently introduced Annual National Assessments. Considering the inertia of systemic reform, the case was made for interim solutions that can be implemented at low cost and, yet, hail timely results.

Methodical chess instruction in schools, lauded by a large body of enthusiasts, could represent such an intervention. Since the 1970s, a variety of methodically diverse studies and reports have reported volatile effects of chess in the scholastic context, such as improvements in problem-solving skills, creativity, critical thinking, and better academic performance. Critical studies are rather sparse and focus on the methodological shortcomings of the research undertaken and their over-reliance on commonsense theory. With regard to regional relevance, examining the effect in a developmental country setting has, hitherto, been largely neglected.

Filling the gap with regard to developmental context, theory-led investigation, and extensive documentation on methodology, the thesis presented in this paper sought to answer the research question whether the introduction of methodical chess lessons in South African township school could positively influence the cognitive abilities and learning outcomes of the students.

The framework opted for was provided by Robert Mills Gagné's theories on learning and instruction. Learning was conceptualized as a hierarchical sequence of learning stages, where learning in a certain way requires the mastering of previous learning types. Problem-solving is considered to be the most complex form of learning that requires (inter alia) that the learner has previous learned how to classify concepts, and how to identify and apply rules. Learning through problem-solving is of superordinate nature, generalizable, and thus applicable to novel situations. Hence it should be made explicit goal of instruction. Whether learning will take place is determined by both internal conditions (the prerequisite skill set of the learner) and external conditions that are to a large extent dependent on the teachers' choices on content, style, and materials. Planning instruction can be seen as the most influential process in arranging conditions for effective learning. Considerable emphasis is placed on context specificity; the goals of teaching should always be aligned with societal needs.

If Gagné's learning theory is transferred to thinking in chess, playing the game of chess can be understood as a continuous problem-solving activity, where each move represents a new "choice-of-move" problem. In order to effectively play chess, prior capabilities need to be internalized by the player. As these learning processes are comparable to those in the "classic" school setting, it is assumed that principles of instructional design can and should also be applied to the teaching of chess, providing fruitful external conditions for learning. The continuous development of one's own thought processes (learning to think) through chess can, then again, be utilized in a variety of novel situations and could also translate into better academic performance.

South Africa, where reforms have not yet had their anticipated effect on educational outcomes, many schools struggle with little resources, and a significant portion of students are at-risk of not completing their schooling, has been considered a prime case for examining the relationship between chess in schools and its cognitive and academic benefits. In addition to the relevance of ameliorating learning outcomes in South Africa, the country's newest curriculum and its respective Curriculum and Assessment Policy Statements are well-suited to consider incorporating chess into its schools. Curriculum and theory follow the same underlying rationale, the prescribed nature of the CAPS makes them appropriate for the inclusion of instruction principles, and a subject specific CAPS for chess could be easily drawn up without impacting instruction in other areas.

Considering the fundamental similarities between learning as postulated by Gagné and the thought processes when learning and playing chess, it was, firstly, assumed that students playing chess possess and utilize higher-order cognitive skills as their non-chess playing counterparts (H1). And secondly, that due to the thinking strategies acquired in chess class, the former condition would also translate into better academic performance of chess students (H2). To test these hypotheses, a mixed-method approach was opted for to assess current performance as well as information on development over time. Most centrally, students were tested on selected subtests of the Snijders-Oomen Non-Verbal Intelligence Test Revised 5½-17, measuring their cognitive abilities with regard to abstract and concrete thinking. Operationalizing previous and current performance, their scholastic records were furthermore analyzed. Qualitative semi-structured interviews with their chess instructors complemented the analysis in terms of evidence on the students' development and South African specificities of chess instruction.

Most importantly, results indicate that the sample students receiving methodical chess instruction score higher in all performance categories vis-à-vis their non-chess playing counterparts. Regarding both average performance scores, this effect is statistically significant, and supports the research hypotheses. Moreover, playing chess on a regular basis outside of school, significantly impacts cognitive abilities. Mere knowledge of chess, in the absence of methodical instruction, fails to produce this effect. This strengthens the assumption that the process of teaching chess is an important determining factor when evaluating chess' impact on learners.

However, a major limitation to this study is posed by its post-test only quasi-experimental design, resulting in a lack of full control over a possible (self-)selection effect. Whilst it cannot be ruled out completely, that those students with previously better performance have either opted for or were assigned to the chess class, various control mechanisms were able to lessen the assumption of such a bias. Most prominently, chess instructors unanimously reported tangible development in their learners, both, in comparison with their prior abilities, and with other students in the school.

An unexpected finding was the emphasis of the development of attitudes, such as discipline and motivation, throughout the interviews, that was used to explain major differences between chess and non-chess playing learners. The attainment of these attitudes and their possible mediating influence on chess' impact on educational outcomes needs to be attended to in future research. Moreover, consecutive research should strive to obtain reliable indicators to control for pre-intervention performance (or even better, make use of a longitudinal design). In addition to previous marks, further qualitative accounts from each student's class teacher could analyze development on a more disaggregated basis. Possible mediating factors, such as duration and frequency of attending the chess class, as well as open-questions investigating motivation, should be collected in the children's mother tongue and scrutinized in more detail. Moreover, the specificities of chess in South Africa should be investigated further. A pre-test and the revised version of the SON-R could serve to reduce cultural bias detected in this study.

Whilst this research points into the direction that the chess enthusiasts' claim to of educational benefits is also applicable in a development country setting, more comprehensive assessments are necessary. If these results confirm and extend findings hitherto presented, South Africa would prove to be a prime example of application, as the country is both in need of low-cost, timely, and innovative strategies to ameliorate learning and exhibits fruitful framework conditions for integrating chess into its school realities.

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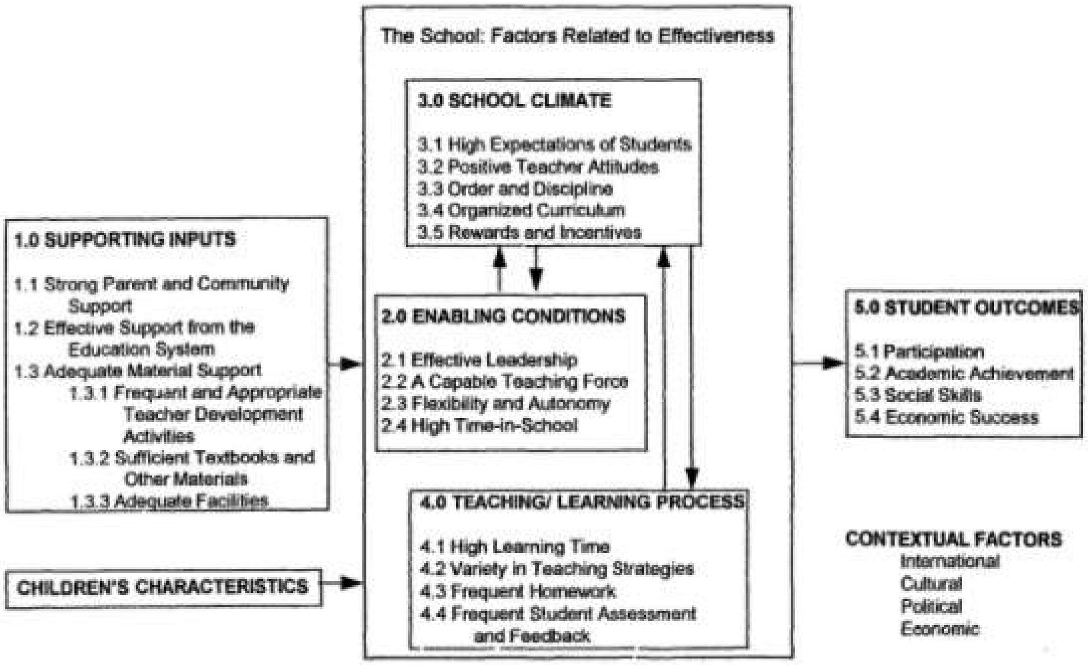
ANNEX

Conceptual framework: Factors that determinate school effectiveness

As illustrated in Heneveld (1994: 6)



Action Plan to 2019: Towards the realisation of Schooling 2030

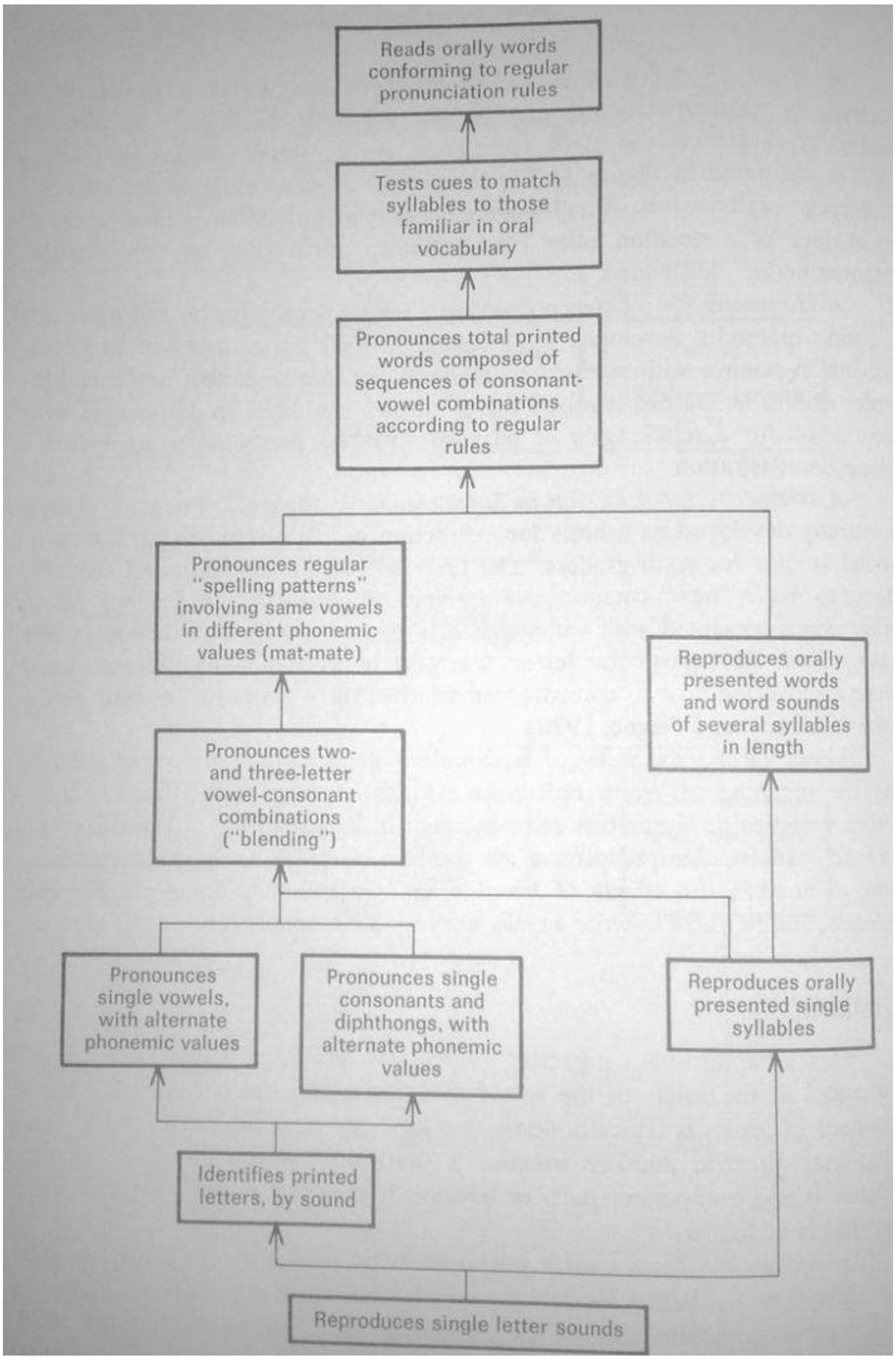
Goal 1	Increase the number of learners in Grade 3 who, by the end of the year, have mastered the minimum language and numeracy competencies for Grade 3.
Goal 2	Increase the number of learners in Grade 6 who, by the end of the year, have mastered the minimum language and mathematics competencies for Grade 6.
Goal 3	Increase the number of learners in Grade 9 who, by the end of the year, have mastered the minimum language and mathematics competencies for Grade 9.
Goal 4	Increase the number of Grade 12 learners who become eligible for a Bachelors programme at a university.
Goal 5	Increase the number of Grade 12 learners who pass *mathematics*.
Goal 6	Increase the number of Grade 12 learners who pass *physical science.*
Goal 7	Improve the average performance of *Grade 6* learners in *languages*.
Goal 8	Improve the average performance of *Grade 6* learners in *mathematics*.
Goal 9	Improve the average performance of Grade 9 learners in *mathematics*.
Goal 10	Ensure that all children remain effectively enrolled in school at least up to the year in which they turn 15.
Goal 11 ★★★	Improve the access of children to quality Early Childhood Development (ECD) below Grade 1.
Goal 12	Improve the grade promotion of learners through Grades 1 to 9.
Goal 13	Improve the access of the youth to Further Education and Training (FET) beyond Grade 9.
Goal 14	Attract a new group of young, motivated and appropriately trained teachers to the teaching profession every year.
Goal 15	Ensure that the availability and utilisation of teachers are such that excessively large classes are avoided.
Goal 16 ★★★	Improve the professionalism, teaching skills, subject knowledge and computer literacy of teachers throughout their entire careers.
Goal 17	Strive for a teacher workforce that is healthy and enjoys a sense of job satisfaction.

Goal 18	Ensure that learners cover all the topics and skills areas that they should cover within their current school year.
Goal 19 ★★★	Ensure that every learner has access to the minimum set of textbooks and workbooks required according to national policy.
Goal 20	Increase access amongst learners to a wide range of media, including computers, which enrich their education.
Goal 21 ★★★	Ensure that the basic annual management processes take place across all schools in the country in a way that contributes towards a functional school environment.
Goal 22	Improve parent and community participation in the governance of schools, partly by improving access to important information via the e-Education strategy.
Goal 23	Ensure that all schools are funded at least at the minimum per learner levels determined nationally and that funds are utilised transparently and effectively.
Goal 24	Ensure that the physical infrastructure and environment of every school inspire learners to want to come to school and learn, and teachers to teach.
Goal 25	Use schools as vehicles for promoting access to a range of public services amongst learners in areas such as health, poverty alleviation, psychosocial support, sport and culture.
Goal 26	Increase the number of schools that effectively implement the inclusive education policy and have access to centres that offer specialist services.
Goal 27 ★★★	Improve the frequency and quality of the monitoring and support services provided to schools by district offices, partly through better use of e-Education.

(Republic of South Africa, Department of Basic Education 2015: 1f)

Exemplary learning hierarchy for a basic reading skill

As illustrated in Gagné & Briggs (1974: 116)



Effective learning conditions depending on type of lesson objective

Own illustration, based on Gagné & Briggs (1974: 148f)

Type of lesson objective	Lessons having intellectual skill objectives					Lessons having cognitive strategy objectives
	Discrimination	Concrete Concept	Defined Concept	Rule	Higher-Order Rule	Cognitive Strategy
Learning conditions	- Recall of S-R connections ("responses") - Repetition of situations presenting "same" and "different" stimuli, with feedback - Emphasis on distinctive features	- Recall of discrimination of relevant object qualities - Presentation of several concept instances, varying in irrelevant object qualities - Identification of concepts instances by student	- Recall of component concepts - Demonstration of the component of the concept, or verbal statement of the definition - Demonstration of concept by the student	- Recall of component concepts or subordinate rules - Demonstration or verbal statement of the rule - Demonstration of rule-application by the student	- Recall of relevant subordinate rules - Presentation of a novel problem - Demonstration of new rule in achieving problem solution	- Recall of relevant rules and concept - Successive presentation (usually over an extended time period) of novel problem situations where the type of solutions remains unspecified - Demonstration of solution by student

Testing sheet for SON-R subtests

Name ________________________ Test date __ / __ / ____ Time __ : __

Age ___ ; ___ Sex m / f Birth date __ / __ / ____ Duration ____ min

Code ___________

School
__ Siyavuma
__ Putalushaka
__ Hitekani

Grade __

Language
__ English
__ Tsonga
__ Venda
__ Zulu
__ non-verbal

Group *(fill out after session)*
__ chess instruction
__ extracurricular
__ no activity

SCORES

	R	N	(E^2)	L	(80%-Int.)
1. Cat	___	___	___	___	___ - ___
2. Sit	___	___	___	___	___ - ___
3. Ana	___	___	___	___	___ - ___
Average		___			
Spez. IQ		___		___	
Gen. IQ				___	

H0 (Subtests) n.s. / $p < 0.05$ / $p < 0.01$

<u>Descriptives</u>

Ref. Age ___ ; ___ Stand. IQ ___ Cum. ___ % norm population

REMARKS
(1) good (2) varying (3) mediocre (4) poor

Motivation ___ ______________________________

Concentration ___ ______________________________

Cooperation ___ ______________________________

Understand. Instructions ___ ______________________________

1. CATEGORIES

Long: Here you see three pictures that belong together, and two of them are missing. From this side, two need to go to the other side. Can you show me which ones?

Short: From here, two need to go to the other side. Can you show me which ones?

Notes: - Feedback only after both were selected

	1	2	3	4	5	6	7	8	9
a-series									
	34	25	13	24	35	14	23	15	34
b-series									
	45	12	35	15	13	24	35	14	23
c-series									
	15	14	23	45	13	24	35	34	25

____ - ____ = ____

____ - ____ = ____

____ - ____ = ____

1. Cat

2. SITUATIONS

Long: Here you see a big picture, and a little piece is missing. From these small pictures, one has to go in here. Can you show me which one? Look careful at all the pictures before you decide!

Short: Which of the little pictures has to go in here?

Notes: - Mention items where more pieces are missing ("Watch out! Now you need to find...")
- Child needs to show which picture goes where, inquire if necessary
- Give appropriate time for the child to correct itself
- Feedback only after all were selected

	1	2	3	4	5	6	7	8	9	10	11
a-series											
	4	3	2	14	16	42	25	268	62	438	0275
b-series											
	2	4	3	35	62	34	25	682	32	439	8309
c-series											
	1	4	1	56	34	53	61	627	41	245	8452

____ - ____ = ____

____ - ____ = ____

____ - ____ = ____

2. Sit

3. ANALOGIES

Long: Look, this picture changes, and it becomes this one. This one has to change in the same way. What does it look like after it has changed? One of the pictures down here has to go here. Can you show me which one? Look carefully, only one is right!

Short: If this pictures changes and becomes this one, this picture has to change and become which one?

	1	2	3	4	5	6	7	8	9	10	11
a-series											
	3	2	4	2	3	1	1	2	4	3	1
b-series											
	2	3	3	4	2	3	2	4	2	4	4
c-series											
	1	2	4	2	1	4	3	4	3	3	2

____ - ____ = ____

____ - ____ = ____

____ - ____ = ____

3. Ana

Additional information obtained from children (follow-up interview)

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IEE Institut für Entwicklungsforschung und Entwicklungspolitik

Institute of Development Research and Development Policy

Chess for Africa

To be completed after the SON-R session by the interviewer	
Date and time of interview:	______________________________
School of participant:	______________________________
Participant's code:	______________________________

1. Gender *(can be ticked by interviewer)*
   - ☐ Male
   - ☐ Female

2. When is your birthday? *(if not obtained from school administration)*

   ______ day ______ month ______ year

3. What is your favorite subject in school? ______________________________

4. Are you in the chess class of your school?
   - ☐ Yes
   - ☐ No

If 4 answered with "yes", continue with question 5, if with "no", continue with question 5b.

If 4 answered with “yes”,

5. Since when are you in the chess class?

    ______ month ______ year

6. How often do you go to the chess class?
    - ☐ Always
    - ☐ Often
    - ☐ Sometimes
    - ☐ Rarely
    - ☐ Never

7. Did you know how to play chess before the chess class?
    - ☐ Yes
    - ☐ No

8. Do your [*insert option from below*] know how to play chess?
    - ☐ Parents
    - ☐ Siblings
    - ☐ Friends

    Anyone else?
    - ☐ Yes, other: ____________________________

9. Do you play chess outside of school, for example at home?
    - ☐ Yes
    - ☐ No

10. If yes, how often? ______ times per week

11. Why have you started to play chess?

12. What do you learn in chess class?

If question 4 answered with “no”,

5b. Do you know how to play chess?

- Yes
- No

If question 5b answered with “yes”,

6b. Do your [*insert option from below*] know how to play chess?

- Parents
- Siblings
- Friends

Anyone else?

- Yes, other: ____________________________

7b. Do you play chess outside of school, for example at home?

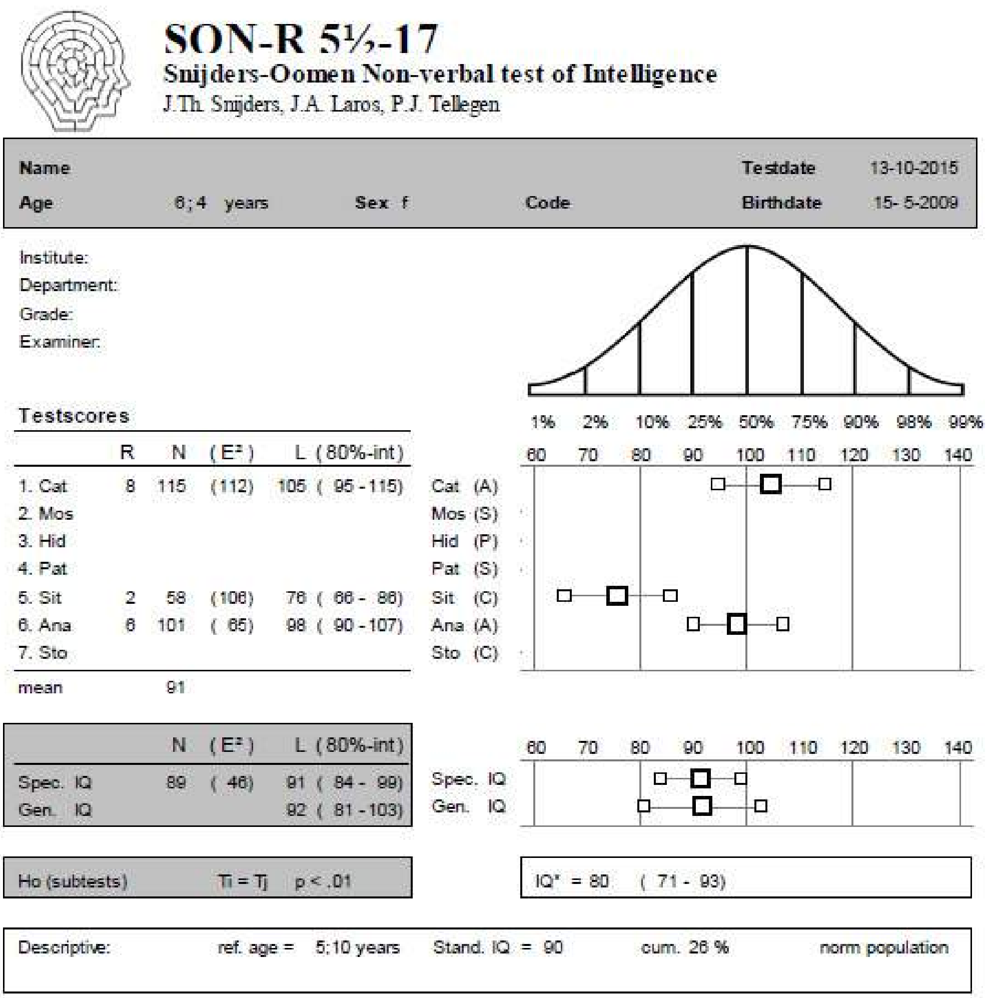
- Yes
- No

8b. If yes, how often? ______ times per week

SON-R software mask

Input data mask:

Output:



Exemplary schedule

No.	Admission Number	Surnames and Names of Learners in Alphabetical Order	Date of Birth			Gender (F/M)	No. of Years in Grade	No. of Years in Phase	No. of days Absent	Subjects: Languages																		Learner Total	Average %	Promotion Code (P / NP)
			Year	Month	Day					Home Language	Level	First Additional Language	Level	Mathematics (Gr 7)	Level	Natural Sciences (Gr 7)	Level	Social Sciences (Gr 7)	Level	Economic Management Sciences (Gr 7)	Level	Technology (Gr 7)	Level	Creative Arts (Gr 7)	Level	Life Orientation (Gr 7)	Level			
1	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	1	1	0	66	5	74	6	56	4	72	6	60	5	80	7	78	6	65	5	86	7	637	71	P
2	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	1	1	0	60	5	58	4	49	3	62	5	45	3	52	4	61	5	50	4	76	6	513	57	P
3	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	1	1	0	75	6	58	4	45	3	52	4	63	5	55	4	64	5	55	4	84	7	551	61	P
4	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	1	1	0	57	4	60	5	43	3	54	4	58	4	50	4	57	4	35	2	68	5	482	54	P
5	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	1	1	0	58	4	69	5	27	1	40	3	33	2	52	4	45	3	40	3	48	3	412	46	NP
6	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	62	5	50	4	40	3	62	5	65	5	53	4	60	5	40	3	74	6	506	56	P
7	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	73	6	61	5	89	7	86	7	83	7	74	6	72	6	55	4	87	7	680	76	P
8	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	1	1	0	71	6	85	7	61	5	62	5	63	5	76	6	85	7	65	5	74	6	642	71	P
9	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	71	6	73	6	80	7	88	7	60	5	67	5	84	7	60	5	74	6	657	73	P
10	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	63	5	62	5	55	4	60	5	50	4	63	5	60	5	60	5	58	4	531	59	P
11	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	76	6	78	6	92	7	94	7	93	7	83	7	93	7	70	6	90	7	769	85	P
12	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	2	1	0	67	5	70	6	55	4	58	4	55	4	71	6	60	5	65	5	58	4	559	62	P
13	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	1	1	0	64	5	50	4	45	3	44	3	50	4	48	3	49	3	40	3	68	5	458	51	P
14	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	60	5	58	4	40	3	46	3	53	4	54	4	52	4	40	3	60	5	463	51	P
15	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	1	1	0	69	5	68	5	55	4	52	4	50	4	75	6	55	4	55	4	48	3	527	59	P
16	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	62	5	79	6	85	7	90	7	83	7	91	7	83	7	65	5	94	7	732	81	P
17	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	67	5	62	5	41	3	48	3	53	4	72	6	67	5	45	3	78	6	533	59	P
18	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	1	1	0	72	6	66	5	52	4	60	5	65	5	63	5	63	5	40	3	84	7	565	63	P
19	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	51	4	58	4	40	3	52	4	63	5	62	5	78	6	55	4	86	7	545	61	P
20	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	1	1	0	64	5	74	6	49	3	60	5	53	4	74	6	79	6	55	4	76	6	584	65	P
21	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	1	1	0	72	6	63	5	40	3	56	4	45	3	57	4	53	4	55	4	64	5	505	56	P
22	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	54	4	47	3	29	1	46	3	55	4	47	3	67	5	60	5	68	5	473	53	NP
23	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	65	5	64	5	52	4	50	4	53	4	67	5	60	5	50	4	56	4	517	57	P
24	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	65	5	72	6	53	4	52	4	58	4	72	6	67	5	55	4	56	4	550	61	P
25	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	53	4	65	5	45	3	66	5	68	5	53	4	56	4	55	4	78	6	539	60	P
26	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	68	5	73	6	61	5	52	4	53	4	65	5	56	4	60	5	56	4	544	60	P
27	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	1	1	0	71	6	87	7	89	7	82	7	73	6	82	7	89	7	60	5	84	7	717	80	P
28	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	59	4	76	6	47	3	56	4	63	5	84	7	74	6	60	5	58	4	577	64	P
29	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	M	1	1	0	44	3	58	4	40	3	46	3	40	3	56	4	60	5	55	4	40	3	439	49	NP
30	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	F	1	1	0	79	6	74	6	40	3	44	3	53	4	69	5	60	5	40	3	54	4	513	57	P

Interview guidelines for semi-structured interviews with teachers

RUHR UNIVERSITÄT BOCHUM RUB

IEE Institut für Entwicklungsforschung und Entwicklungspolitik
Institute of Development Research and Development Policy

Chess for Africa

To be filled out by interviewer

Date and time of interview: ____________________________

Place of interview: ____________________________

School of interviewee: ____________________________

Name of interviewee: ____________________________

I. Introduction

- *introduce myself (name, institution, master program)*
- *introduce research purpose*
- *ask for permission to record*
- *inform about confidentiality (academic purpose only, master thesis)*
- *inform about duration of the interview (approx. 30 to 45 minutes)*

II. Ice-breaker questions

1. Please describe how you came to teaching chess in your school.

   (further possible questions)
   a. How did you come to playing chess personally?

   b. How did you become interested in the project "Chess for Africa"?

2. Please describe how you are teaching chess in your lessons. What does a "normal" lesson look like?

III. General chess-related questions

3. What do you think children learn through studying and playing chess?

4. What significance has chess in South Africa?

   (further possible questions)
   a. What can chess bring to South African schools in particular?

   b. Should chess be introduced in all South African schools?

IV. Specific questions on chess course implemented

5. How did your students develop during the course?

   (further possible questions)
   a. Did all students develop in a similar manner?

   b. If no, can you describe the development of one child you found particularly striking? You do not have to mention the name of the student.

   c. Can you recall any incidents that could have influenced one or several of your students since the start of the program?

6. Did they develop differently from other students in the school?

7. Which challenges were you confronted with when you were implementing the course?

V. Closing question

8. Is there anything else you wish to tell me?

VI. Thank you statement for qualitative part, transition to characteristics questionnaire

School characteristics questionnaire

Originally designed as ex-ante inquiry, eventually completed after qualitative interview

I. School Characteristics

1. Sector

- ☐ Public
- ☐ Semi-private
- ☐ Private

2. Number of students ___________

3. Primary language of instruction

- ☐ Afrikaans
- ☐ English
- ☐ Ndebele
- ☐ Northern Sotho
- ☐ Sotho
- ☐ Swazi
- ☐ Tswana
- ☐ Tsonga
- ☐ Venda
- ☐ Xhosa
- ☐ Zulu

4. Further languages of instruction (multiple answers possible)

- ☐ Afrikaans
- ☐ English
- ☐ Ndebele
- ☐ Northern Sotho
- ☐ Sotho
- ☐ Swazi
- ☐ Tswana
- ☐ Tsonga
- ☐ Venda
- ☐ Xhosa
- ☐ Zulu

5. Which extracurricular activities can be chosen from at your school?

____

____

____

____

II. Chess Instruction

6. Was chess taught at this school before the project “Chess for Africa”?

- ☐ Yes
- ☐ No

7. When did you start implementing chess lessons in this school?

______ month ______ year

8. When did you (last) participate in a training by “Chess for Africa”?

______ month ______ year

9. How is chess integrated into the school curriculum?

- ☐ Extracurricular activity
- ☐ Incorporated into a subject: ____________________________

10. How often are chess lessons taught? ______ hours per week

11. How many students attend chess lessons on a regular basis? ______

12. Which materials are available for chess lessons (multiple answers possible)?

- ☐ Classic chess boards
- ☐ Self-made chess boards
- ☐ Demonstration boards
- ☐ Other: ____________________________

(Foreseen) interview guidelines for semi-structured interviews with stakeholders in South African chess

To be filled out by interviewer

Date and time of interview: ____________________________

Place of interview: ____________________________

Name of interviewee: ____________________________

Organization and position of interviewee: ____________________________

I. Introduction

- *introduce myself (name, institution, master program)*
- *introduce research purpose*
- *ask for permission to record*
- *inform about confidentiality (academic purpose only, master thesis)*
- *inform about duration of the interview (approx. 30 to 45 minutes)*

II. Ice-breaker questions

1. Please describe how you came to working with chess.

   (further questions)
   a. How did you come to playing chess personally?

   b. What motivated you to pursue chess as a part of your career?

2. What significance has chess in South Africa?

III. Specific questions on chess instruction in schools

3. What do you think children learn through studying and playing chess?
4. Why do you think chess should be introduced in schools?
5. What are the problems associated with introducing chess into schools?
6. How should chess be incorporated into teaching?

   (further question)
   a. Can you recommend a particular mode of instruction?

7. Is there anything particular about introducing chess into South African schools?

IV. Closing question

8. Is there anything else you wish to tell me?

V. Thank you statement

Coding agenda for qualitative interviews

Main category	Category	Subcategory	Definition	Example(s)	Coding Rules
Students' development / learning	Types of learning	Concept learning	The learner develops one reaction to a class of stimuli, although these stimuli vary in appearance. He/she learns to classify them into concepts.	"then also challenge the learners, teach the learners how to draw the chess board, and label it" (I01: 50ff)	If referring to the learning process
		Rule learning	Drawing on two concepts A and B understood in the previous phase, the learner establishes a rule such as "If (concept) A, then (concept) B".	"Because once you instill the rules, in a younger generation, by the time they're old, obviously, they will be automatically applying those principles, and rules." (I01: 145-148)	
		Problem solving	The learner combines two previously established rules into a higher-order rule. New knowledge is acquired that "multiplies the applicability of rules already learned", capabilities for further thinking are developed.	"it eh helps children, to solve their own problems or to solve problems inside the classroom" (I02: 66-68)	
	Learning outcomes	Intellectual skills	Acquiring intellectual competencies going beyond verbal information	"[...] if I look most of the time the marks of the learners who are doing chess, they are doing well in class. They are doing well." (I03: 200-203)	If referring to an outcome of learning
		Cognitive strategies	Developing strategies to "[govern] individual's own learning, remembering and thinking behavior"	"the chess game is allowing a person to think deep before he decides, to do something, because of the consequences that will come at the later stage" (I01: 134-137)	

Main category	Category	Subcategory	Definition	Example(s)	Coding Rules
		Attitudes	Modifying the learner's internal state influencing choices in a particular area of action	"[...] one has to, make sure that he abides, he respects, he recognizes the rules, in order for a person to be able to be successful, to have a progress, of what he's intending to do." (I01: 89-92) "Then you will see that, you know, they are eager, they want to go there. And you know, the moment you eh, you eh eh the child or a learner develop love for a subject, there's no way that that learner can fail the subject." (I03: 141-145)	
		Verbal information	Having acquired information such as names, events, or facts	"chess notation and then [...] there are so many words like horizontal movement see, vertical movement" (I02: 85-89)	
	Other	General information on development	General information about the learners' development process	"I've just seen eh eh eh much development in their life compared to the previous time when they eh eh, they were not attending the chess class." (I01: 176ff)	If specific kind of development is not indicated
Instruction	Instructional events	Gaining attention	Raising the learners' interest for the lesson	No example	If reference is made to one of the nine instructional events specified in Gagné's "Principles of Instructional Design"
		Informing the learner of objectives	Making sure the learners know what is expected of them	"I just present introduce the the the lesson for the day" (I01: 67f)	
		Stimulating recall of prior learning (Sequential teaching)	Paying attention to mastery of a skill upon teaching a new skill	"[...] that I've got to first emphasize the the rules, of the game, of chess, the basic rules of the game of chess. I've got to make sure that the learners do understand them clearly" (I01: 35-38)	

Main category	Category	Subcategory	Definition	Example(s)	Coding Rules
		Presenting the stimulus material	Introducing the learners to the content to be learned	"I would explain and write some explanation on the board, just for the learners to see and then demonstrate it on the demonstration board [...]" (I01: 69-72)	
		Providing learner guidance	Assisting the learners in acquiring the new content/skill	"They are able to play for themselves, but with ehhh somebody who is guiding them." (I02: 94f)	
		Eliciting performance	Having the learner demonstrate the acquired skill	"[...] and then after that I'm going to allow the learners to, practice those eh lessons, on the chess board that I I I ehhh requested them to draw" (I01: 72-74)	
		Providing feedback	Letting the learner know how they are progressing where feedback is not immanent in the skill itself	No example	
		Assessing performance	Having the learners demonstrate the acquired skill in a testing setting	No example	
		Enhancing retention and transfer	Reviewing learned content and motivating learners to use this in novel situations	No example	
		Other teaching method	Teaching style not mentioned above	"During the normal lesson, ehhh I first emphasize the rules, the class room rules. That the learners know that there's a system that they have to abide with, when coming to attend to the class, the chess class." (I01: 62-65)	If reference is made to a style of teaching not to be allocated within Gagné's theory
	Challenges		Difficulties, problems, barriers to the implementation of chess instruction	"And another challenge is that there are learners who want to play chess but, they are using transport. That's a challenging, because most of the learners who play	If mentioning issues that arose in the preparation or implementation

Main category	Category	Subcategory	Definition	Example(s)	Coding Rules
				chess, you find that they are learners who stay around, those, who are who don't stay around when the bell rings, the transport is waiting for him or her. And you find that the learner wants to play, but the problem is the transport." (I03: 289-296)	of the chess course
	At-home practice		Practicing chess outside of class (e.g. at home, with friends or family)	"Because what I've noticed is, that most of the learners who excel in chess, they also do it at home. They also play a lot of chess. They will tell you "I play chess with my uncle, I play chess with my brothers". They even challenge each other at home, mhmmm. That's what I've noticed about the learn-, especially those who do well. Because they don't only do chess here at school, they they also do it at home." (I03: 250-257)	If referring to out-of-school practice of chess
Country relevance			Mentioning country specific aspects to chess learning and instruction	"Like when you check, ehh, I think you know we've got a, here in South Africa we've got a problem of math." (I03: 156f)	If specific reference to South Africa is made

Qualitative interview transcriptions and coding

Interview I

Date and time of interview:	15/10/2015, 10:25
Duration of interview:	00:30:40
Place of interview:	Soweto, Johannesburg
School of interviewee:	School 1
Interviewee code:	I01

Main Categories

Development/ learning
Instruction
Country relevance

(Sub) Categories

[*Introduction*]

FL Let’s start with these questions: Can you describe to me how you came to teaching chess in your school?

I01 Ehhh, in fact, I am this person that is involved in extracurricular activities in our school. Ehhh, mostly with sports, arts and culture issues. Ehhh, so it happens that the district, ehhh which is the the the the office that is facilitating or monitoring the school activities. So there’s a sports unit, they sent the the the letters, the letter to our school eh that speaks of the chess program that needs to be eh accommodated on the extracurricular activities. So the principal, ehhh as well as the SMT, saw it necessary that I should, they should assign to me that I, take an initiative to make sure that the chess program in our school, eh becomes a reality. So that is why I had to take that responsibility, of conducting the chess program in our school.

FL So how did you come to playing chess personally? Do you play chess?

I01 Ehhh, in fact, it was such a big challenge because, I never got an opportunity of playing chess. This was for the first time ever, I get to become involved in playing chess. Yes, I did ehhh have a brother, my twin brother, knows how to play chess as well as my younger brother. I used to watch them playing chess. But I did not know anything about chess.

FL Can you describe to me how you are generally teaching chess in your lessons? [*Pause for answer*] How do you design your lessons?

I01 Okay, ehhh. In fact I, I I first considered the the important points with the chess lesson, that I've got to first emphasize the the rules, of the game, of chess, the basic rules of the game of chess. I've got to make sure that the learners do understand them clearly. So that when it happens that, ehh they've got to en- engage themselve in the game of chess, at least first of all they understand how far, ahhh, what is expected of them in terms of the rules.

Stimulating recall of prior learning

FL And then?

I01 And then ehhh, of course I would organize the equipment. Ehhh, I am I was aware that in our school eh we do not have chess mat. So I had to improvise to organize the the blank charts, to draw the chess boards, the the chess demonstration board and then also challenge the learners, teach the learners how to draw the chess board, and label it. And then after that eh improvise also on eh designing, creating the chess pieces that I will be using on the demonstration board, just to explain the different types of chess pieces that the chess board is using, yah. And then, that's how I've started to have the the the class going on.

Other teaching method

FL What do you do during a normal lesson with the kids?

I01	During the normal normal lesson [*phone rings, switches it off*]. During the normal lesson, ehhh I first emphasize the rules, the class room rules. That the learners know that there’s a system that they have to abide with, when coming to attend to the class, the chess class. They’ve got to sit up well, ehhh remember the rules. And then, ahhh, I just present introduce the the the lesson for the day. Even if I’m going to cover some eh knowledge on particular pieces of the chess piece. I would explain and write some explanation on the board, just for the learners to see and then demonstrate it on the demonstration board and then after that I’m going to allow the learners to, practice those eh lessons, on the chess board that I I I ehhh requested them to draw, to organize. So lucky enough, I also managed to to request for the chess pieces from our district, to help us. So lucky enough, they managed to eh at least eh provide us with the district three pairs of chess pieces. And then that was added by my chess board also, ehhh as well as some learners ah ah ah do have the chess boards from their home. I have just requested them to, bring along their chess board. So and then, I would allow them to use those chess board to practice, whatever.	Other teaching method Informing learners of objective Presenting the stimulus material Eliciting performance
FL	Ok, and what do you think children learn through studying and playing chess?	
I01	Ehhh, what I’ve just seen is that, ehhh the issue of, the chess, it makes them to to to to be aware that one has to, make sure that he abides, he respects, he recognizes the rules, in order for a person to be able to be successful, to have a progress, of what he’s intending to do. So the the the rules, part of it, it has got a a bigger impact in the learner’s life.	Attitude

FL And what do you think, what significance has chess in South Africa?

I01 Mhmmm, can you can you simplify the question again?

FL Ehm, for example what can chess bring to South African schools in particular? What is special about chess in South Africa?

Attitude

I01 Okay, ehhh. Well, what I can see is that at least it can contribute in collecting discipline. Because of the issue of abiding by the rules. So, once a particular individual or a person is not recognizing or respecting the rules, so that person automatically, he or she will not be in a good environment. So, the the part of the rules has so much influence eh on somebody. Ya, in a way that he has he has to wake up to make up his mind of whatever actions or anything he wants to do. He's got to think of the rules, ya.

FL And is that particularly important in South Africa?

Country relevance

Cognitive strategies

I01 It is important because eh what we've seen, we see so many people, they do things haphazardly. They don't think before they do that, they just do it haphazardly. They don't think of the consequences that can come after a particular incident that one has engaged himself or herself on. So, on the chess game, when you decide to take a certain initiative or to move a particular piece to another, from one point to another, you you you are you are you are faced with the challenge of thinking first as to what will be the consequences at a later stage. Yes, I can I see that I've got have an opportunity of capturing a particular piece, but at the end of the day what will be the consequences after I’ve just captured that particular piece? Only to find out that maybe I will be exposing eh the the the danger to my to the king. And that will be checkmate. I will I will be exposing myself to a checkmate eh error, ya. So now, the chess, the chess game is allowing a person to think deep before he decides, to do something, because of the consequences that will come at the later stage.

FL And do you think chess should be introduced in all South African schools?

I01 Starting from a very tender age, the younger younger younger, eh learners. They need to be eh, given an opportunity to learn chess, to be involved in chess, in chess games. Because once you instill the rules, in a younger generation, by the time they’re old, obviously, they will be automatically applying those principles, and rules.

Country relevance

Rule learning

FL And let’s come to your class right here. Can you tell me, how did your students develop since you’ve started the course?

I01 Ehhh, this is this is one thing that is very much surprising that I I I’ve just witnessed. It is not too long that I’ve started with the program of chess in this school. Since it is for the first time ever, our school ehhh recognizing the chess program. What I’ve seen is the eagerness, the interest, that learners had and moreover, ehhh it has just influenced them in in making sure that they take note of their conduct, of their behavior. Their behavior was, I I I saw a change. It was now learners learned to, eh to think before, they act. They they they learned to, to to be able to think of the consequences,

Attitude

before they do something, yeah. So now, it has just improved the learners and ehhh it has just motivated the learners to, not to miss, the school. The attendance, it's very good. And, and they are improving also on the issue of, it's the issue of attendance, late-coming, as well as disciplined discipline.

Attitude

FL Ok, and is this the case for all your students? Did all students develop in a similar manner?

I01 Ehhh, well, I I I can not just say all of them. Most of the students, most of them I've just seen eh eh eh much development in their life compared to the previous time when they eh eh, they were not attending the chess class.

General information on development

FL Can you maybe the development of one child that you found particularly striking? You don't need to mention the name of the child. Was there somebody who stood out?

I01 Okay, ehhh. There's something that I've seen, some things in fact which I've seen ehhh in some of the learners. The issue of the behavior, it was such a challenge in this school. Ehhh, so the learners do not, they they lack they lack a bit of respect. Their conduct, their behavior, they have very bad conduct. Ehhh, now because they, they attend, here, this is where now they they they learned one has to, think of the consequences, when before doing the thing. At the end of the day what will be the results if I do such a thing? So, there are results that one has to face, either good or bad. So whenever you do something, there are results which makes consequences. So now, ehhh, the issue of the behavior, I've seen a behavior eh eh that improves on some learners. Ehhh, there were the issue of the

Attitude

Cognitive strategies

Attitude

attendance. So some learners were very much lazy to come and attend. You'd find so much absenteeism in this school. And then, the issue of late-coming. I've seen the improvement because ehhh some other time I would ehhh, challenge the learners and say 'You've got to come an hour earlier, just to get an opportunity of practicing'. [*NOTE: Students come an hour before classes start to play chess in the library autonomously*] Ehhh, they would definitely make sure that an hour before they do come because they are highly interested to get an opportunity of practicing. But only to find out that in fact I was just ehhh motivating them on the issue of reaching of reaching out for the the the program, the the the extracurricular, in fact not the extracurricular as such, the program that was created by the school in terms of ehhh helping the learners to their academic performance, ya ya academic plan, yeah. So they had to be, come earlier so that they will attend the the the the academic improvement plan, where they do the reading, and the practicing of maths and everything ya. So they come earlier just to first come and attend the chess class practice and then, eventually they would divert, go to the the the academic improvement plan. — Attitude

FL — Can you maybe recall any incidents, anything that has happened in the school or at home that could've influenced one or several of your students since the start of the program? Do you think there anything else that I need to consider?

I01 — Mhmmm, ehhh, what what I can what I can share with you, ehhh is that it happened that, eh some of the learners, they had they had a misbehavior attitude. Now ah I just applied the the the disciplinary measure of expelling them out of the chess class. So now, those — Attitude learners when they went out they just reported, they just cried to their parents, yaaa. Reporting that they they were expelled on the chess class. So now [*learner enters the room and leaves again*] so now eh, it had to happen that their parent, ehhh had to come to our school, and come to me to at least, ehhh to to to negotiate with me, just to request to request for the the apology, to to at least give that child that learner a chance again. They were requesting that ehhh I should apologize, I should I should eh accept the apology of of their learner, yeah, of their child. So, ehhh, they they they even, they even explained that that, that child was crying bitterly. Yaaa [*laughs*] He could not believe that ehhh he missed that opportunity of, getting to get an opportunity to attend the chess class. So after that, I've noticed a dramatic change, from that particular learner. Because I did emphasize in front of their parent that if somebody ehhh will not behave in a manner that is expected of him to behave, surely, he we have to apply the disciplinary measures of cutting all those opportunities that one can get.

Attitude

FL And would you say that your chess class has developed differently from other students in this school?

I01 Yes! Yes, because [*laughs*] sometimes it makes me to laugh... ehhh I would notice from, here from school, eh in some, insome other classes ehhh or subject, I would be called to those eh particular subjects for just to to to to to report, they would be reporting the nasty behavior of some learners. Yeah, so in a way that I should apply a disciplinary measure, since, they are aware that most of the learners are also interested to come in for the chess class, ya. So now, because of this particular behavior, because they behave like this, so I need to

Attitude

apply disciplinary measures of like cutting them off. So now, ehhh, I would warn them, so obviously at a later stage, these learners will eh come back to their behavior, yes. So, I’ve seen the influence also, they even notice on some other subjects that, ehhh there’s a bit of an element that is somehow eh active to at least be used to call the order from the learners.

Attitude

FL And can you tell me – this is almost the last question – which challenges you were confronted with when you were implementing the course?

Challenge

I01 Yeah of course it was the issue of ehhh, the resources... because once you present a lesson, to the learners on the demonstration board, on the improvised demonstration board [*laughs*], so for you to see if they have understood, they’ve got to apply those ehhh rules. But unfortunately when you do not have the chess board and enough chess boards and in fact enough chess sets, so it’s hard to reach out to them. Because you’re gonna have to use one, two or three and then to to to give each other a chance [*NOTE: Many chess boards are shared between more than two people*]. Now that will prolong, the lesson time, it will delay the progress. It will take forever, because you’ve got to make sure that you give those ones a chance and those ones a chance, because at the end of the day once there are people that did not get a chance, they will not be motivated to either come, frequently or regularly to the chess class because they know very well that they’re not gonna get an opportunity to use the chess set. So, in the beginning, there was the time whereby it was, there there was a pressure of some assessment issues whereby ehhh they had to use, they had to request for, they had not to release the learners to come quickly attend the chess

Challenge

session, during the chess class during the chess session... Yeah, so now it was very much complicated for them to come to the class. So those were the other challenges, ya.

Challenge

FL So, is there anything else you wish to tell me about your chess program? Anything that I need to take into consideration?

I01 Mhmmm... Ah... I don’t know if we could maybe, get a system of like ehhh motivating the parents, the parents, the learners’ parents to at least, ehhh have a contribution, on the chess program also, that their learners are attending. In terms of supply supporting by organizing the chess pieces for their children, so as to practice at home during their spare time. That will eh allow an opportunity of ehhh, quicker improvement on the learner. So, I don’t know if we can, what can we do to reach out to the parents to motivate them to at least have a bit of a contribution on the issue of improving, the the the chess program that is offered to their children? We’ve got that challenge too. What can we do to improve, to to to motivate the parents? Just to get their involvement...

Challenge

At-home practice

FL We will have to see... Thank you very much for your time, as always!

Interview II

Date and time of interview:	22/10/2015, 12:35
Duration of interview:	00:16:39
Place of interview:	Soweto, Johannesburg
School of interviewee:	School 2
Interviewee code:	I02

[*Introduction*]

FL Let us start with a few first questions: Can you describe to me how it started that you are teaching chess in your school?

I02 How I became a teacher for, the chess?

FL Yes.

I02 Okay, I can’t even think about the year, but it was, maybe before, 20... and what? Okay, it started like this: Ehm, it was the chess that other schools were playing, and then, in this school, I I admired to to lead the chess the chess eh the chess. When I talked about the chess with the prin- the previous principal, he liked it. And then, they tried to buy some pieces from the one who was at the district, the the man was selling the the the chess pieces to different schools. So, even the principal did so, for us. Because then we start to organize the team for chess.

FL Do you play chess personally?

I02 Yes, I did! But now I can’t, because of poor vision. I used to play chess.

FL And did you work with the project “Chess for Africa”?

Main Categories

Development/ learning
Instruction
Country relevance

(Sub) Categories

I02 Nahah, we did not even reach that. We used to go to compete with other schools. Yes... But we did not even go that far.

FL So you have never attended a training by “Chess for Africa”?

I02 Chess for Africa... I don’t know whether the man that I attended was from the chess Africa, but, ehhh, that was the man our principal bought the chess from him at the college. I don’t even remember if it was from the chess Africa or from where.

FL It is usually a week training for the teachers...

I02 A week training? That was with eh a week training... Maybe I did not, I was not there.

FL No problem, let’s continue. Can you describe to me how you are generally teaching chess in your lessons? What does a normal lesson look like?

I02 Mhmmm, in the normal lesson, chess is good because ehhh it helps the learners to sit down and concentrate to what you are doing inside the classroom. They... because in the chess room, children are not supposed to talk, they are supposed to concentrate on what, they are doing. And then, I don’t know whether I’m answering in a way you like it.

Attitude

FL No, don’t worry, I am interested in what you have to say!

I02	[*laughs*] Ehm, chess, according to my own understanding, chess opens the mind for the learners, for whoever is playing the chess. Mhmm, because there are so many moves that, you as a chess player can able to move, to defend the position. So in another way, I could say that, ehhh also it eh helps children, to solve their own problems or to solve problems inside the classroom. Like an example in math, lesson, they can able to solve it. Chess is, I can see chess is ehhh integrated with many subjects, it can be in languaging because you use so many words, when we, play chess, we learn, that is an integration with both the math and the language in chess.	Cognitive strategies Problem solving Intellectual skills
FL	That would've been my next question what you think students learn through studying and playing chess [*laughs*].	
I02	Meaning I already answered that [*laughs*].	
FL	Yes [*laughs*]. But can you maybe describe when the students come to chess class, what does a normal lesson look like? What do they do?	
I02	They learn, ehhh, chess notation. And then, even the movement of the chess, the the movement of the chess, the the the names of the piece... ehhh there are so many words like horizontal movement see, vertical movement. So, they can be able to learn in chess class.	Verbal information Rule learning Verbal information
FL	And do they have time to play for themselves? Or is it only teaching?	

I02 They are able to play for themselves, but with ehhh somebody who is guiding them. Not to make a lot of noise, there is somebody who is supervising there.

Providing learner guidance

FL And who is doing that?

I02 It was me [*both laugh*].

FL Hahaha ok. So, what do you think, what significance has chess in South Africa? What is special about chess in South Africa?

I02 Ehhh, it’s like it promoting the thinking ability, I don’t know, but is that ehhh, thinking ability. Not just to sit down and not using of your mind, your mind must always be used.

Cognitive strategies

FL So what do you think can chess bring to South African schools in particular?

I02 Come again?

FL South African school in particular. What’s the special thing that chess can bring to South African schools?

I02 The the people in South Africa, the people in Africa can able to ehhh, play with or to to to come together with other people from other countries.

Country relevance

FL And do you think chess should be introduced in all South African schools?

I02 Yes!

FL And why is that?

I02 Eh, to start with if, ehhh, people are willing to to to integrate with eh people from outside. Meaning that they themselves can able to start to practice with themselves. So, African people, African schools, all of them must, according to my own understanding, eh they must, play chess. So that they, all of us, all of them, can able to, go to other countries to play chess. Because they cannot just go there while they have well, the tournament or the chess club are playing whereas they don't know how to play chess.

Country relevance

FL [*short interruption*] And, can you tell me, how did your students develop in chess class? How did they develop from the start until now?

I02 How did they develop from where?

FL The children, how did they develop, from what they were before they were playing chess until now?

I02 The students that I can talk about now are the students from before, because now I am not strong, in the chess class. But, those students before, they were very very powerful, I can say yeah, they were, they were dynamic, in other words they don't know, I don't know how to explain them, but if, for an example, there was an a competition somewhere, they don't even hesitate to go there and play.

Attitude

FL And how did they change during the chess class? Were they different after playing chess for a while?

I02 Come again?

FL The children, did they change during the chess class from when they started? Was there a change?

I02 Yeah, yes there was a change, a big change in understanding the things, in understanding the things, for an example, ehhh let's take for an example in the classroom, the classroom has classroom rules, ne? But ehhh, in chess club or in chess classes we used to have some rules. Ehhh, some of them are the same with the classroom rules whereby, learners become more disciplined in chess class.

General information on development

Attitude

FL Ok, and did all students develop similarly?

I02 Uhmmm, development in which way?

FL In their personal development, or academic, or social... everything you can think of.

I02 Mhmmm, you know children are not the same... You can find that ehm, some children takes ehhh chess, mhm some children take take chess seriously, and ehhh others did not even consider chess as, serious as others. One can find that, ehmm if some an example as a teacher you can say in the chess room they are not supposed to talk, others can do so, but others did not. So, mhmm academically you can find that, ehhh, those learners that they don't understand inside the classroom, but in chess club you can find that they are moving. So, I don't know... But two learners are not the same.

Attitude

Intellectual skills

FL Of course. Was there one student that was developing very differently from everyone else? You don't need to mention the name of the child.

I02 Performing ehmm, let's say for example in chess playing? Or developing holistically?

FL Generally, holistically...

Attitudes

I02 Chess has morals, and norms. It ehhh makes those people, that are playing chess become somewhere different from those that they did not even playing chess.

FL So do you think they developed differently from other students in the school?

General information on development

I02 Mhmmm, I couldn't know all the learners, they just, they developed differently. They developed differently.

FL Can you maybe recall any incidents, anything that has happened in the school or at home that could've influenced one or several of your students since the start of the program? Do you think there anything else that I need to consider?

I02 Anything what?

FL Anything that happened with the learners at school or at home that was particularly important, that could've influenced them other than the chess class?

I02 Something differently from the chess one?

FL Yes. Can you recall anything important that happened?

I02 You mean, on the to those to whose that were playing chess?

FL Yes.

I02 I think... I don't remember.

FL No worry, it's fine! And we are now almost finished. So can you tell me, what were the challenges in implementing the chess class?

Challenge

I02 It was a challenge because when you start things, you are supposed to organize, ehmmm, those children they are there to play chess. So, because there are so many grades, it was very very very difficult for me to choose who is going to participate, but as times go on, it was easier, because they themselves ehhh knows who is playing better than who.

FL So how did you choose them? [*NOTE: Necessary to ensure that not only those with higher academic results were selected, which would have biased the entire sample*]

I02 According to their abilities. I choose them according to their abilities.

FL In chess playing or generally?

I02 In eh, choosing in chess play.

FL So not everyone can come to the class?

I02 Nahah, I am not saying that, not everyone who can come to play chess. But those that they are go to compete with others.

FL Ah okay, but to the chess class now, everyone can go?

I02 [*nods*]

FL Great! Any other challenges, any other problems?

Challenge

I02 Mhmmm, it takes time for the children to to settle down. Even though you can say “Sit down, don’t make noise” like that.

[*teacher is being called back to class*]

FL We are almost finished. So, is there anything else you want to tell me about the chess class?

I02 Mhmm, I don’t think there is more that I can add because you know... [*laughs*]

FL Okay, then we are all finished. Thank you very much!

Interview III

Date and time of interview: 23/10/2015, 11:40
Duration of interview: 00:22:45
Place of interview: Soweto, Johannesburg
School of interviewee: School 3
Interviewee code: I03

[*Introduction*]

FL Let's start with something simple: Can you describe to me how you came to teaching chess in this school?

I03 Mhmm, it started when by the way? Mhmm, I remember I was still in eh teaching this side, I don't know if maybe we can stop it [*points at the recorder*] just I, I must think first... It's fine... okay... Mhm, hh my god why am I not thinking about it. Mhm, I came here I think it was 2009. Yes, if I'm not mistaken, not to be... 2009! Yes, I started teaching chess in 2010. Ehhh apparently, there's this guy called Hendricks from Chess... It's not Chess for Africa because... Chess Kids, yes! They came here to school, we had, they told us that grade 6 learners must start learning chess in class and by then I was one of the teachers who were teaching grade 6. We were three, it was myself, Mr. Baloyi, and Mr. Djenga. Then they said to us we must go for training, and every, Wednesday, we used to go there. I didn't know anything about chess, even the pieces, nothing about chess. Then we went there for trainings, it was maybe for an hour every, eh Wednesday. Then and I started to developed that eh that eh love of chess. We learn about, you know when you learn chess, you must first, they will explain to you what is chess, when did the chess started, what happened, the history of chess. There was this guy, Mister, was it Mac or something like it? Uh that guy

Main Categories

Development/ learning
Instruction
Country relevance

(Sub) categories

was good, he was good. Then he taught us chess, the pieces, the movement of pieces, the board, all those things. And, again, they said each and every school must have, eh a person that will come at least once a week to teach all the learners, not only the grade 6. Then, that's where Jabulani [*NOTE: Jabulani Banda, now local project manager of CfA*] came in. Then ay, he was very good. He taught them chess and most of the learners to be honest, that Jabulani taught, they were excellent. I remember, we once make a video, and eh my learners were busy playing chess and you know, those German guys they comment, they said "You know what, these kids are excellent". I had, you know they were excellent. And even in class, they were so excellent. And now they're in High School, they're in High School. And when I look at it, you know, Chess for Africa came in, and we continue taking the learners to, it was on Saturdays we used to go to Mambo [*Primary School*] for Jabulani to teach them. And because Jabulani saw that Hitekani is one of the schools that they have love of chess, and even when you go to district competitions, cluster, we managed to win most of the games. Then, we had a problem with eh Prochessa, there are also good chess learners there. Then usually we go up to Province, yes, we go to Cluster, than we proceed to District, District, then we proceed to Province. But we have never been to National to show that we eh this learners are really doing good in chess. Even this year, like even if I'm saying, you know what I'm not that, ehhh like I'm not doing it like before, I'm not in it, I'm not involved like before, but still these learners are doing good. Because if I remember, this year, again, we went to Pretoria for Province, the under 13, mixed and girls only. It was good.

Intellectual skills

FL And how did the contact with “Chess for Africa” establish? How did that start? [*short interruption*]

I03 Like I said, Chess for Africa because Jabulani used to come here to teach our learners chess. One day, he said to me “You know, I went to some place in town, there were these Germans. They came here, they were talking about chess.” Then because he was already involved in chess. Then luckily Jabulani can speak Germany and he said “I spoke to them, I eh invited them to come this side” for them to come and see what is happening this side. And really, when they come, they were impressed, they were impressed really because we, eh without eh with few resources but we managed to do the best.

Challenge

FL And can you describe to me how you are generally teaching chess in your lessons? What does a normal lesson look like?

I03 Oh okay, what happens is when chess period, then they’ll have to take out their chess board and pieces, and also the big board. Then, we start teaching from like, they must know the pieces, how many pieces, know the board, how to place board. From there, we start with the pawn war. How the pawns move, how the pawns capture. From the pawns then we introduce piece one by one, until ehhh we complete all the pieces. And by then we introduce, we can you can start with the pawns, from there maybe we introduce eh bishop, then we explain how the bishop moves, how bishop capture. Like each and every piece will explain how it moves. And again, as soon as they understand the movement of the pieces, then it becomes easier for

Concept learning

Rule learning

Concept learning

Rule learning

them. Even though, in the beginning they were struggling, but in the end, because what is important is for them to know all the pieces and to, know how they move. And you know, chess because it needs concentration, most of the learners, you know if they get told about his sport, ehmmm carry... Matimba! Matimba cannot sit still, standing and moving up and down. But when it's chess time, Matimba will just sit still, and I remember when I said to Mam [*NOTE: the school principal*] "You know what, Mam? I am taking Matimba with me to chess tournament, for the cluster". She said "No no no no, yo Matimba, you are going to put yourself in trouble". I said "No, Matimba is going to play chess". And then I called him "Matimba, you know I wanted to take you to chess, now Mam is saying no, you cannot sit still and, but man, I know that you can play chess". And then he said "Mam, I can play chess". I said "You know what, chess needs learners who are disciplined, who listen to their teachers and, Matimba did an amazing thing. And he even won some of the games there. It was nice to see that you know that chess plays an important role because, you know the concentration, develops. Because you need to concentrate, you need to think of the movement. If I move this piece, what is my opponent going to do? You eh you must always think ahead, and it's helping them. It is helping them.

Attitude

Cognitive strategies

FL This is leading to my next question. Other than concentration, what do you think children learn through studying and playing chess?

I03 Eh, you know, because they, you know they love playing chess. You know you gotta always say to them "You know what, you must love what you are doing.

Attitude

And even in class, love math and the moment you love math, you'll excel in math. The way you are excelling in chess, in other subjects you must do the same". Because I can see, you know, all of them they really are, they got that love of chess, all of them they want to play chess, and they also want to participate [*NOTE: in the chess tournaments*]. Especially you know, it becomes difficult to select few to go for the tournament. Then you will see that, you know, they are eager, they want to go there. And you know, the moment you eh, you eh eh the child or a learner develop love for a subject, there's no way that that learner can fail the subject.

Attitude

FL — And what do you think, what is special about chess in South Africa?

I03 — Mhmm...

FL — Ehm, for example what can chess bring to South African schools in particular? What is special about chess in South Africa?

I03 — Like when you check, ehh, I think you know we've got a, here in South Africa we've got a problem of math. We've got that problem of math. Most of the learners are not doing well in math. And you know, the thing is, I think eh they've got that attitude towards math, but if, really like like I was saying that if a learner can develop that interest of chess, and if the learner can also develop an interest of math, the learner can do well. Because what eh the bottom line is you must love what you are doing. The moment you've got an attitude towards whatever you are doing, then there's no way that you are gonna make it. But if you love

Country relevance

Attitude

what you are doing, then you will do well. Then if, they can allow and again, by the look of things, our learners, you know their concentration is very poor. Their concentration is very poor. And you know that sometime you need to have supplements, but, still, naturally you can be able to concentrate. Because when you play chess, you can play chess for the whole day. You need to concentrate, but then if we can have those learners that can sit in class, concentrate, listen to the teacher and do what eh eh what the teacher is telling them to do, then we can excel really. Because really if you check, we've got that problem of math and if all of us here, if each and every school can have chess, then it will take us somewhere.

Country relevance

Cognitive strategies
Attitude

FL So do you think chess should be introduced in all South African schools?

I03 Yeees, mhm!

FL And let's go back to the chess class in this school. Can you tell me, how did your students develop since you've started the course?

I03 Looking at chess specifically?

FL All of it...

I03 Okay, you know eh what I've realized is, the moment a learner comes into chess class, after some time you see the changes. And even in class, you see the eh eh eh the thing is I don't teach the learners down there but if I look at especially the grade 6 now, grade 6 and 7, if I look most of the time the marks of the learners who are doing chess, they are doing well in class. They are

General information on development
Intellectual skills

doing well. And you know there was this group, of learners they're in High School now, ehmm some are in Altmond, some in Ruani, mostly it's eh Altmond and Ruani, you know, they are doing well and at this point again Mashudu. He was, eh I remember he ehhh came last year, ehhh end of the year, showing us a trophy, he was, eh, one of the best learners in grade 12 and he used to attend chess, he used to soccer, doing lot of things in spo- doing sports. I think sports play eeh plays an important role really when it comes to ehhh our kids' education.

FL So, do you think that the students in the chess class developed differently than other learners in the school?

I03 Unless if that learner is gifted. But, if that learner is not gifted, then, really the chess learners most of the time we see them doing well, than the others learners. You know there are those learners that are naturally gifted, that even if she's not doing any sport or whatever, she is still doing well in class, but, learners who do chess, they do well. Especially those who are seriously, there are those who just come in, you see, just make noise and they know that if they do that, I just chase them "You know what, you don't come here to play, you must come here, you play chess. And when you play chess, you know that you must be quiet, you sit still, you concentrate, then you enjoy chess. No jumping around." And they know that. And really they improve a lot, they do improve.

Intellectual skills

Attitude

General information on development

FL Can you maybe remember any incidents, anything that has happened in the school or at home that could've influenced your students since the start of the program?

Do you think there anything else that I need to consider?

I03 How? Can you make me understand the question?

FL Yes, so ehmm, were there any incidents during the time when the chess class was implemented. Maybe at school, or with the chess learners at home, is there anything significantly happening that could have also influenced their development, something that comes to mind?

I03 Like ehhh influenced them in what way? Like maybe, the love of chess or? Because what I've noticed is, that most of the learners who excel in chess, they also do it at home. They also play a lot of chess. They will tell you "I play chess with my uncle, I play chess with my brothers". They even challenge each other at home, mhmmm. That's what I've noticed about the learn-, especially those who do well. Because they don't only do chess here at school, they they also do it at home. They also do chess at home, ya. Because some, some of the learners like, ehhh, I'll give example with by with Matimba, yes. Matimba, yes, I I I, he do attend the classes, but, when I check, he also have background of chess, not from here, I think even at home.

At-home practice

FL We are now almost finished. Can you tell me, which challenges you were confronted with when you were implementing the course?

I03 Yeah, the challenges, are, eh except eh eh you know what for grade 6, it's compulsory and it's up to the school to if you want to play or not. Because at the moment you just choose whether you want to play or not, but always when the principal asks me “Do you still have to continue with chess?”, I said “Yes, mam! Let us continue with chess”. Eh, like my at the moment, eh we used to have someone to come and teach them, after school, but at the moment we don’t have anyone to come, and eh to teach them, but there’s a guy who I spoke to, last time he said to me “You know what, I don’t have a problem, I can come and eh”. He’s an uncle of one of my learners, my chess learners, he said to me “No, I don’t have problem, I can come, and help with the chess.” Because you know, I cannot do this by eh all by myself, because most of the time you find that, I must prepare, I must do this and that, then I end up not, having time for, these learners for chess class, but what I’m thinking of is next term, I’m ’ll phone the guy to come in and help with the chess. And another challenge is that there are learners who want to play chess but, they are using transport. That’s a challenging, because most of the learners who play chess, you find that they are learners who stay around, those, who are who don’t stay around when the bell rings, the transport is waiting for him or her. And you find that the learner wants to play, but the problem is the transport. And another challenge is, you know, the chess boards and the pieces, they get lost quickly, you know these learners, you’ll task one or two learners, to take care of them after playing games, but sometimes you find one or two pieces missing. And you know in chess, if one piece is missing, then the whole board, cannot be used, the board and the other pieces. But so far it’s time, time, we don’t have enough time, enough time really.

Challenge

Challenge

Challenge

Challenge

Challenge

FL Alright, is there anything else you wish to tell me about your chess program? Anything that I need to take into consideration?

I03 I think what I can say about chess club is, you know, ehhh, maybe you you saw even the learners, most of them they are disciplined, they are disciplined and they listen to you. And because, you know, in chess class we don’t only talk about chess, you also, you know eh emphasize the importance of being a disciplined learner, and if you don’t understand something, ask, you don’t have to be shy. And every time I tell them “You know what, you must tell yourself that today I’m going to play with eh Abigail [*grade 7*], even if you’re in grade 3 or grade 1. Just tell yourself that I’m going to play Abigail and I’m going to win!”. And, by doing that, because I I mostly I like to do this, if I take the under 9 mix them with the elders, with Abigail and the others, and I know that, they’re going to get, tough challenges. And sometimes you know, you’ll you’ll find that the learners say “You know what, Mam, tomorrow, tomorrow I’m going to win the game” and I said “I know that you’re going to win it, win the game”. And you know what, I always tell them that, you can make it in life, you can make it in life. And always, you must think ahead, like when you play chess, you always think ahead.

Attitude

Other teaching method

Attitude

Other teaching method

Cognitive strategies

FL Alright, thank you so much!

Code book for quantitative data processing

Variable name	Variable description	Codes	Recoding	Scale level
code	participant's code	None		-
tocheck	issues that need to be considered again in analysis	None		-
ORG_group	groups originally sampled	0: chess as an extracurricular activity 1: other extracurricular activities 2: no extracurricular activities		Ordinal
ORG_Chess_ vs_NoChess	recoded into chess vs. no chess (from original groups, all chess)	0: no chess 1: chess	ORG_group 0 → 1 1, 2 → 0	Nominal
NEW_group_5	groups considering compulsory chess instruction	0: chess extracurricular activity 1: other extracurricular activities 2: no extracurricular activities 3: chess compulsory 4: chess compulsory and extracurricular		Ordinal
NEW_group_3	restructured final three groups	0: general chess instruction 1: other extracurricular activities 2: no chess, no extracurricular activities	NEW_group_5 0, 3, 4 → 1 1, 2 → 0	Ordinal
I_Chess_ vs_NoChess	recoded into chess vs. no chess (from restructured groups, all chess)	0: no chess 1: chess	NEW_group_3 0 → 1 1, 2 → 0	Nominal
chess_ knowledge	knowledge of chess in general	0: no knowledge 1: knowledge		Nominal
I_Extra_ vs_NoExtra	recoded into extracurriculars vs. no extracurriculars (from original groups, all chess)	0: extracurricular activities 1: no extracurricular activities	NEW_group_5 0, 1, 4 → 1 2, 3 → 0	Nominal
groups_ longterm	restructured groups only considering more than three months of chess instruction	0: general chess instruction 1: other extracurricular activities 2: no chess, no extracurricular activities	those chess_length > 3 = NEW_group_3; rest copy from ORG_group	Nominal

Variable name	Variable description	Codes	Recoding	Scale level
II_Chess_ vs_NoChess	recoded into chess vs. no chess (from restructured groups, only chess > 3m)	0: no chess 1: chess	groups_longterm 0 → 1 1, 2 → 0	Nominal
II_Extra_ vs_NoExtra	recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)	0: extracurricular activities 1: no extracurricular activities	groups_longterm 0, 1 → 1 2 → 0	Nominal
school	school name	1: Siyavuma Primary School 2: Putalushaka Primary School 3: Hitekani Primary School		Scale
grade	grade	None		Scale
age_y	age (years only)	None		Scale
age_m	age (months only)	None		Scale
age_recoded	age (complete in months)	None	(age_y * 12) + age_m	Scale
sex	sex	0: female 1: male		Nominal
date_test	test date	None		-
time_test	test time	None		-
duration_test	test duration in minutes	None		Scale
language_test	language of test instruction	1: English 2: Full instruction non-English (Tsonga, Venda, Zulu) 3: Mixed instructions 4: Instructions English, questions non-English		Nominal
score_C_R	R score of Categories subtest	None		Scale
score_C_N	N score of Categories subtest	None		Scale
score_C_E2	E² score of Cateogories subtest	None		Scale

Variable name	Variable description	Codes	Recoding	Scale level
score_C_L	L score of Categories subtest	None		Scale
score_S_R	R score of Situations subtest	None		Scale
score_S_N	N score of Situations subtest	None		Scale
score_S_E2	E^2 score of Situations subtest	None		Scale
score_S_L	L score of Situations subtest	None		Scale
score_A_R	R score of Analogies subtest	None		Scale
score_A_N	N score of Analogies subtest	None		Scale
score_A_E2	E^2 score of Analogies subtest	None		Scale
score_A_L	L score of Analogies subtest	None		Scale
mean_N	mean of N scores	None		Scale
spezIQ_N	N value of Spez. IQ	None		Scale
spezIQ_L	L value of Spez. IQ	None		Scale
genIQ_L	L value of Gen. IQ	None		Scale
H0_subtests	Do subtest vary significantly from each other?	0: n.s. 1: $p < 0.05$ 2: $p < 0.01$		Nominal
ref_age_y	reference age (years only)	None		Scale
ref_age_m	reference age (months only)	None		Scale
ref_age_ recoded	reference age (complete in months)	None	(ref_age_y * 12) + ref_age_m	Scale

Variable name	Variable description	Codes	Recoding	Scale level
standIQ	standard IQ	None		Scale
cum_norm	cumulative percent of the norm population	None		Scale
remarks	remarks on testing session	None		-
CA1	Categories subtest, a-series, item 1	0: item not solved 1: item solved		Nominal
CA2	Categories subtest, a-series, item 2	0: item not solved 1: item solved		Nominal
CA3	Categories subtest, a-series, item 3	0: item not solved 1: item solved		Nominal
CA4	Categories subtest, a-series, item 4	0: item not solved 1: item solved		Nominal
CA5	Categories subtest, a-series, item 5	0: item not solved 1: item solved		Nominal
CA6	Categories subtest, a-series, item 6	0: item not solved 1: item solved		Nominal
CA7	Categories subtest, a-series, item 7	0: item not solved 1: item solved		Nominal
CA8	Categories subtest, a-series, item 8	0: item not solved 1: item solved		Nominal
CA9	Categories subtest, a-series, item 9	0: item not solved 1: item solved		Nominal
CB1	Categories subtest, b-series, item 1	0: item not solved 1: item solved		Nominal
CB2	Categories subtest, b-series, item 2	0: item not solved 1: item solved		Nominal
CB3	Categories subtest, b-series, item 3	0: item not solved 1: item solved		Nominal
CB4	Categories subtest, b-series, item 4	0: item not solved 1: item solved		Nominal
CB5	Categories subtest, b-series, item 5	0: item not solved 1: item solved		Nominal
CB6	Categories subtest, b-series, item 6	0: item not solved 1: item solved		Nominal
CB7	Categories subtest, b-series, item 7	0: item not solved		Nominal

Variable name	Variable description	Codes	Recoding	Scale level
		1: item solved		
CB8	Categories subtest, b-series, item 8	0: item not solved 1: item solved		Nominal
CB9	Categories subtest, b-series, item 9	0: item not solved 1: item solved		Nominal
CC1	Categories subtest, c-series, item 1	0: item not solved 1: item solved		Nominal
CC2	Categories subtest, c-series, item 2	0: item not solved 1: item solved		Nominal
CC3	Categories subtest, c-series, item 3	0: item not solved 1: item solved		Nominal
CC4	Categories subtest, c-series, item 4	0: item not solved 1: item solved		Nominal
CC5	Categories subtest, c-series, item 5	0: item not solved 1: item solved		Nominal
CC6	Categories subtest, c-series, item 6	0: item not solved 1: item solved		Nominal
CC7	Categories subtest, c-series, item 7	0: item not solved 1: item solved		Nominal
CC8	Categories subtest, c-series, item 8	0: item not solved 1: item solved		Nominal
CC9	Categories subtest, c-series, item 9	0: item not solved 1: item solved		Nominal
SA1	Situations subtest, a-series, item 1	0: item not solved 1: item solved		Nominal
SA2	Situations subtest, a-series, item 2	0: item not solved 1: item solved		Nominal
SA3	Situations subtest, a-series, item 3	0: item not solved 1: item solved		Nominal
SA4	Situations subtest, a-series, item 4	0: item not solved 1: item solved		Nominal
SA5	Situations subtest, a-series, item 5	0: item not solved 1: item solved		Nominal
SA6	Situations subtest, a-series, item 6	0: item not solved 1: item solved		Nominal
SA7	Situations subtest, a-series, item 7	0: item not solved 1: item solved		Nominal

Variable name	Variable description	Codes	Recoding	Scale level
SA8	Situations subtest, a-series, item 8	0: item not solved 1: item solved		Nominal
SA9	Situations subtest, a-series, item 9	0: item not solved 1: item solved		Nominal
SA10	Situations subtest, a-series, item 10	0: item not solved 1: item solved		Nominal
SA11	Situations subtest, a-series, item 11	0: item not solved 1: item solved		Nominal
SB1	Situations subtest, b-series, item 1	0: item not solved 1: item solved		Nominal
SB2	Situations subtest, b-series, item 2	0: item not solved 1: item solved		Nominal
SB3	Situations subtest, b-series, item 3	0: item not solved 1: item solved		Nominal
SB4	Situations subtest, b-series, item 4	0: item not solved 1: item solved		Nominal
SB5	Situations subtest, b-series, item 5	0: item not solved 1: item solved		Nominal
SB6	Situations subtest, b-series, item 6	0: item not solved 1: item solved		Nominal
SB7	Situations subtest, b-series, item 7	0: item not solved 1: item solved		Nominal
SB8	Situations subtest, b-series, item 8	0: item not solved 1: item solved		Nominal
SB9	Situations subtest, b-series, item 9	0: item not solved 1: item solved		Nominal
SB10	Situations subtest, b-series, item 10	0: item not solved 1: item solved		Nominal
SB11	Situations subtest, b-series, item 11	0: item not solved 1: item solved		Nominal
SC1	Situations subtest, c-series, item 1	0: item not solved 1: item solved		Nominal
SC2	Situations subtest, c-series, item 2	0: item not solved 1: item solved		Nominal
SC3	Situations subtest, c-series, item 3	0: item not solved 1: item solved		Nominal
SC4	Situations subtest, c-series, item 4	0: item not solved		Nominal

Variable name	Variable description	Codes	Recoding	Scale level
		1: item solved		
SC5	Situations subtest, c-series, item 5	0: item not solved 1: item solved		Nominal
SC6	Situations subtest, c-series, item 6	0: item not solved 1: item solved		Nominal
SC7	Situations subtest, c-series, item 7	0: item not solved 1: item solved		Nominal
SC8	Situations subtest, c-series, item 8	0: item not solved 1: item solved		Nominal
SC9	Situations subtest, c-series, item 9	0: item not solved 1: item solved		Nominal
SC10	Situations subtest, c-series, item 10	0: item not solved 1: item solved		Nominal
SC11	Situations subtest, c-series, item 11	0: item not solved 1: item solved		Nominal
AA1	Analogies subtest, a-series, item 1	0: item not solved 1: item solved		Nominal
AA2	Analogies subtest, a-series, item 2	0: item not solved 1: item solved		Nominal
AA3	Analogies subtest, a-series, item 3	0: item not solved 1: item solved		Nominal
AA4	Analogies subtest, a-series, item 4	0: item not solved 1: item solved		Nominal
AA5	Analogies subtest, a-series, item 5	0: item not solved 1: item solved		Nominal
AA6	Analogies subtest, a-series, item 6	0: item not solved 1: item solved		Nominal
AA7	Analogies subtest, a-series, item 7	0: item not solved 1: item solved		Nominal
AA8	Analogies subtest, a-series, item 8	0: item not solved 1: item solved		Nominal
AA9	Analogies subtest, a-series, item 9	0: item not solved 1: item solved		Nominal
AA10	Analogies subtest, a-series, item 10	0: item not solved 1: item solved		Nominal
AA11	Analogies subtest, a-series, item 11	0: item not solved 1: item solved		Nominal

Variable name	Variable description	Codes	Recoding	Scale level
AB1	Analogies subtest, b-series, item 1	0: item not solved 1: item solved		Nominal
AB2	Analogies subtest, b-series, item 2	0: item not solved 1: item solved		Nominal
AB3	Analogies subtest, b-series, item 3	0: item not solved 1: item solved		Nominal
AB4	Analogies subtest, b-series, item 4	0: item not solved 1: item solved		Nominal
AB5	Analogies subtest, b-series, item 5	0: item not solved 1: item solved		Nominal
AB6	Analogies subtest, b-series, item 6	0: item not solved 1: item solved		Nominal
AB7	Analogies subtest, b-series, item 7	0: item not solved 1: item solved		Nominal
AB8	Analogies subtest, b-series, item 8	0: item not solved 1: item solved		Nominal
AB9	Analogies subtest, b-series, item 9	0: item not solved 1: item solved		Nominal
AB10	Analogies subtest, b-series, item 10	0: item not solved 1: item solved		Nominal
AB11	Analogies subtest, b-series, item 11	0: item not solved 1: item solved		Nominal
AC1	Analogies subtest, c-series, item 1	0: item not solved 1: item solved		Nominal
AC2	Analogies subtest, c-series, item 2	0: item not solved 1: item solved		Nominal
AC3	Analogies subtest, c-series, item 3	0: item not solved 1: item solved		Nominal
AC4	Analogies subtest, c-series, item 4	0: item not solved 1: item solved		Nominal
AC5	Analogies subtest, c-series, item 5	0: item not solved 1: item solved		Nominal
AC6	Analogies subtest, c-series, item 6	0: item not solved 1: item solved		Nominal
AC7	Analogies subtest, c-series, item 7	0: item not solved 1: item solved		Nominal
AC8	Analogies subtest, c-series, item 8	0: item not solved		Nominal

Variable name	Variable description	Codes	Recoding	Scale level
		1: item solved		
AC9	Analogies subtest, c-series, item 9	0: item not solved 1: item solved		Nominal
AC10	Analogies subtest, c-series, item 10	0: item not solved 1: item solved		Nominal
AC11	Analogies subtest, c-series, item 11	0: item not solved 1: item solved		Nominal
fav_sub	favorite subject in school	1: math 2: English 3: language other than English 4: life skills 5: extracurricular activities 6: chess 7: other		Nominal
fav_sub_ recode	favorite subject (recoded into categories)	1: math 2: language studies 3: other	fav_sub 1 → 1 2, 3 → 2 ELSE → 3	Nominal
fav_sub_ MnoM	favorite subject (recoded into math vs. no math)	1: math 2: other than math	fav_sub 1 → ELSE → 2	Nominal
chess_yn	"Are you in the chess class?"	0: no 1: yes		Nominal
chess_start_m	"Since when are you in the chess class?" (month)	None		Scale
chess_start_y	"Since when are you in the chess class?" (year)	None		Scale
chess_length	Length of chess instruction (in months)	None		Nominal
chess_length_ recode	Length of chess instruction (recoded into categories of starting point)	1: second half of 2015 2: first half of 2015 3: 2014 4: 2013 5: before 2013	Observed from chess_start_y and _m	Ordinal
chess_length_ recode_II	Length of chess instruction (recoded into categories of starting year)	1: 2015 2: 2014 3: before 2014	chess_length_recode 1, 2 → 1 3 → 2	Ordinal

Variable name	Variable description	Codes	Recoding	Scale level
			ELSE → 3	
chess_ frequency	"How often do you attend the chess class?"	1: never 2: rarely 3: sometimes 4: often 5: always		Ordinal
chess_prior	"Did you know how to play chess before the chess class?"	0: no 1: yes		Nominal
chess_othersP	"Do your parents know how to play chess?" (chess students only)	0: no 1: yes		Nominal
chess_othersS	"Do your brothers or sisters know how to play chess?" (chess students only)	0: no 1: yes		Nominal
chess_othersF	"Do your friends know how to play chess?" (chess students only)	0: no 1: yes		Nominal
chess_others	"Do you know anyone else who knows how to play chess?" (chess students only)	0: no 1: yes		Nominal
chess_home	"Do you sometimes play chess at home?" (chess students only)	0: no 1: yes		Nominal
chess_home_ freq	"How often do you play chess at home in a week?" (chess students only)	None		Scale
chess_why	"Why have you started to play chess?"	None		-
chess_input	"What do you learn in chess class?"	None		-
nochess_know	"Do you know how to play chess?" (non-chess students only)	0: no 1: yes		Nominal
nochess_others P	"Do your parents know how to play chess?" (non-chess students only)	0: no 1: yes		Nominal
nochess_others S	"Do your brothers or sisters know how to play chess?" (non-chess students only)	0: no 1: yes		Nominal
nochess_others F	"Do your friends know how to play chess?" (non-chess students only)	0: no 1: yes		Nominal

Variable name	Variable description	Codes	Recoding	Scale level
nochess_others	"Do you know anyone else who knows how to play chess?" (non-chess students only)	0: no 1: yes		Nominal
nochess_home	"Do you sometimes play chess at home?" (non-chess students only)	0: no 1: yes		Nominal
nochess_home_ freq	"How often do you play chess at home in a week?" (non-chess students only)	None		Scale
chess_home_ total	students playing chess at home (all students)	0: no 1: yes	1) recode missing chess_home & nochess_home → 0; 2) add variables	Nominal
T1_absent	days absent in term 1 2015	None		Scale
T1_HL_mark	mark in home language in term 1 2015 (percentage points)	None		Scale
T1_HL_level	level in home language in term 1 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T1_FAL_mark	mark in first additional language in term 1 2015 (percentage points)	None		Scale
T1_FAL_level	level in first additional language in term 1 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T1_LS_mark	mark in life skills in term 1 2015 (percentage points)	None		Scale
T1_LS_level	level in life skills in term 1 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%)		Ordinal

Variable name	Variable description	Codes	Recoding	Scale level
		5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		
T1_M_mark	mark in mathematics in term 1 2015 (percentage points)	None		Scale
T1_M_level	level in mathematics in term 1 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T1_NS_mark	mark in natural sciences in term 1 2015 (percentage points)	None		Scale
T1_NS_level	level in natural sciences in term 1 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T1_SS_mark	mark in social sciences in term 1 2015 (percentage points)	None		Scale
T1_SS_level	level in social sciences in term 1 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T1_EMS_mark	mark in economic management sciences in term 1 2015 (percentage points)	None		Scale
T1_EMS_level	level in economic management sciences in term 1 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%)		Ordinal

Variable name	Variable description	Codes	Recoding	Scale level
		5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		
T1_T_mark	mark in technology in term 1 2015 (percentage points)	None		Scale
T1_T_level	level in technology in term 1 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T1_CA_mark	mark in creative arts in term 1 2015 (percentage points)	None		Scale
T1_CA_level	level in creative arts in term 1 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T1_LO_mark	mark in life orientation in term 1 2015 (percentage points)	None		Scale
T1_LO_level	level in life orientation in term 1 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T1_NSandT_ mark	average between natural science and technology mark term 1 2015	None	(T1_NS_mark + T1_T_mark) / 2	Scale
T1_NSandT_ level	average between natural science and technology level term 1 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%)	(T1_NS_ level + T1_T_ level) / 2	Ordinal

Variable name	Variable description	Codes	Recoding	Scale level
		5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		
T1_LSorLO_ mark	mark in life skills/orientation in term 1 2015 (percentage points)	None	1) recode missing T1_LS_mark & T1_LO_mark → 0 2) add variables	Scale
T1_average_ mark	average mark in term 1 2015 (percentage points)	None		Scale
T1_average_ level	average level in term 1 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T2_absent	days absent in term 2 2015	None		Scale
T2_HL_mark	mark in home language in term 2 2015 (percentage points)	None		Scale
T2_HL_level	level in home language in term 2 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T2_FAL_mark	mark in first additional language in term 2 2015 (percentage points)	None		Scale
T2_FAL_level	level in first additional language in term 2 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal

Variable name	Variable description	Codes	Recoding	Scale level
T2_LS_mark	mark in life skills in term 2 2015 (percentage points)	None		Scale
T2_LS_level	level in life skills in term 2 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T2_M_mark	mark in mathematics in term 2 2015 (percentage points)	None		Scale
T2_M_level	level in mathematics in term 2 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T2_NS_mark	mark in natural sciences in term 2 2015 (percentage points)	None		Scale
T2_NS_level	level in natural sciences in term 2 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T2_SS_mark	mark in social sciences in term 2 2015 (percentage points)	None		Scale
T2_SS_level	level in social sciences in term 2 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal

Variable name	Variable description	Codes	Recoding	Scale level
T2_EMS_mark	mark in economic management sciences in term 2 2015 (percentage points)	None		Scale
T2_EMS_level	level in economic management sciences in term 2 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T2_T_mark	mark in technology in term 2 2015 (percentage points)	None		Scale
T2_T_level	level in technology in term 2 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T2_CA_mark	mark in creative arts in term 2 2015 (percentage points)	None		Scale
T2_CA_level	level in creative arts in term 2 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T2_LO_mark	mark in life orientation in term 2 2015 (percentage points)	None		Scale
T2_LO_level	level in life orientation in term 2 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal

Variable name	Variable description	Codes	Recoding	Scale level
T2_NSandT_ mark	average between natural science and technology mark term 2 2015	None	(T2_NS_mark + T2_T_mark) / 2	Scale
T2_NSandT_ level	average between natural science and technology level term 2 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)	(T2_NS_level + T2_T_level) / 2	Ordinal
T2_average_ mark	average mark in term 2 2015 (percentage points)	None		Scale
T2_average_ level	average level in term 2 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T3_absent	days absent in term 3 2015	None		Scale
T3_HL_mark	mark in home language in term 3 2015 (percentage points)	None		Scale
T3_HL_level	level in home language in term 3 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T3_FAL_mark	mark in first additional language in term 3 2015 (percentage points)	None		Scale
T3_FAL_level	level in first additional language in term 3 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%)		Ordinal

Variable name	Variable description	Codes	Recoding	Scale level
		6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		
T3_LS_mark	mark in life skills in term 3 2015 (percentage points)	None		Scale
T3_LS_level	level in life skills in term 3 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T3_M_mark	mark in mathematics in term 3 2015 (percentage points)	None		Scale
T3_M_level	level in mathematics in term 3 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T3_NS_mark	mark in natural sciences in term 3 2015 (percentage points)	None		Scale
T3_NS_level	level in natural sciences in term 3 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T3_SS_mark	mark in social sciences in term 3 2015 (percentage points)	None		Scale
T3_SS_level	level in social sciences in term 3 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%)		Ordinal

Variable name	Variable description	Codes	Recoding	Scale level
		6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		
T3_EMS_mark	mark in economic management sciences in term 3 2015 (percentage points)	None		Scale
T3_EMS_level	level in economic management sciences in term 3 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T3_T_mark	mark in technology in term 3 2015 (percentage points)	None		Scale
T3_T_level	level in technology in term 3 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T3_CA_mark	mark in creative arts in term 3 2015 (percentage points)	None		Scale
T3_CA_level	level in creative arts in term 3 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
T3_LO_mark	mark in life orientation in term 3 2015 (percentage points)	None		Scale
T3_LO_level	level in life orientation in term 3 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%)		Ordinal

Variable name	Variable description	Codes	Recoding	Scale level
		6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		
T3_NSandT_ mark	average between natural science and technology mark term 3 2015	None	(T3_NS_mark + T3_T_mark) / 2	Scale
T3_NSandT_ level	average between natural science and technology level term 3 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)	(T3_NS_level + T3_T_level) / 2	Ordinal
T3_LSorLO	mark in life skills/orientation in term 3 2015 (percentage points)	None	1) recode missing T3_LS_mark & T3_LO_mark → 0 2) add variables	Scale
T3_average_ mark	average mark in term 3 2015 (percentage points)	None		Scale
T3_average_ level	average level in term 3 2015	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		Ordinal
improvement_ T1T2_marks	Improvement from term 1 to term 2 in marks	None	T2_average_mark – T1_average_mark	Scale
improvement_ T2T3_marks	Improvement from term 2 to term 3 in marks	None	T3_average_mark – T2_average_mark	Scale
improvement_ T1T3_marks	Improvement from term 1 to term 3 in marks	None	T3_average_mark – T1_average_mark	Scale
improvement_ T1T2_level	Improvement from term 1 to term 2 in levels	None	T2_average_level – T1_average_level	Scale
improvement_ T2T3_level	Improvement from term 2 to term 3 in levels	None	T3_average_level – T2_average_level	Scale

Variable name	Variable description	Codes	Recoding	Scale level
improvement_ T1T3_level	Improvement from term 1 to term 3 in levels	None	T3_average_level – T1_average_level	Scale
before_HL_ mark	mark in home language before joining the chess class (percentage points) (Siyavuma only)	None	observed from chess_start_y and _m whether T1 or T2	Scale
before_HL_ level	level in home language before joining the chess class (Siyavuma only)	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)	observed from chess_start_y and _m whether T1 or T2	Ordinal
before_FAL_ mark	mark in first additional language before joining the chess class (percentage points) (Siyavuma only)	None	observed from chess_start_y and _m whether T1 or T2	Scale
before_FAL_ level	level in first additional language before joining the chess class (Siyavuma only)	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)	observed from chess_start_y and _m whether T1 or T2	Ordinal
before_LS_ mark	mark in life skills before joining the chess class (percentage points) (Siyavuma only)	None	observed from chess_start_y and _m whether T1 or T2	Scale
before_LS_ level	level in life skills before joining the chess class (Siyavuma only)	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)	observed from chess_start_y and _m whether T1 or T2	Ordinal
before_M_ mark	mark in math before joining the chess class (percentage points) (Siyavuma only)	None	observed from chess_start_y and _m whether T1 or T2	Scale
before_M_level	level in math before joining the chess class (Siyavuma only)	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%)	observed from chess_start_y and _m whether T1 or T2	Ordinal

Variable name	Variable description	Codes	Recoding	Scale level
		5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		
before_average _mark	average mark before joining the chess class (percentage points) (Siyavuma only)	None	observed from chess_start_y and _m whether T1 or T2	Scale
before_average _level	average level before joining the chess class (Siyavuma only)	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)	observed from chess_start_y and _m whether T1 or T2	Ordinal
after_HL_ mark	mark in home language after joining the chess class (percentage points) (Siyavuma only)	None	= respective T3	Scale
after_HL_level	level in home language after joining the chess class (Siyavuma only)	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)	= respective T3	Ordinal
after_FAL_ mark	mark in first additional language after joining the chess class (percentage points) (Siyavuma only)	None	= respective T3	Scale
after_FAL_ level	level in first additional language after joining the chess class (Siyavuma only)	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)	= respective T3	Ordinal
after_LS_mark	mark in life skills after joining the chess class (percentage points) (Siyavuma only)	None	= respective T3	Scale
after_LS_level	level in life skills after joining the chess class (Siyavuma only)	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%)	= respective T3	Ordinal

Variable name	Variable description	Codes	Recoding	Scale level
		5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)		
after_M_mark	mark in math after joining the chess class (percentage points) (Siyavuma only)	None	= respective T3	Scale
after_M_level	level in math after joining the chess class (Siyavuma only)	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)	= respective T3	Ordinal
after_average_ mark	average mark after joining the chess class (percentage points) (Siyavuma only)	None	= respective T3	Scale
after_average_ level	average level after joining the chess class (Siyavuma only)	1: not achieved (0-29%) 2: elementary achievement (30-39%) 3: moderate achievement (40-49%) 4: adequate achievement (50-59%) 5: substantial achievement (60-69%) 6: meritorious achievement (70-79%) 7: outstanding achievement (80-100%)	= respective T3	Ordinal

SPSS Output

```
GET
  FILE='C:\Users\Franziska\Documents\MADM\MA thesis\Testing\SPSS data\Franziska
Lammers MA Thesis Dataset.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
USE ALL.
COMPUTE filter_$=(NEW_group_3 ~= 999).
VARIABLE LABELS filter_$ 'NEW_group_3 ~= 999 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=NEW_group_5 NEW_group_3 I_Chess_vs_NoChess I_Extra_vs_NoExtra
  /ORDER=ANALYSIS.
```

Frequencies

```
[DataSet1] C:\Users\Franziska\Documents\MADM\MA thesis\Testing\SPSS data\Franziska
Lammers MA Thesis Dataset.sav
```

Statistics

		groups considering compulsory chess instruction	restructured final three groups	recoded into chess vs. no chess (from restructured groups, all chess)	recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)
N	Valid	80	80	80	80
	Missing	0	0	0	0

Frequency Table

groups considering compulsory chess instruction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	chess extracurricular	30	37,5	37,5	37,5
	other extracurriculars	22	27,5	27,5	65,0
	no extracurriculars	22	27,5	27,5	92,5
	chess compulsory	3	3,8	3,8	96,3
	chess compulsory and extracurricular	3	3,8	3,8	100,0
	Total	80	100,0	100,0	

restructured final three groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	chess	36	45,0	45,0	45,0

	extracurriculars	22	27,5	27,5	72,5
	no activity, no chess	22	27,5	27,5	100,0
	Total	80	100,0	100,0	

recoded into chess vs. no chess (from restructured groups, all chess)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no chess	44	55,0	55,0	55,0
	chess	36	45,0	45,0	100,0
	Total	80	100,0	100,0	

recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no extracurriculars	25	31,3	31,3	31,3
	extracurriculars	55	68,8	68,8	100,0
	Total	80	100,0	100,0	

```
FREQUENCIES VARIABLES=school grade age_recoded sex duration_test language_test
  /STATISTICS=STDDEV MINIMUM MAXIMUM MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Statistics

		school name	grade	age (complete in months)	sex	test duration in minutes	language of test instruction
N	Valid	80	80	80	80	78	77
	Missing	0	0	0	0	2	3
Mean		1,96	3,99	118,24	,50	18,13	1,68
Median		2,00	4,00	115,50	,50	17,00	1,00
Mode		1	2	95	0[a]	17	1
Std. Deviation		,818	2,161	26,092	,503	5,812	1,175
Minimum		1	1	75	0	10	1
Maximum		3	7	161	1	46	4

a. Multiple modes exist. The smallest value is shown

Frequency Table

school name

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Siyavuma	28	35,0	35,0	35,0
	Putalushaka	27	33,8	33,8	68,8

	Hitekani	25	31,3	31,3	100,0
	Total	80	100,0	100,0	

grade

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	13	16,3	16,3	16,3
	2	15	18,8	18,8	35,0
	3	7	8,8	8,8	43,8
	4	11	13,8	13,8	57,5
	5	7	8,8	8,8	66,3
	6	13	16,3	16,3	82,5
	7	14	17,5	17,5	100,0
	Total	80	100,0	100,0	

sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	female	40	50,0	50,0	50,0
	male	40	50,0	50,0	100,0
	Total	80	100,0	100,0	

language of test instruction

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	English	56	70,0	72,7	72,7
	Non-English full (Zulu, Venda, Tsonga)	3	3,8	3,9	76,6
	Mixed instructions	5	6,3	6,5	83,1
	Instructions in English, questions non-English	13	16,3	16,9	100,0
	Total	77	96,3	100,0	
Missing	999	3	3,8		
Total		80	100,0		

```
CORRELATIONS
  /VARIABLES=mean_N T3_average_mark
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Correlations

Correlations

		mean of N scores	average mark in term 3 2015 (percentage points)
mean of N scores	Pearson Correlation	1	,281*
	Sig. (2-tailed)		,012
	N	80	80
average mark in term 3 2015 (percentage points)	Pearson Correlation	,281*	1
	Sig. (2-tailed)	,012	
	N	80	80

*. Correlation is significant at the 0.05 level (2-tailed).

```
NONPAR CORR
  /VARIABLES=score_C_N score_S_N score_A_N
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Correlations

			N score of Categories subtest	N score of Situations subtest	N score of Analogies subtest
Spearman's rho	N score of Categories subtest	Correlation Coefficient	1,000	,283*	,383**
		Sig. (2-tailed)	.	,011	,000
		N	80	80	80
	N score of Situations subtest	Correlation Coefficient	,283*	1,000	,363**
		Sig. (2-tailed)	,011	.	,001
		N	80	80	80
	N score of Analogies subtest	Correlation Coefficient	,383**	,363**	1,000
		Sig. (2-tailed)	,000	,001	.
		N	80	80	80

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

```
NONPAR CORR
  /VARIABLES=score_C_N score_S_N score_A_N T3_average_mark T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Correlations

			N score of Categories subtest	N score of Situations subtest	N score of Analogies subtest	average mark in term 3 2015 (percentage points)	mark in home language in term 3 2015 (percentage points)	mark in first additional language in term 3 2015 (percentage points)	mark in mathematics in term 3 2015 (percentage points)	mark in life skills/orientation in term 3 2015 (percentage points)
Spearman's rho	N score of Categories subtest	Correlation Coefficient	1,000	,283*	,383**	,161	,220	,173	,103	,184
		Sig. (2-tailed)	.	,011	,000	,153	,052	,126	,365	,103
		N	80	80	80	80	79	80	80	80
	N score of Situations subtest	Correlation Coefficient	,283*	1,000	,363**	,026	-,002	,033	,041	,065
		Sig. (2-tailed)	,011	.	,001	,817	,987	,773	,719	,567
		N	80	80	80	80	79	80	80	80
	N score of Analogies subtest	Correlation Coefficient	,383**	,363**	1,000	,397**	,361**	,375**	,346**	,264*
		Sig. (2-tailed)	,000	,001	.	,000	,001	,001	,002	,018
		N	80	80	80	80	79	80	80	80

average mark in term 3 2015 (percentage points)	Correlation Coefficient	,161	,026	,397**	1,000	,729**	,825**	,839**	,784**
	Sig. (2-tailed)	,153	,817	,000	.	,000	,000	,000	,000
	N	80	80	80	80	79	80	80	80
mark in home language in term 3 2015 (percentage points)	Correlation Coefficient	,220	-,002	,361**	,729**	1,000	,546**	,579**	,585**
	Sig. (2-tailed)	,052	,987	,001	,000	.	,000	,000	,000
	N	79	79	79	79	79	79	79	79
mark in first additional language in term 3 2015 (percentage points)	Correlation Coefficient	,173	,033	,375**	,825**	,546**	1,000	,671**	,468**
	Sig. (2-tailed)	,126	,773	,001	,000	,000	.	,000	,000
	N	80	80	80	80	79	80	80	80
mark in mathematics in term 3 2015 (percentage points)	Correlation Coefficient	,103	,041	,346**	,839**	,579**	,671**	1,000	,638**
	Sig. (2-tailed)	,365	,719	,002	,000	,000	,000	.	,000
	N	80	80	80	80	79	80	80	80
mark in life skills/orientation in term 3 2015 (percentage points)	Correlation Coefficient	,184	,065	,264*	,784**	,585**	,468**	,638**	1,000
	Sig. (2-tailed)	,103	,567	,018	,000	,000	,000	,000	.
	N	80	80	80	80	79	80	80	80

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

```
CORRELATIONS
  /VARIABLES=T1_average_mark T3_average_mark
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Correlations

Correlations

		average mark in term 1 2015 (percentage points)	average mark in term 3 2015 (percentage points)
average mark in term 1 2015 (percentage points)	Pearson Correlation	1	,877**
	Sig. (2-tailed)		,000
	N	73	73
average mark in term 3 2015 (percentage points)	Pearson Correlation	,877**	1
	Sig. (2-tailed)	,000	
	N	73	80

**. Correlation is significant at the 0.01 level (2-tailed).

```
REGRESSION
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT T3_average_mark
  /METHOD=ENTER T1_average_mark.
```

Regression

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	average mark in term 1 2015 (percentage points)[b]	.	Enter

a. Dependent Variable: average mark in term 3 2015 (percentage points)

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,877[a]	,769	,766	5,729

a. Predictors: (Constant), average mark in term 1 2015 (percentage points)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7761,876	1	7761,876	236,505	,000[b]
	Residual	2330,152	71	32,819		
	Total	10092,027	72			

a. Dependent Variable: average mark in term 3 2015 (percentage points)

b. Predictors: (Constant), average mark in term 1 2015 (percentage points)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	8,399	4,051		2,073	,042
	average mark in term 1 2015 (percentage points)	,926	,060	,877	15,379	,000

a. Dependent Variable: average mark in term 3 2015 (percentage points)

```
MEANS TABLES=mean_N score_C_N score_S_N score_A_N BY NEW_group_3
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
mean of N scores * restructured final three groups	80	100,0%	0	0,0%	80	100,0%
N score of Categories subtest * restructured final three groups	80	100,0%	0	0,0%	80	100,0%
N score of Situations subtest * restructured final three groups	80	100,0%	0	0,0%	80	100,0%
N score of Analogies subtest * restructured final three groups	80	100,0%	0	0,0%	80	100,0%

Report

restructured final three groups		mean of N scores	N score of Categories subtest	N score of Situations subtest	N score of Analogies subtest
chess	Mean	76,44	80,17	66,72	82,61
	N	36	36	36	36
	Std. Deviation	13,177	16,391	17,196	17,889
extracurriculars	Mean	71,50	75,91	61,23	77,50
	N	22	22	22	22
	Std. Deviation	12,074	17,127	15,829	12,003
no activity, no chess	Mean	69,91	72,91	59,18	77,73
	N	22	22	22	22
	Std. Deviation	9,995	15,790	14,773	13,698
Total	Mean	73,29	77,00	63,14	79,86
	N	80	80	80	80
	Std. Deviation	12,282	16,518	16,336	15,369

```
MEANS TABLES=T3_average_mark T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO BY
NEW_group_3
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent

average mark in term 3 2015 (percentage points) * restructured final three groups	80	100,0%	0	0,0%	80	100,0%
mark in home language in term 3 2015 (percentage points) * restructured final three groups	79	98,8%	1	1,3%	80	100,0%
mark in first additional language in term 3 2015 (percentage points) * restructured final three groups	80	100,0%	0	0,0%	80	100,0%
mark in mathematics in term 3 2015 (percentage points) * restructured final three groups	80	100,0%	0	0,0%	80	100,0%
mark in life skills/orientation in term 3 2015 (percentage points) * restructured final three groups	80	100,0%	0	0,0%	80	100,0%

Report

restructured final three groups		average mark in term 3 2015 (percentage points)	mark in home language in term 3 2015 (percentage points)	mark in first additional language in term 3 2015 (percentage points)	mark in mathematics in term 3 2015 (percentage points)	mark in life skills/orientation in term 3 2015 (percentage points)
chess	Mean	71,78	72,64	70,06	69,56	73,97
	N	36	36	36	36	36
	Std. Deviation	12,071	11,485	14,493	16,892	15,423
extracurriculars	Mean	67,14	71,48	68,41	62,64	70,55
	N	22	21	22	22	22
	Std. Deviation	10,521	14,469	13,633	14,265	11,143
no activity, no chess	Mean	65,36	68,95	65,59	65,05	63,73
	N	22	22	22	22	22
	Std. Deviation	12,564	13,937	16,846	17,549	18,030
Total	Mean	68,74	71,30	68,38	66,41	70,21
	N	80	79	80	80	80
	Std. Deviation	12,002	12,944	14,878	16,473	15,588

```
MEANS TABLES=mean_N score_C_N score_S_N score_A_N BY I_Chess_vs_NoChess
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
mean of N scores * recoded into chess vs. no chess (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%
N score of Categories subtest * recoded into chess vs. no chess (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%
N score of Situations subtest * recoded into chess vs. no chess (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%
N score of Analogies subtest * recoded into chess vs. no chess (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%

Report

recoded into chess vs. no chess (from restructured groups, all chess)		mean of N scores	N score of Categories subtest	N score of Situations subtest	N score of Analogies subtest
no chess	Mean	70,70	74,41	60,20	77,61
	N	44	44	44	44
	Std. Deviation	10,983	16,350	15,167	12,728
chess	Mean	76,44	80,17	66,72	82,61
	N	36	36	36	36
	Std. Deviation	13,177	16,391	17,196	17,889
Total	Mean	73,29	77,00	63,14	79,86
	N	80	80	80	80
	Std. Deviation	12,282	16,518	16,336	15,369

```
MEANS TABLES=mean_N score_C_N score_S_N score_A_N BY I_Extra_vs_NoExtra
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
mean of N scores * recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%
N score of Categories subtest * recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%
N score of Situations subtest * recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%
N score of Analogies subtest * recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%

Report

recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)		mean of N scores	N score of Categories subtest	N score of Situations subtest	N score of Analogies subtest
no extracurriculars	Mean	70,52	74,12	60,36	77,16
	N	25	25	25	25
	Std. Deviation	9,514	15,640	14,410	12,931
extracurriculars	Mean	74,55	78,31	64,40	81,09
	N	55	55	55	55
	Std. Deviation	13,240	16,877	17,115	16,320
Total	Mean	73,29	77,00	63,14	79,86
	N	80	80	80	80
	Std. Deviation	12,282	16,518	16,336	15,369

```
MEANS TABLES=mean_N score_C_N score_S_N score_A_N BY chess_knowledge
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
mean of N scores * knowledge of chess in general	69	86,3%	11	13,8%	80	100,0%
N score of Categories subtest * knowledge of chess in general	69	86,3%	11	13,8%	80	100,0%
N score of Situations subtest * knowledge of chess in general	69	86,3%	11	13,8%	80	100,0%
N score of Analogies subtest * knowledge of chess in general	69	86,3%	11	13,8%	80	100,0%

Report

knowledge of chess in general		mean of N scores	N score of Categories subtest	N score of Situations subtest	N score of Analogies subtest
no	Mean	73,69	75,94	64,31	81,06
	N	16	16	16	16
	Std. Deviation	9,457	12,567	16,875	13,005
yes	Mean	73,66	77,79	63,47	80,00
	N	53	53	53	53
	Std. Deviation	13,419	17,094	16,775	16,724
Total	Mean	73,67	77,36	63,67	80,25
	N	69	69	69	69
	Std. Deviation	12,547	16,091	16,677	15,855

```
MEANS TABLES=mean_N score_C_N score_S_N score_A_N BY chess_home_total
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent

mean of N scores * students playing chess at home (all students)	80	100,0%	0	0,0%	80	100,0%
N score of Categories subtest * students playing chess at home (all students)	80	100,0%	0	0,0%	80	100,0%
N score of Situations subtest * students playing chess at home (all students)	80	100,0%	0	0,0%	80	100,0%
N score of Analogies subtest * students playing chess at home (all students)	80	100,0%	0	0,0%	80	100,0%

Report

students playing chess at home (all students)		mean of N scores	N score of Categories subtest	N score of Situations subtest	N score of Analogies subtest
no	Mean	70,32	73,49	59,68	77,71
	N	41	41	41	41
	Std. Deviation	10,093	15,168	15,433	13,735
yes	Mean	76,41	80,69	66,77	82,13
	N	39	39	39	39
	Std. Deviation	13,668	17,255	16,663	16,799
Total	Mean	73,29	77,00	63,14	79,86
	N	80	80	80	80
	Std. Deviation	12,282	16,518	16,336	15,369

```
MEANS TABLES=T3_average_mark T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO BY
I_Chess_vs_NoChess
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases		
	Included	Excluded	Total

	N	Percent	N	Percent	N	Percent
average mark in term 3 2015 (percentage points) * recoded into chess vs. no chess (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%
mark in home language in term 3 2015 (percentage points) * recoded into chess vs. no chess (from restructured groups, all chess)	79	98,8%	1	1,3%	80	100,0%
mark in first additional language in term 3 2015 (percentage points) * recoded into chess vs. no chess (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%
mark in mathematics in term 3 2015 (percentage points) * recoded into chess vs. no chess (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%
mark in life skills/orientation in term 3 2015 (percentage points) * recoded into chess vs. no chess (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%

Report

recoded into chess vs. no chess (from restructured groups, all chess)		average mark in term 3 2015 (percentage points)	mark in home language in term 3 2015 (percentage points)	mark in first additional language in term 3 2015 (percentage points)	mark in mathematics in term 3 2015 (percentage points)	mark in life skills/orientation in term 3 2015 (percentage points)
no chess	Mean	66,25	70,19	67,00	63,84	67,14
	N	44	43	44	44	44
	Std. Deviation	11,487	14,087	15,212	15,851	15,208
chess	Mean	71,78	72,64	70,06	69,56	73,97
	N	36	36	36	36	36
	Std. Deviation	12,071	11,485	14,493	16,892	15,423
Total	Mean	68,74	71,30	68,38	66,41	70,21
	N	80	79	80	80	80
	Std. Deviation	12,002	12,944	14,878	16,473	15,588

```
MEANS TABLES=T3_average_mark T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO BY
I_Extra_vs_NoExtra
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
average mark in term 3 2015 (percentage points) * recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%
mark in home language in term 3 2015 (percentage points) * recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)	79	98,8%	1	1,3%	80	100,0%
mark in first additional language in term 3 2015 (percentage points) * recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%
mark in mathematics in term 3 2015 (percentage points) * recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%
mark in life skills/orientation in term 3 2015 (percentage points) * recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)	80	100,0%	0	0,0%	80	100,0%

recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)		average mark in term 3 2015 (percentage points)	mark in home language in term 3 2015 (percentage points)	mark in first additional language in term 3 2015 (percentage points)	mark in mathematics in term 3 2015 (percentage points)	mark in life skills/orientation in term 3 2015 (percentage points)
no extracurriculars	Mean	66,16	68,72	66,20	65,44	65,32
	N	25	25	25	25	25
	Std. Deviation	12,175	13,075	15,864	16,467	18,011
extracurriculars	Mean	69,91	72,50	69,36	66,85	72,44
	N	55	54	55	55	55
	Std. Deviation	11,848	12,828	14,450	16,608	13,971
Total	Mean	68,74	71,30	68,38	66,41	70,21
	N	80	79	80	80	80
	Std. Deviation	12,002	12,944	14,878	16,473	15,588

```
MEANS TABLES=T3_average_mark T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO BY
chess_knowledge
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
average mark in term 3 2015 (percentage points) * knowledge of chess in general	69	86,3%	11	13,8%	80	100,0%
mark in home language in term 3 2015 (percentage points) * knowledge of chess in general	68	85,0%	12	15,0%	80	100,0%
mark in first additional language in term 3 2015 (percentage points) * knowledge of chess in general	69	86,3%	11	13,8%	80	100,0%

mark in mathematics in term 3 2015 (percentage points) * knowledge of chess in general	69	86,3%	11	13,8%	80	100,0%
mark in life skills/orientation in term 3 2015 (percentage points) * knowledge of chess in general	69	86,3%	11	13,8%	80	100,0%

Report

knowledge of chess in general		average mark in term 3 2015 (percentage points)	mark in home language in term 3 2015 (percentage points)	mark in first additional language in term 3 2015 (percentage points)	mark in mathematics in term 3 2015 (percentage points)	mark in life skills/orientation in term 3 2015 (percentage points)
no	Mean	71,06	77,19	70,38	69,50	72,44
	N	16	16	16	16	16
	Std. Deviation	11,000	12,183	15,192	14,455	18,103
yes	Mean	68,08	70,13	67,45	65,08	70,13
	N	53	52	53	53	53
	Std. Deviation	12,394	12,460	14,631	16,709	15,904
Total	Mean	68,77	71,79	68,13	66,10	70,67
	N	69	68	69	69	69
	Std. Deviation	12,073	12,669	14,702	16,221	16,330

```
MEANS TABLES=T3_average_mark T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO BY
chess_home_total
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
average mark in term 3 2015 (percentage points) * students playing chess at home (all students)	80	100,0%	0	0,0%	80	100,0%
mark in home language in term 3 2015 (percentage points) * students playing chess at home (all students)	79	98,8%	1	1,3%	80	100,0%

mark in first additional language in term 3 2015 (percentage points) * students playing chess at home (all students)	80	100,0%	0	0,0%	80	100,0%
mark in mathematics in term 3 2015 (percentage points) * students playing chess at home (all students)	80	100,0%	0	0,0%	80	100,0%
mark in life skills/orientation in term 3 2015 (percentage points) * students playing chess at home (all students)	80	100,0%	0	0,0%	80	100,0%

Report

students playing chess at home (all students)		average mark in term 3 2015 (percentage points)	mark in home language in term 3 2015 (percentage points)	mark in first additional language in term 3 2015 (percentage points)	mark in mathematics in term 3 2015 (percentage points)	mark in life skills/orientation in term 3 2015 (percentage points)
no	Mean	68,39	72,18	68,59	66,63	68,12
	N	41	40	41	41	41
	Std. Deviation	11,899	13,765	14,474	17,136	15,978
yes	Mean	69,10	70,41	68,15	66,18	72,41
	N	39	39	39	39	39
	Std. Deviation	12,253	12,158	15,478	15,967	15,057
Total	Mean	68,74	71,30	68,38	66,41	70,21
	N	80	79	80	80	80
	Std. Deviation	12,002	12,944	14,878	16,473	15,588

```
FREQUENCIES VARIABLES=chess_knowledge
  /STATISTICS=STDDEV MINIMUM MAXIMUM MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Statistics

knowledge of chess in general

N	Valid	69
	Missing	11
Mean		,77
Median		1,00
Mode		1

Std. Deviation	,425
Minimum	0
Maximum	1

knowledge of chess in general

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	16	20,0	23,2	23,2
	yes	53	66,3	76,8	100,0
	Total	69	86,3	100,0	
Missing	999	11	13,8		
Total		80	100,0		

```
EXAMINE VARIABLES=mean_N score_C_N score_S_N score_A_N
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
mean of N scores	80	100,0%	0	0,0%	80	100,0%
N score of Categories subtest	80	100,0%	0	0,0%	80	100,0%
N score of Situations subtest	80	100,0%	0	0,0%	80	100,0%
N score of Analogies subtest	80	100,0%	0	0,0%	80	100,0%

Descriptives

			Statistic	Std. Error
mean of N scores	Mean		73,29	1,373
	95% Confidence Interval for Mean	Lower Bound	70,55	
		Upper Bound	76,02	
	5% Trimmed Mean		72,72	
	Median		71,00	
	Variance		150,840	
	Std. Deviation		12,282	
	Minimum		50	
	Maximum		112	

	Range		62	
	Interquartile Range		17	
	Skewness		,651	,269
	Kurtosis		,508	,532
N score of Categories subtest	Mean		77,00	1,847
	95% Confidence Interval for Mean	Lower Bound	73,32	
		Upper Bound	80,68	
	5% Trimmed Mean		76,57	
	Median		76,00	
	Variance		272,835	
	Std. Deviation		16,518	
	Minimum		47	
	Maximum		123	
	Range		76	
	Interquartile Range		22	
	Skewness		,374	,269
	Kurtosis		-,179	,532
N score of Situations subtest	Mean		63,14	1,826
	95% Confidence Interval for Mean	Lower Bound	59,50	
		Upper Bound	66,77	
	5% Trimmed Mean		62,03	
	Median		58,50	
	Variance		266,854	
	Std. Deviation		16,336	
	Minimum		45	
	Maximum		111	
	Range		66	
	Interquartile Range		26	
	Skewness		,812	,269
	Kurtosis		-,112	,532
N score of Analogies subtest	Mean		79,86	1,718
	95% Confidence Interval for Mean	Lower Bound	76,44	
		Upper Bound	83,28	
	5% Trimmed Mean		79,69	
	Median		81,00	
	Variance		236,221	
	Std. Deviation		15,369	
	Minimum		49	
	Maximum		125	

	Range	76	
	Interquartile Range	19	
	Skewness	,174	,269
	Kurtosis	-,074	,532

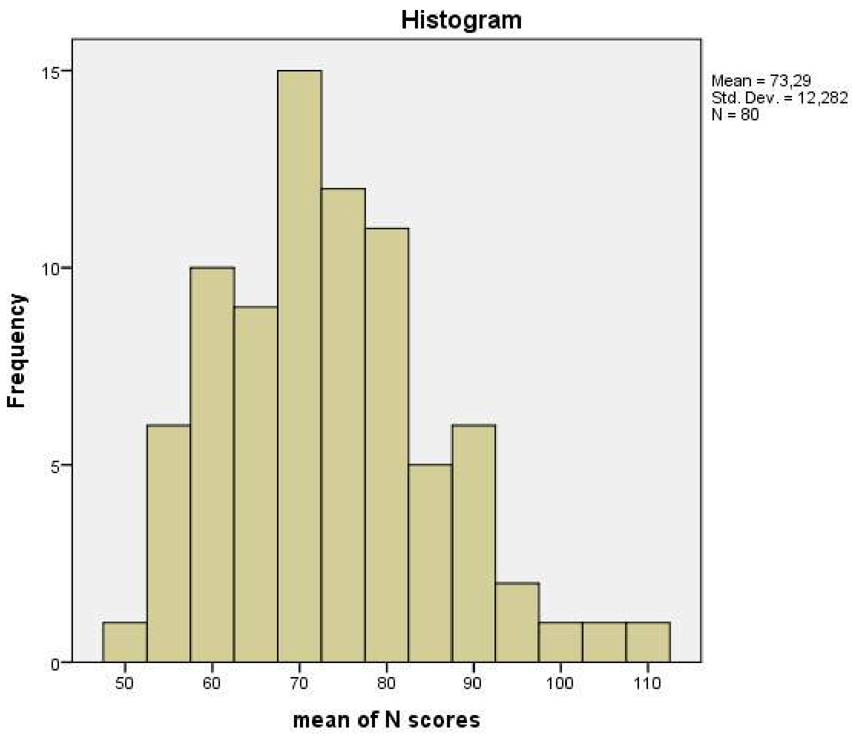
Tests of Normality

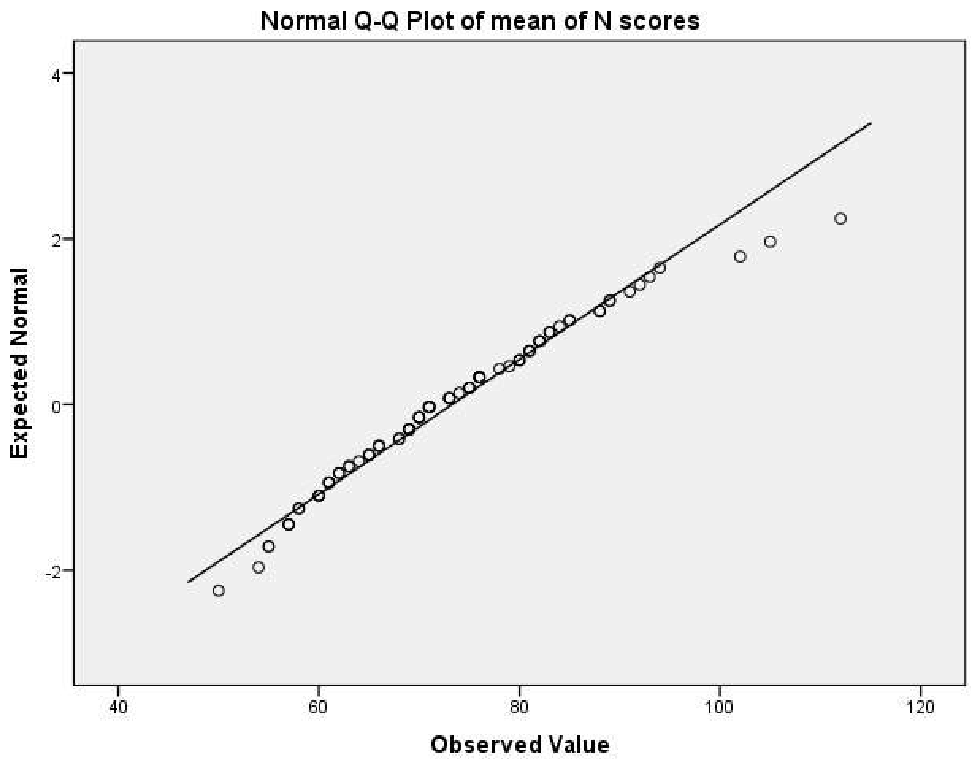
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
mean of N scores	,086	80	,200*	,971	80	,066
N score of Categories subtest	,074	80	,200*	,983	80	,385
N score of Situations subtest	,134	80	,001	,903	80	,000
N score of Analogies subtest	,067	80	,200*	,983	80	,383

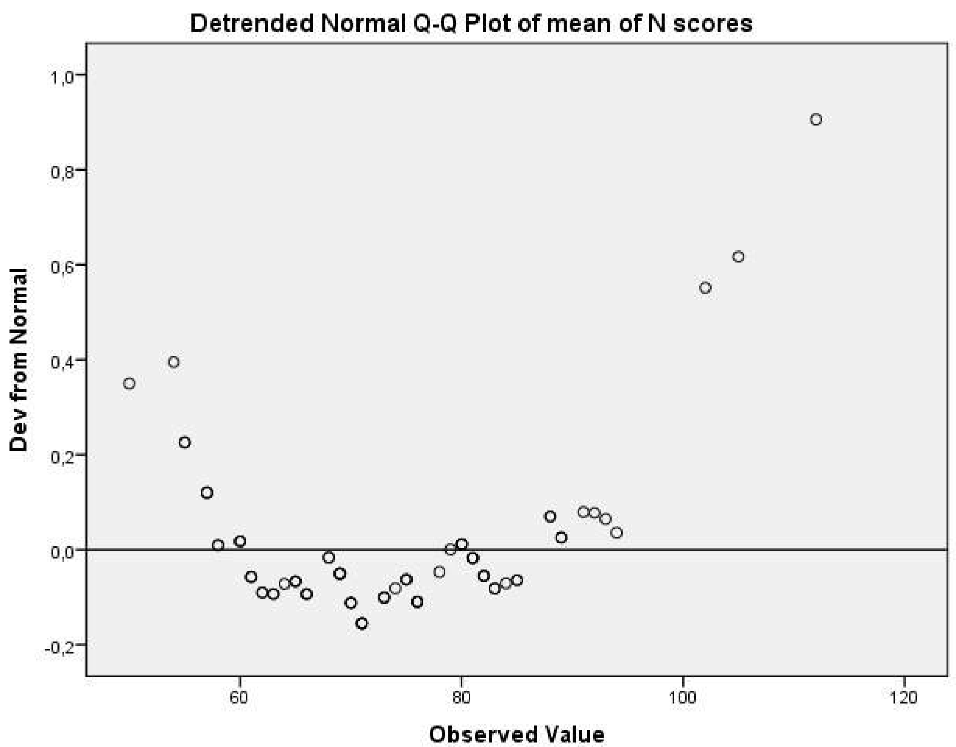
*. This is a lower bound of the true significance.

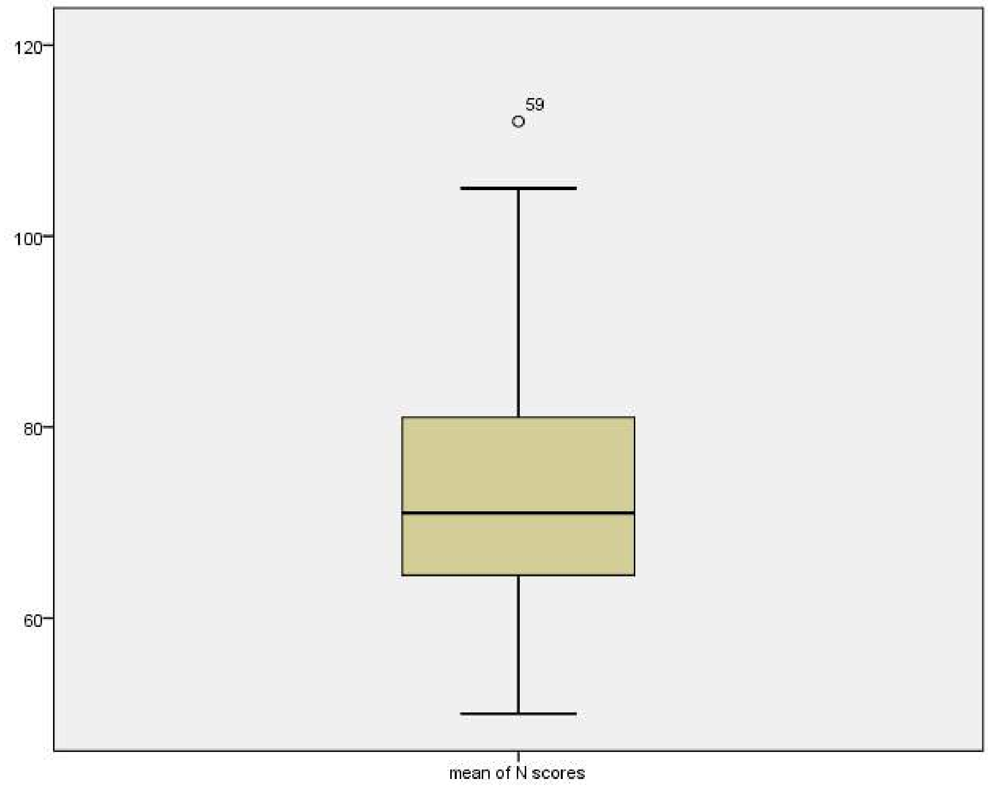
a. Lilliefors Significance Correction

mean of N scores

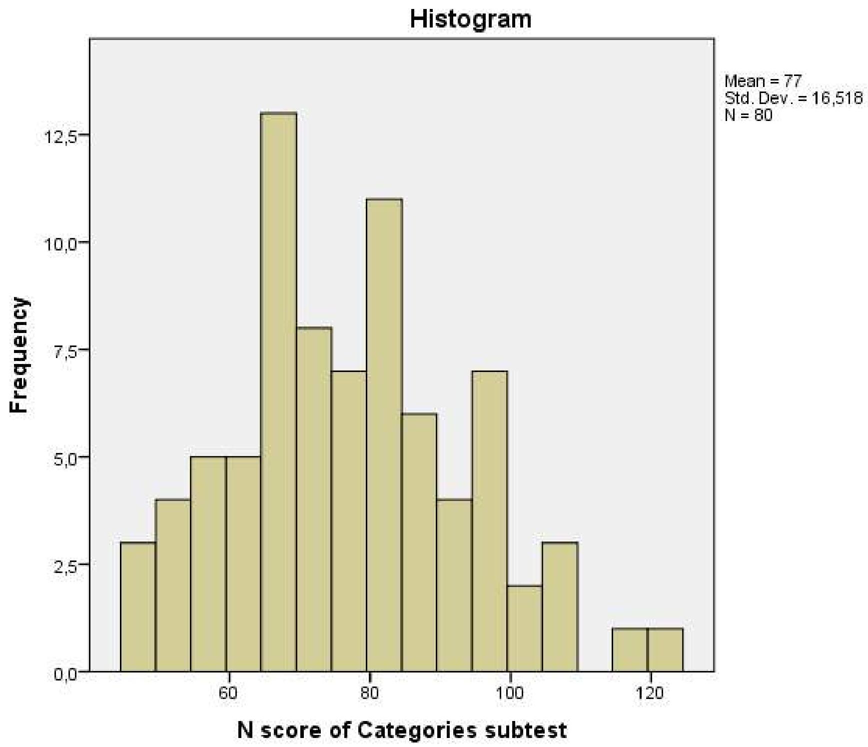


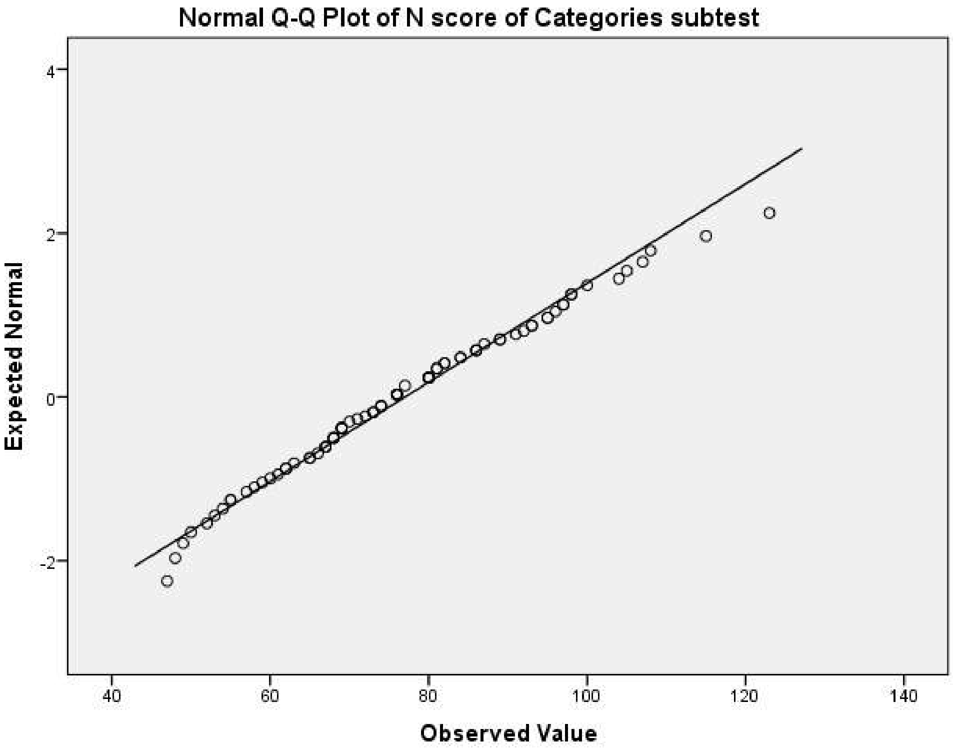

Normal Q-Q Plot of mean of N scores
Expected Normal
Observed Value
4
2
0
-2
40
60
80
100
120

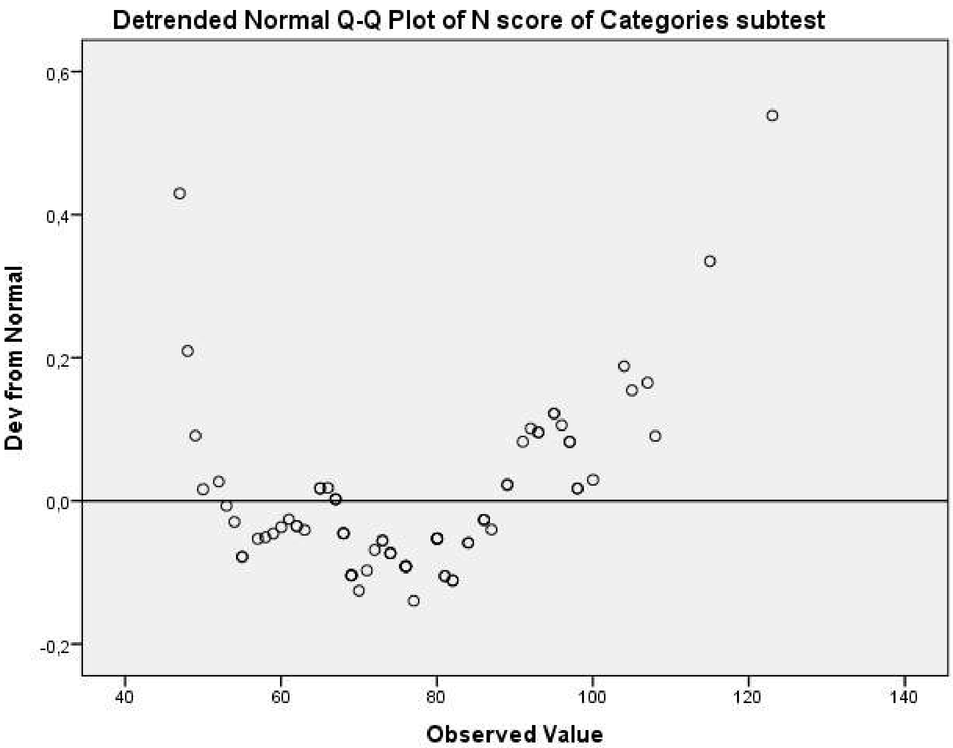

Detrended Normal Q-Q Plot of mean of N scores
Dev from Normal
Observed Value
1,0
0,8
0,6
0,4
0,2
0,0
-0,2
60
80
100
120

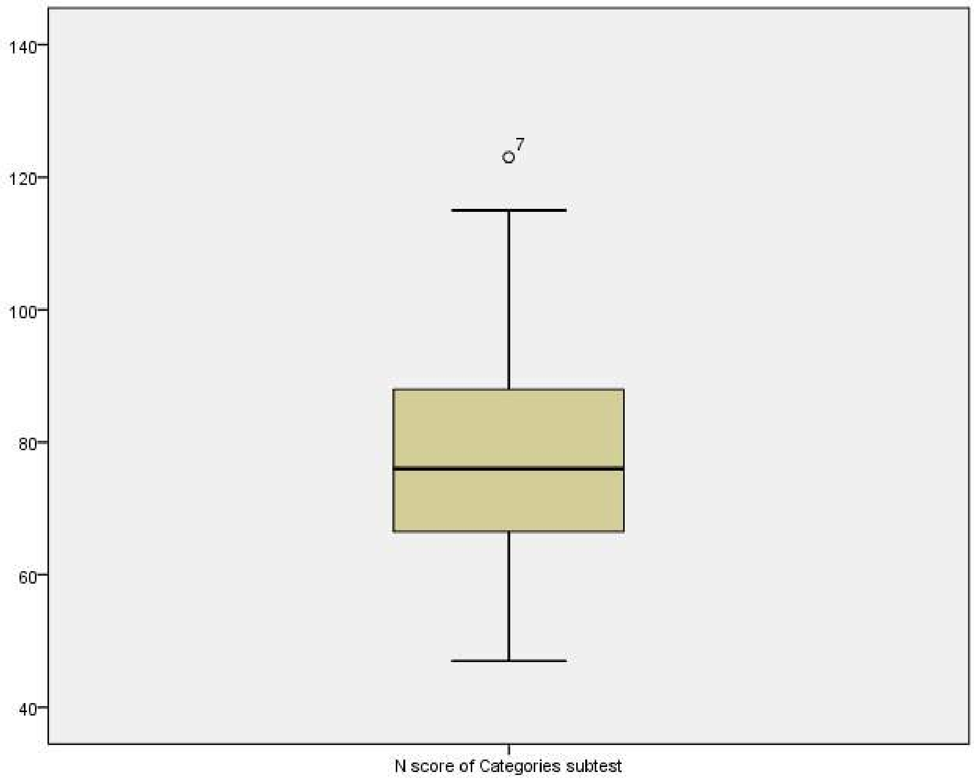


N score of Categories subtest

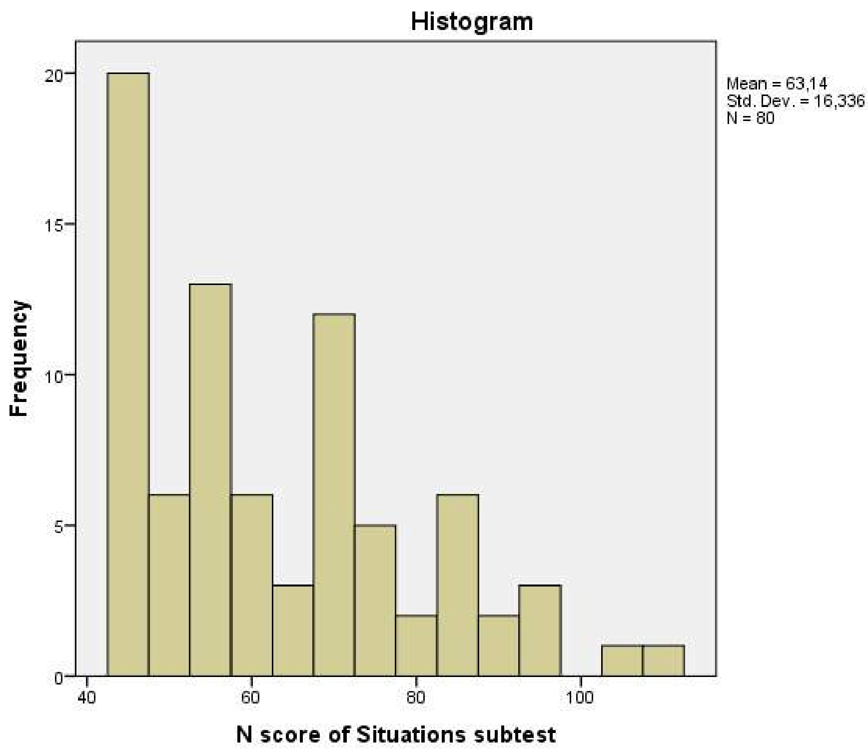


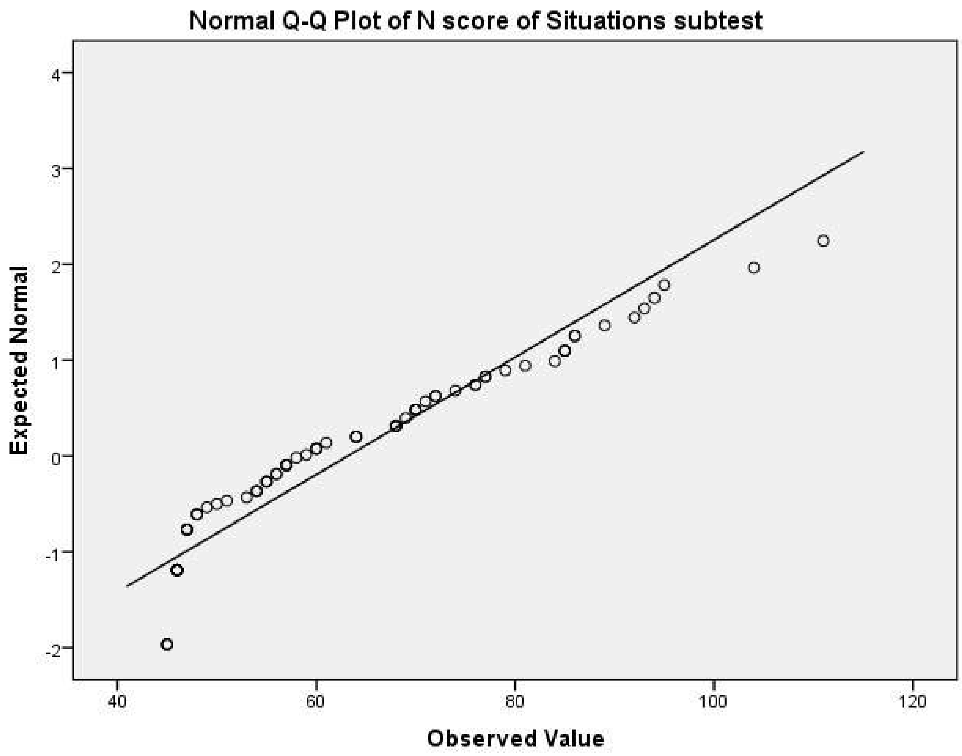

Normal Q-Q Plot of N score of Categories subtest
Expected Normal
4
2
0
-2
40
60
80
100
120
140
Observed Value

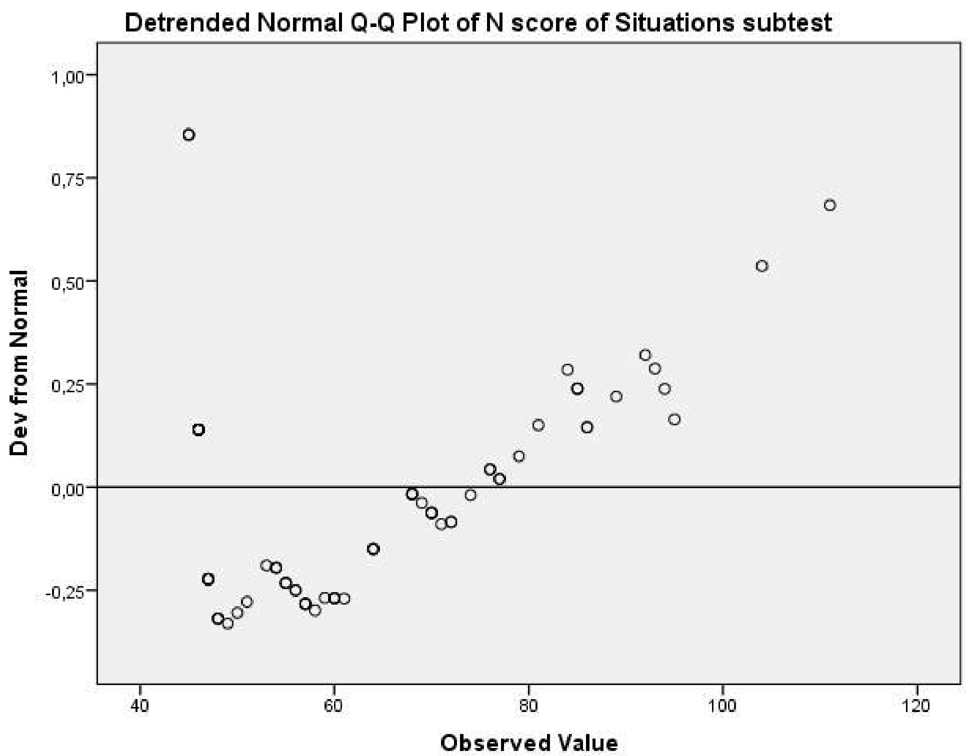

Detrended Normal Q-Q Plot of N score of Categories subtest
Dev from Normal
0,6
0,4
0,2
0,0
-0,2
40
60
80
100
120
140
Observed Value

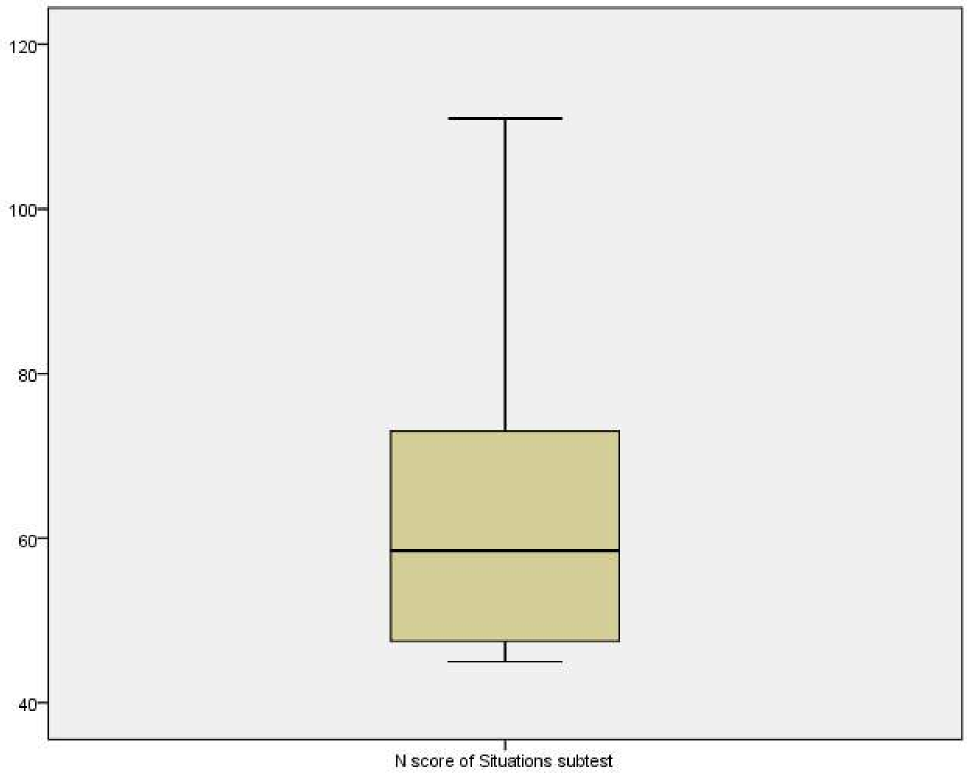


N score of Situations subtest

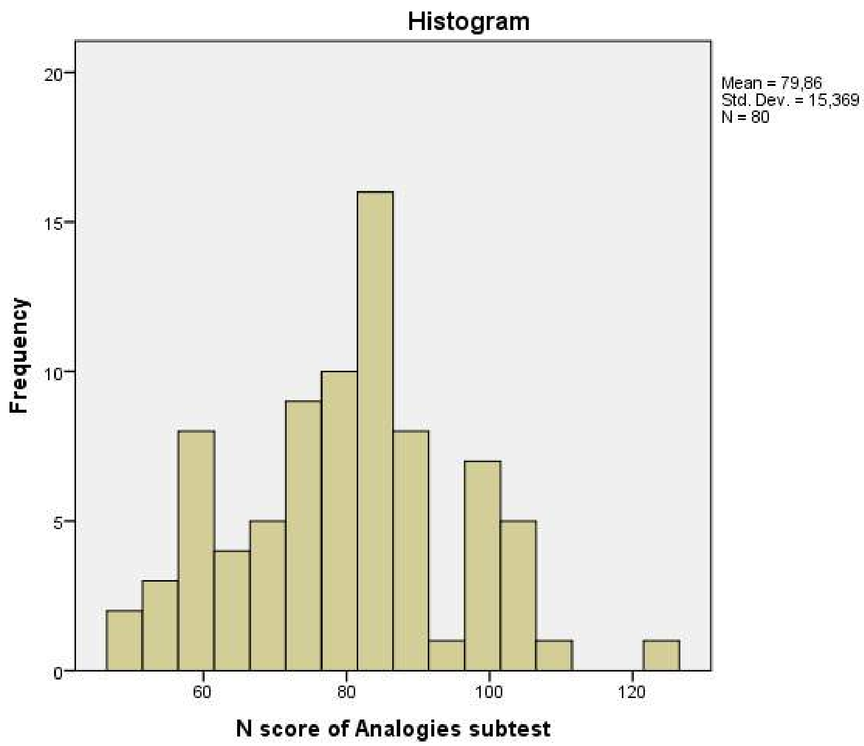


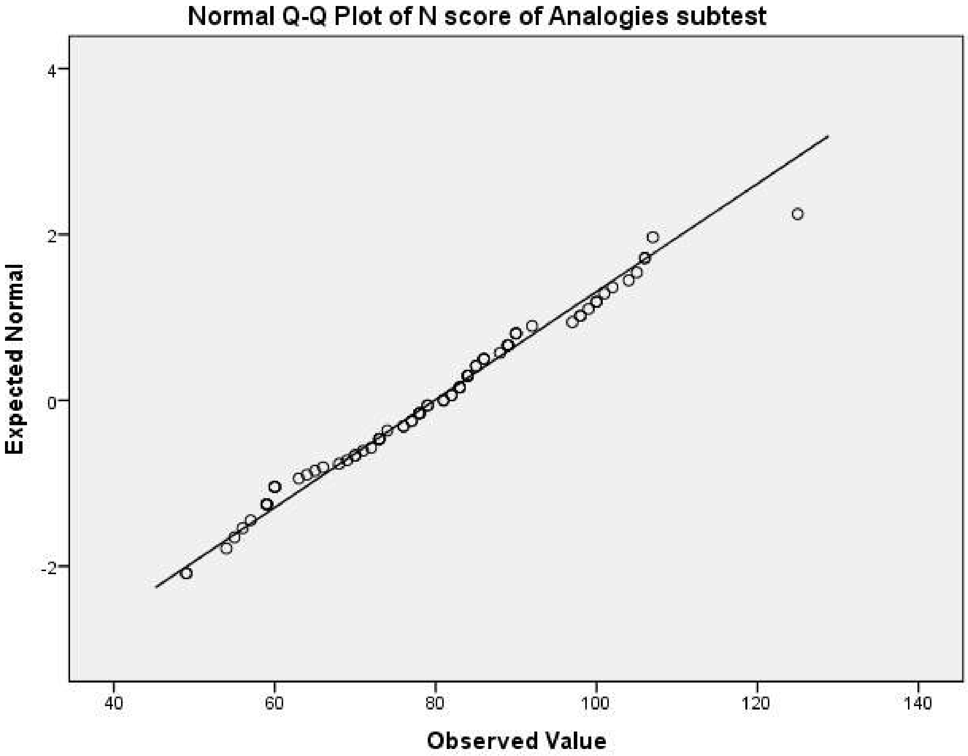

Normal Q-Q Plot of N score of Situations subtest
Expected Normal
Observed Value
4
3
2
1
0
-1
-2
40
60
80
100
120

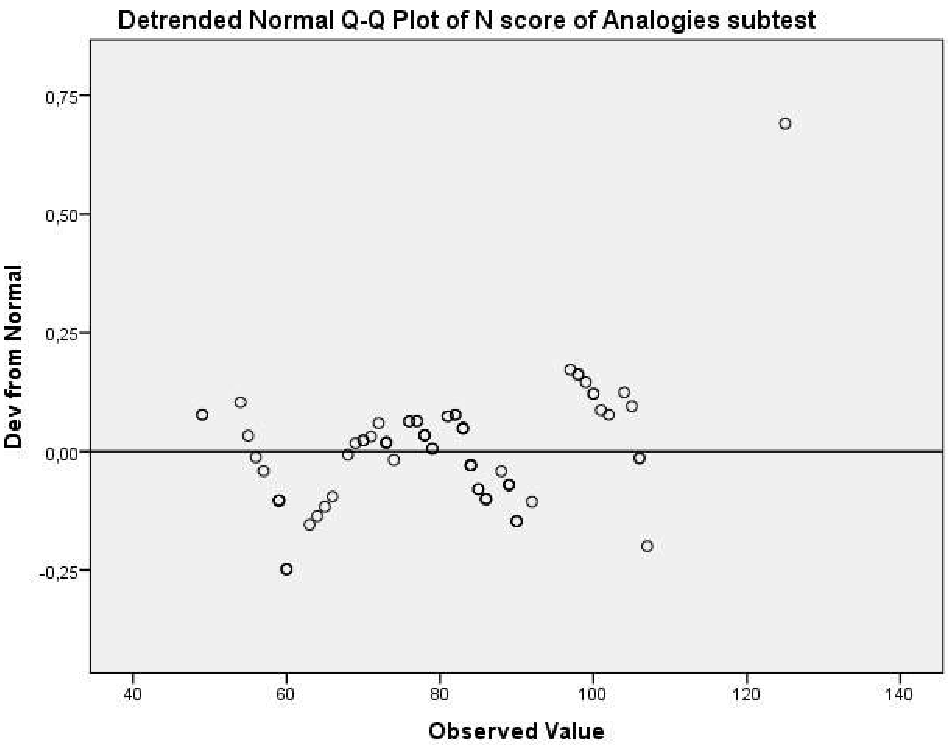

Detrended Normal Q-Q Plot of N score of Situations subtest
Dev from Normal
Observed Value
1,00
0,75
0,50
0,25
0,00
-0,25
40
60
80
100
120

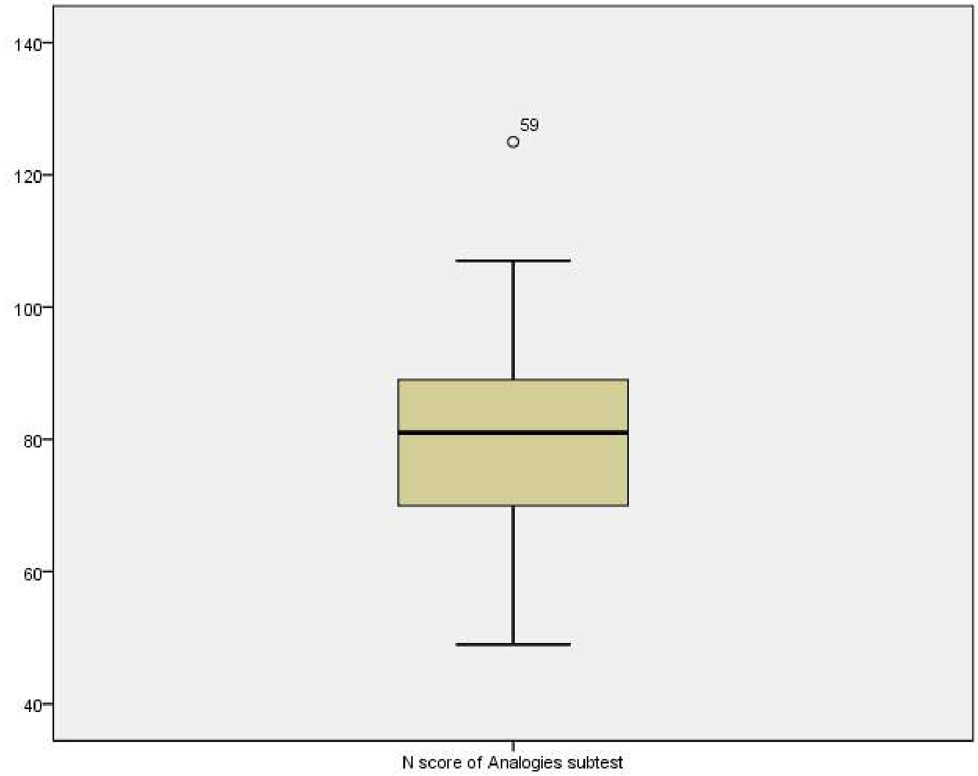


N score of Analogies subtest




Normal Q-Q Plot of N score of Analogies subtest
Expected Normal
4
2
0
-2
40
60
80
100
120
140
Observed Value


Detrended Normal Q-Q Plot of N score of Analogies subtest
Dev from Normal
0,75
0,50
0,25
0,00
-0,25
40
60
80
100
120
140
Observed Value




```
EXAMINE VARIABLES=T3_average_mark T3_FAL_mark T3_M_mark T3_LSorLO
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
average mark in term 3 2015 (percentage points)	80	100,0%	0	0,0%	80	100,0%
mark in first additional language in term 3 2015 (percentage points)	80	100,0%	0	0,0%	80	100,0%
mark in mathematics in term 3 2015 (percentage points)	80	100,0%	0	0,0%	80	100,0%
mark in life skills/orientation in term 3 2015 (percentage points)	80	100,0%	0	0,0%	80	100,0%

Descriptives

	Statistic	Std. Error

average mark in term 3 2015 (percentage points)	Mean		68,74	1,342
	95% Confidence Interval for Mean	Lower Bound	66,07	
		Upper Bound	71,41	
	5% Trimmed Mean		68,74	
	Median		68,00	
	Variance		144,044	
	Std. Deviation		12,002	
	Minimum		46	
	Maximum		93	
	Range		47	
	Interquartile Range		19	
	Skewness		,098	,269
	Kurtosis		-,910	,532
mark in first additional language in term 3 2015 (percentage points)	Mean		68,38	1,663
	95% Confidence Interval for Mean	Lower Bound	65,06	
		Upper Bound	71,69	
	5% Trimmed Mean		68,18	
	Median		70,00	
	Variance		221,351	
	Std. Deviation		14,878	
	Minimum		43	
	Maximum		99	
	Range		56	
	Interquartile Range		25	
	Skewness		,092	,269
	Kurtosis		-1,013	,532
mark in mathematics in term 3 2015 (percentage points)	Mean		66,41	1,842
	95% Confidence Interval for Mean	Lower Bound	62,75	
		Upper Bound	70,08	
	5% Trimmed Mean		66,11	
	Median		65,50	
	Variance		271,359	
	Std. Deviation		16,473	
	Minimum		41	
	Maximum		98	
	Range		57	
	Interquartile Range		27	
	Skewness		,255	,269
	Kurtosis		-,990	,532
	Mean		70,21	1,743

mark in life skills/orientation in term 3 2015 (percentage points)	95% Confidence Interval for Mean	Lower Bound	66,74	
		Upper Bound	73,68	
	5% Trimmed Mean		71,24	
	Median		71,00	
	Variance		242,980	
	Std. Deviation		15,588	
	Minimum		16	
	Maximum		98	
	Range		82	
	Interquartile Range		16	
	Skewness		-1,238	,269
	Kurtosis		3,136	,532

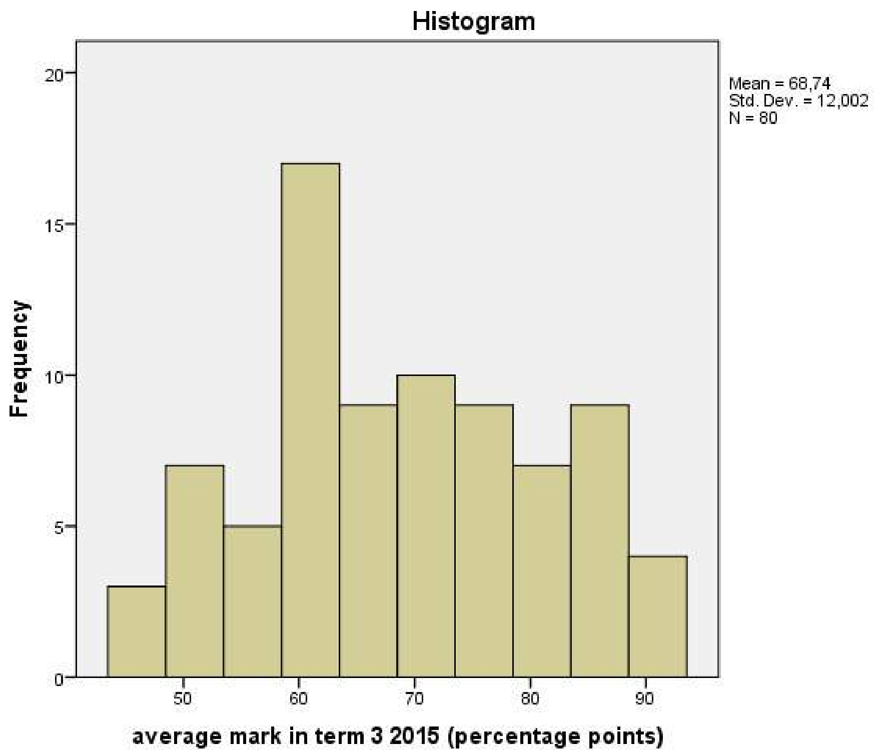
Tests of Normality

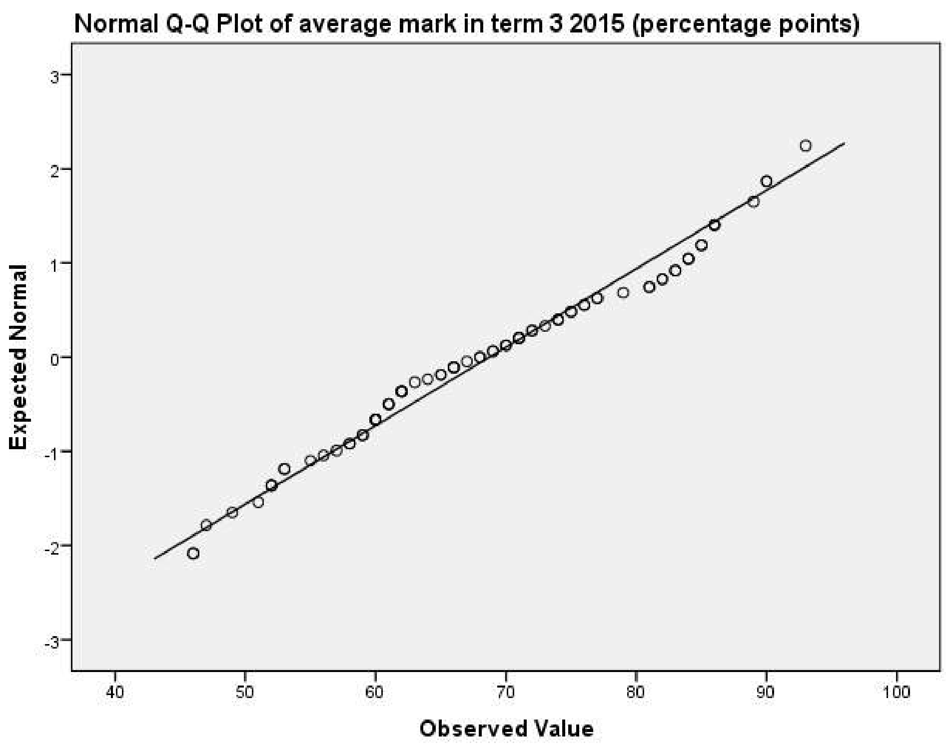
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
average mark in term 3 2015 (percentage points)	,100	80	,045	,971	80	,067
mark in first additional language in term 3 2015 (percentage points)	,090	80	,165	,964	80	,024
mark in mathematics in term 3 2015 (percentage points)	,075	80	,200*	,955	80	,007
mark in life skills/orientation in term 3 2015 (percentage points)	,131	80	,002	,909	80	,000

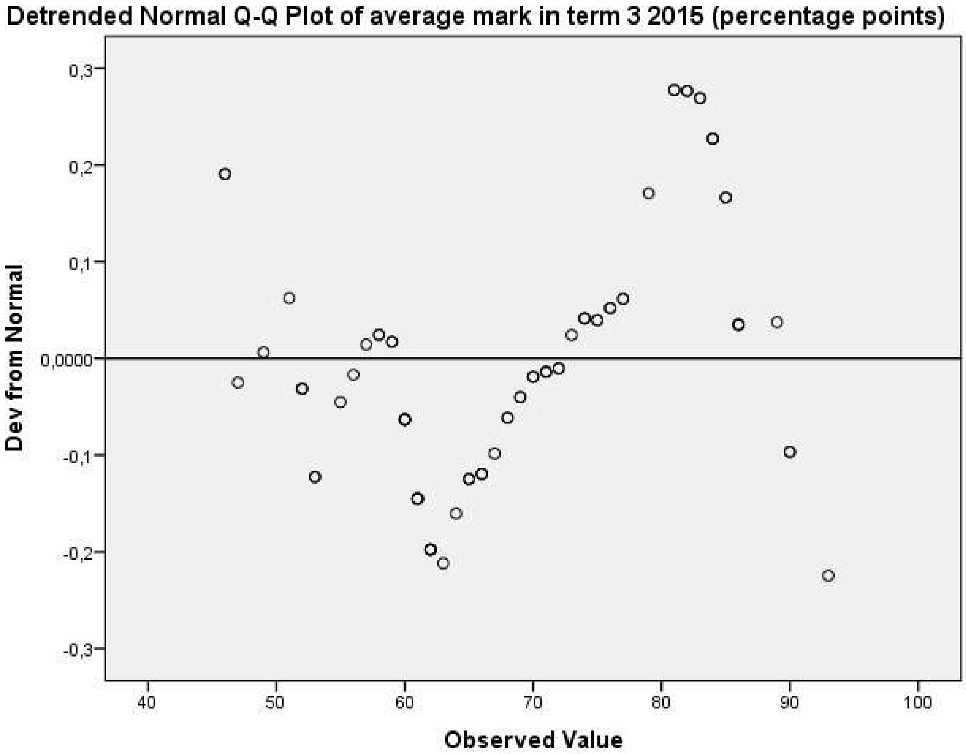
*. This is a lower bound of the true significance.

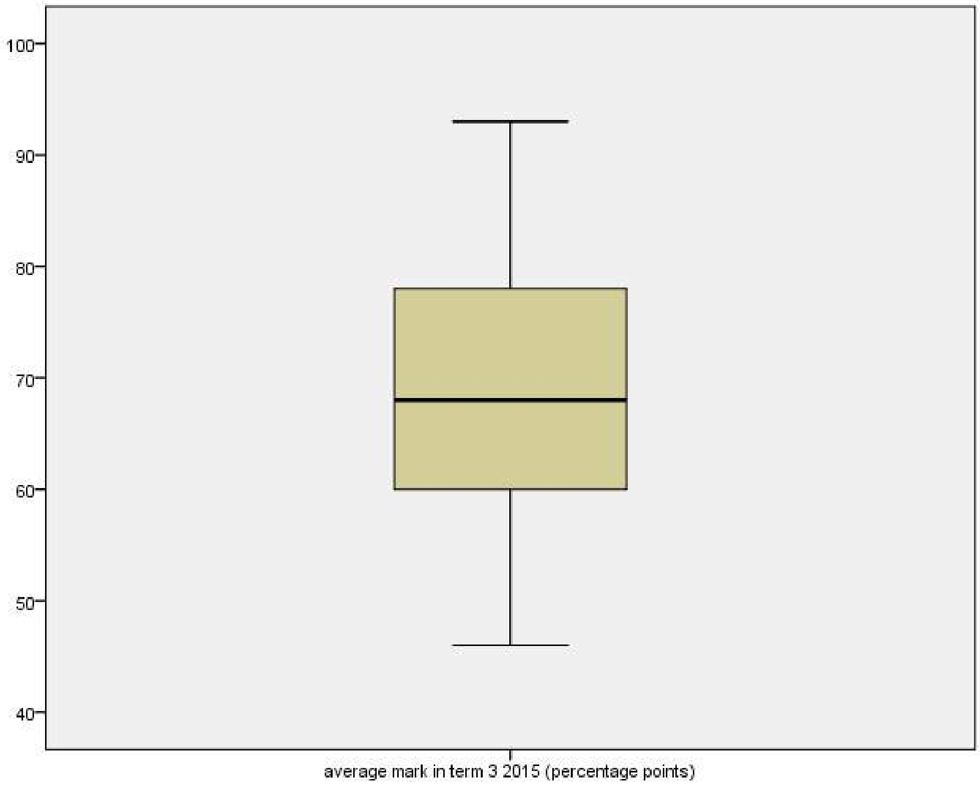
a. Lilliefors Significance Correction

average mark in term 3 2015 (percentage points)

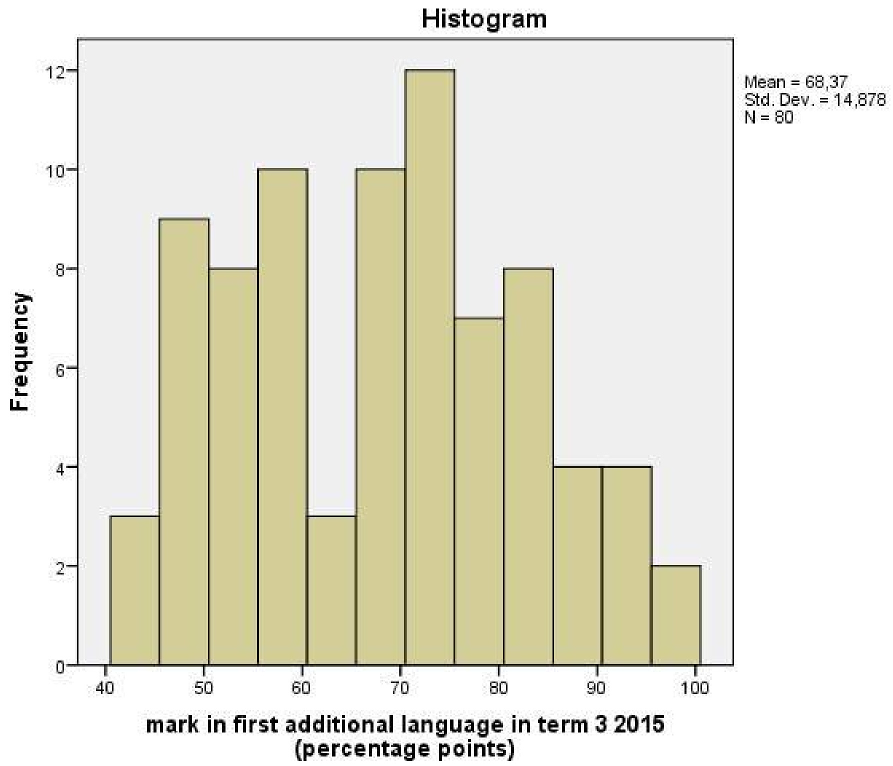


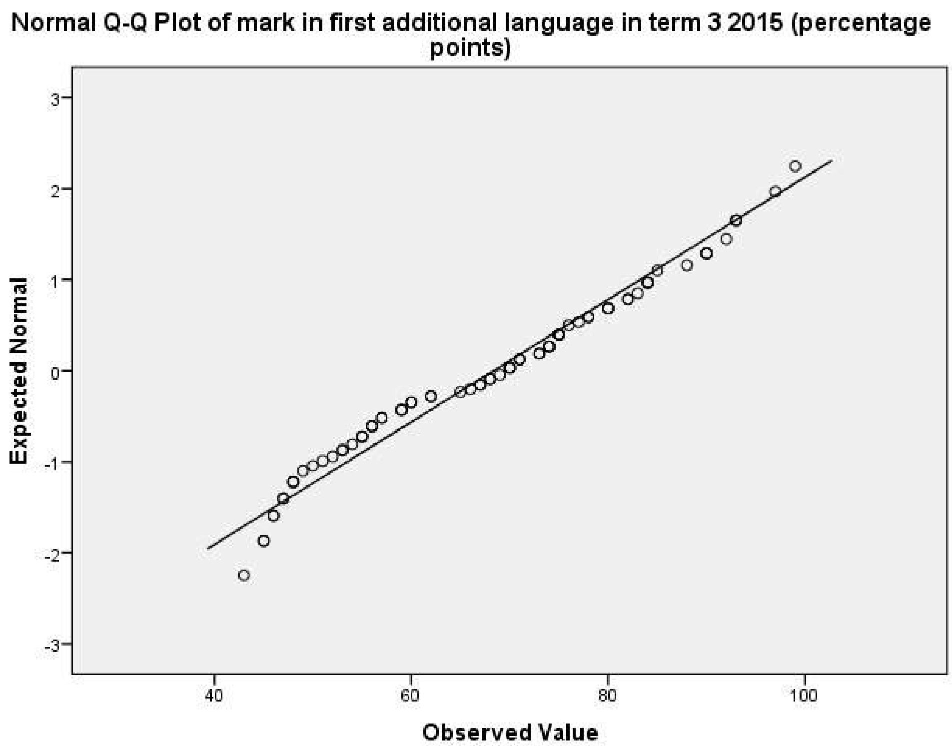


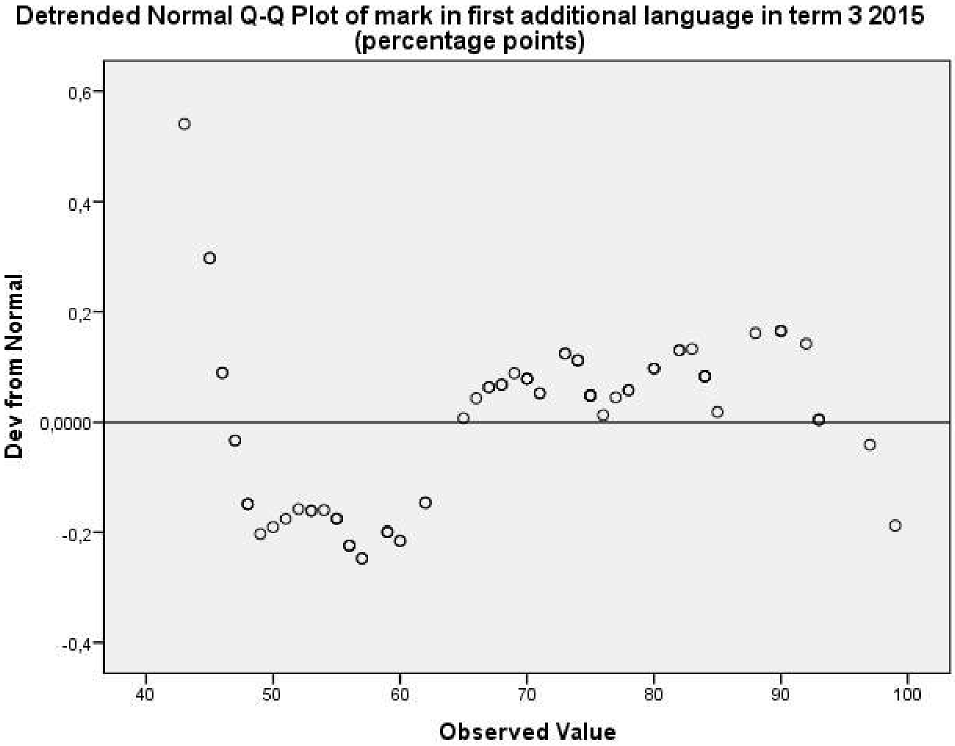

Detrended Normal Q-Q Plot of average mark in term 3 2015 (percentage points)
0,3
0,2
0,1
0,0000
-0,1
-0,2
-0,3
Dev from Normal
40
50
60
70
80
90
100
Observed Value

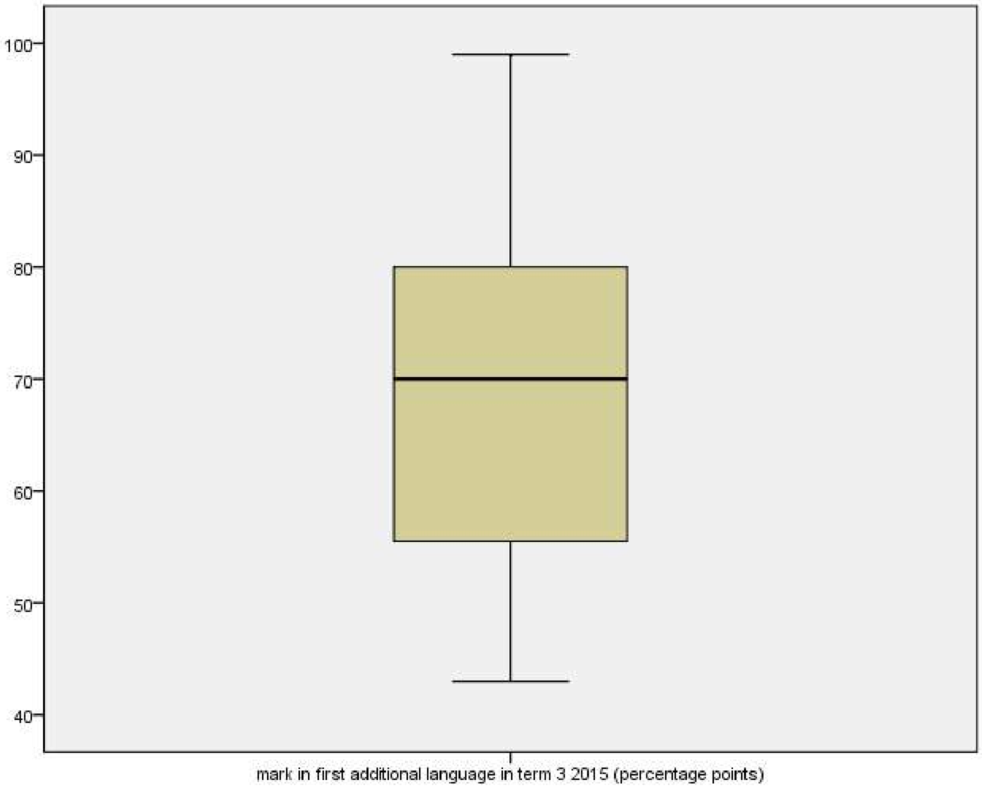

100
90
80
70
60
50
40
average mark in term 3 2015 (percentage points)

mark in first additional language in term 3 2015 (percentage points)

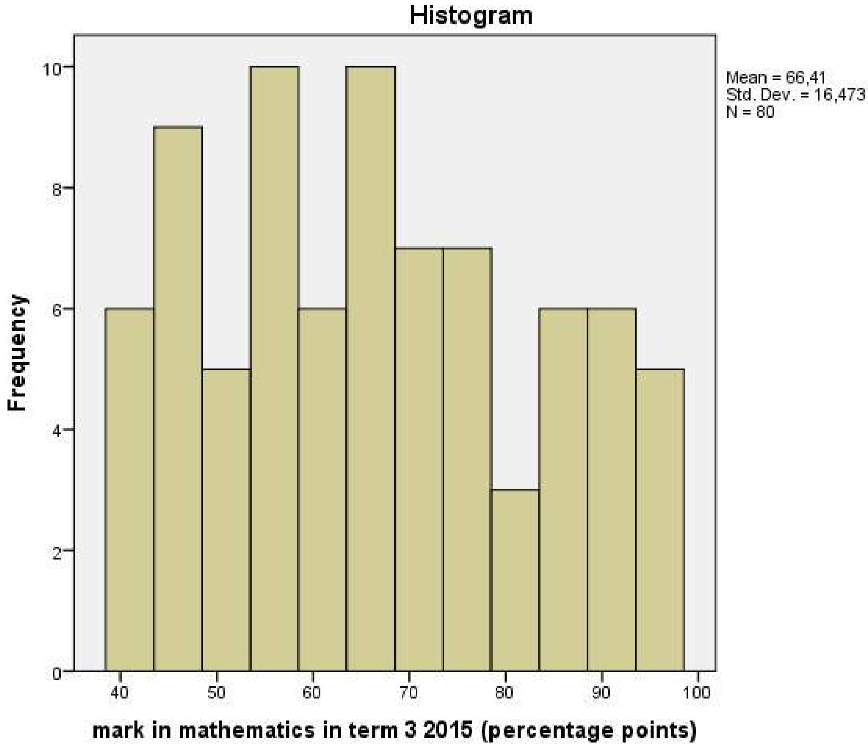


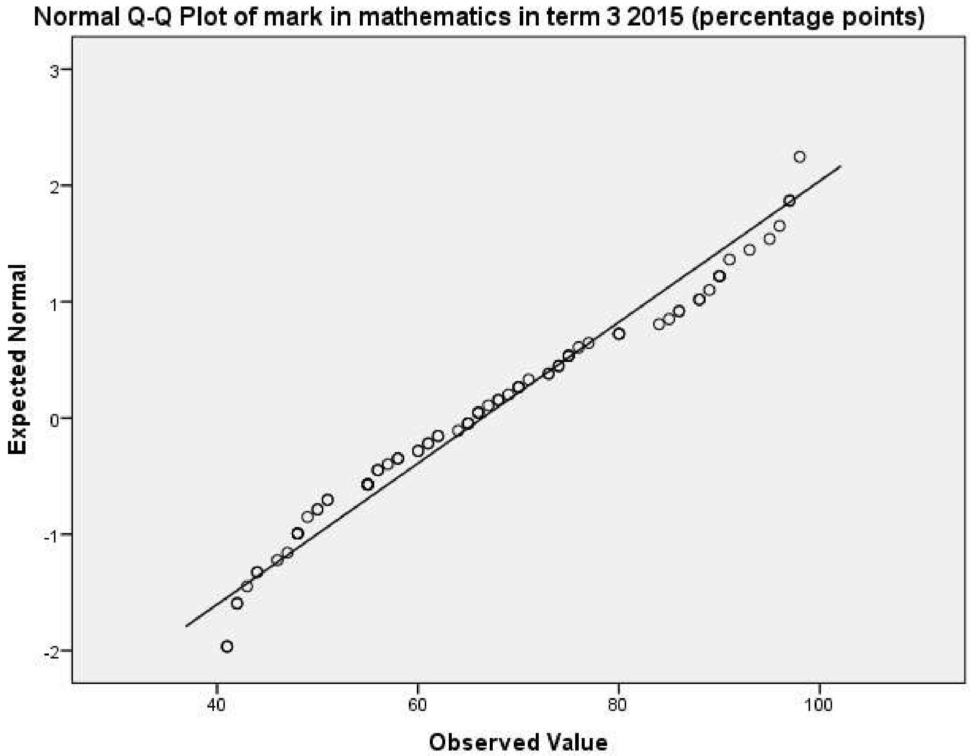



Detrended Normal Q-Q Plot of mark in first additional language in term 3 2015
(percentage points)
Dev from Normal
0,6
0,4
0,2
0,0000
-0,2
-0,4
40
50
60
70
80
90
100
Observed Value

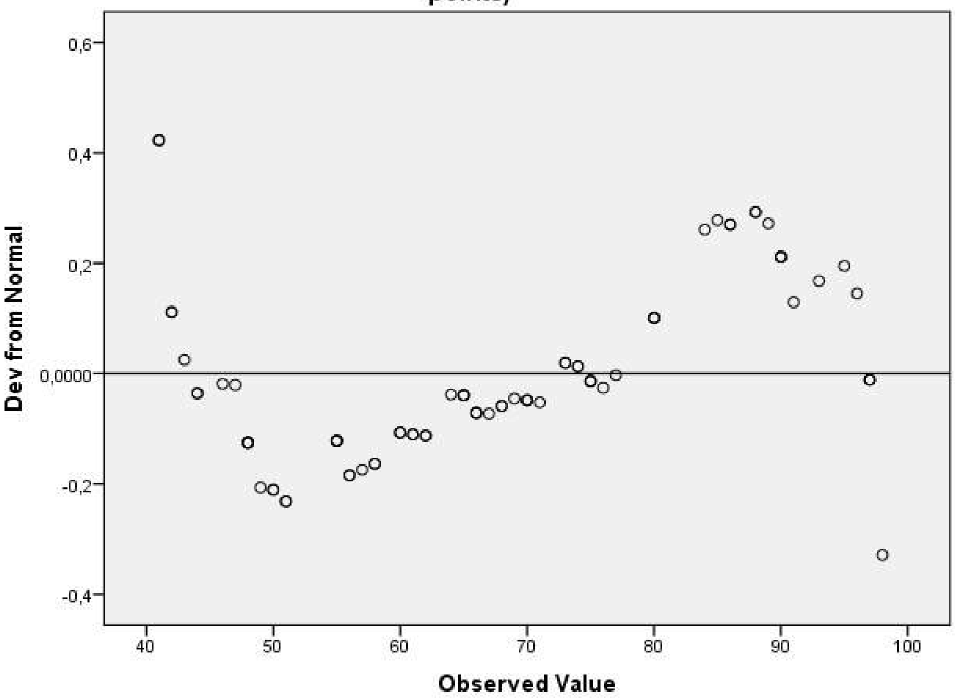

100
90
80
70
60
50
40
mark in first additional language in term 3 2015 (percentage points)

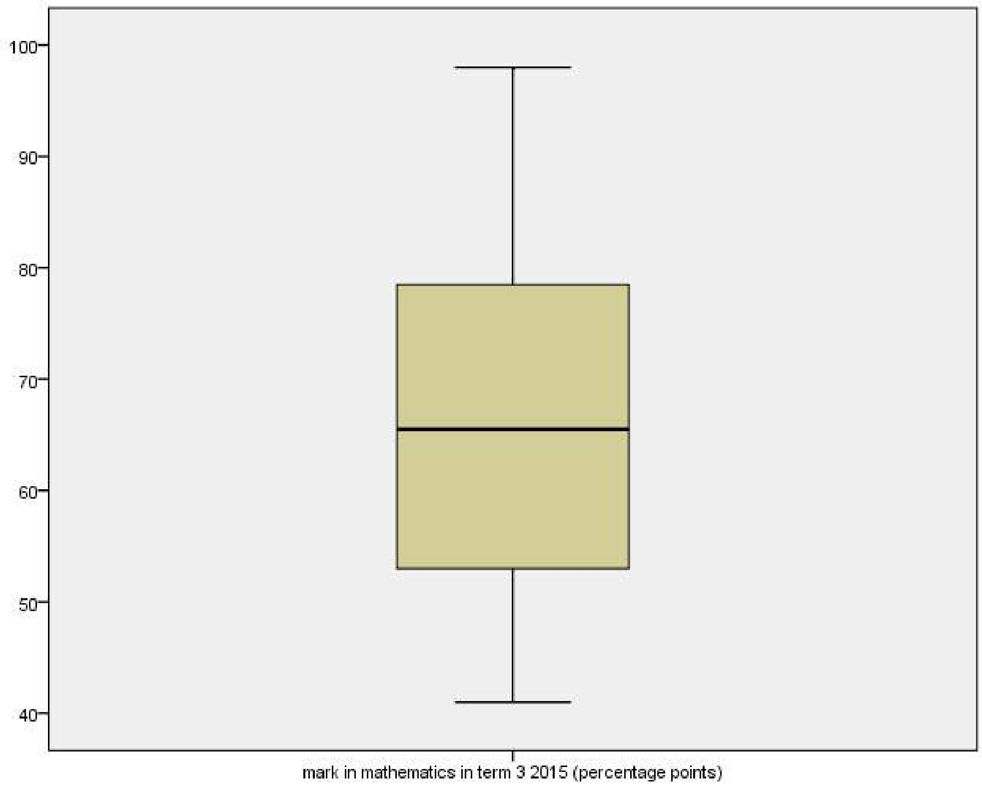
mark in mathematics in term 3 2015 (percentage points)



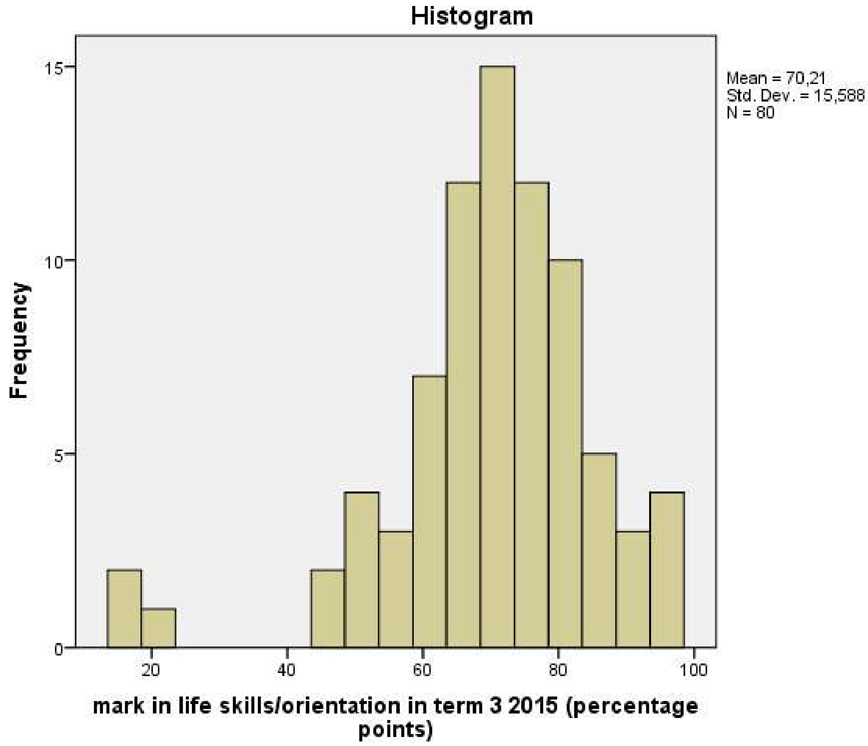


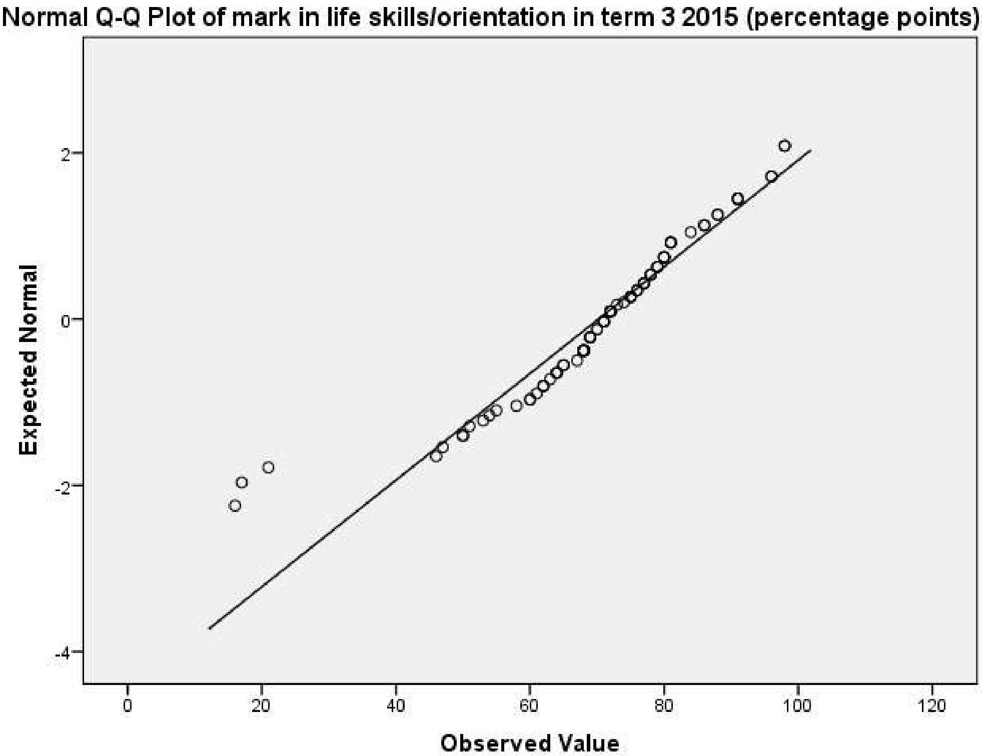
Detrended Normal Q-Q Plot of mark in mathematics in term 3 2015 (percentage points)

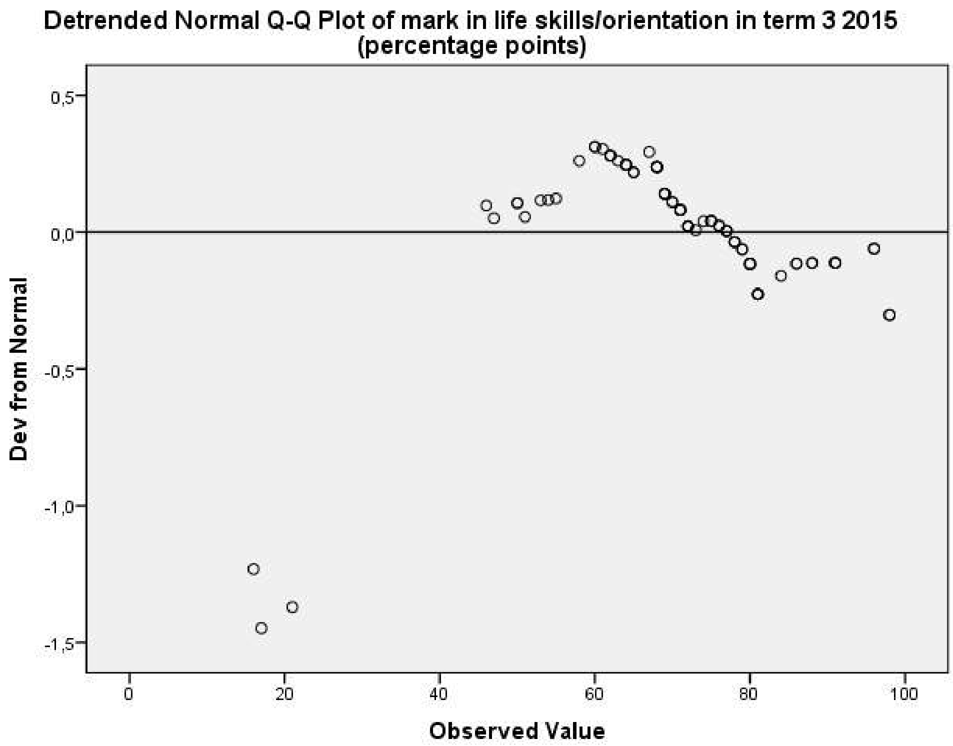


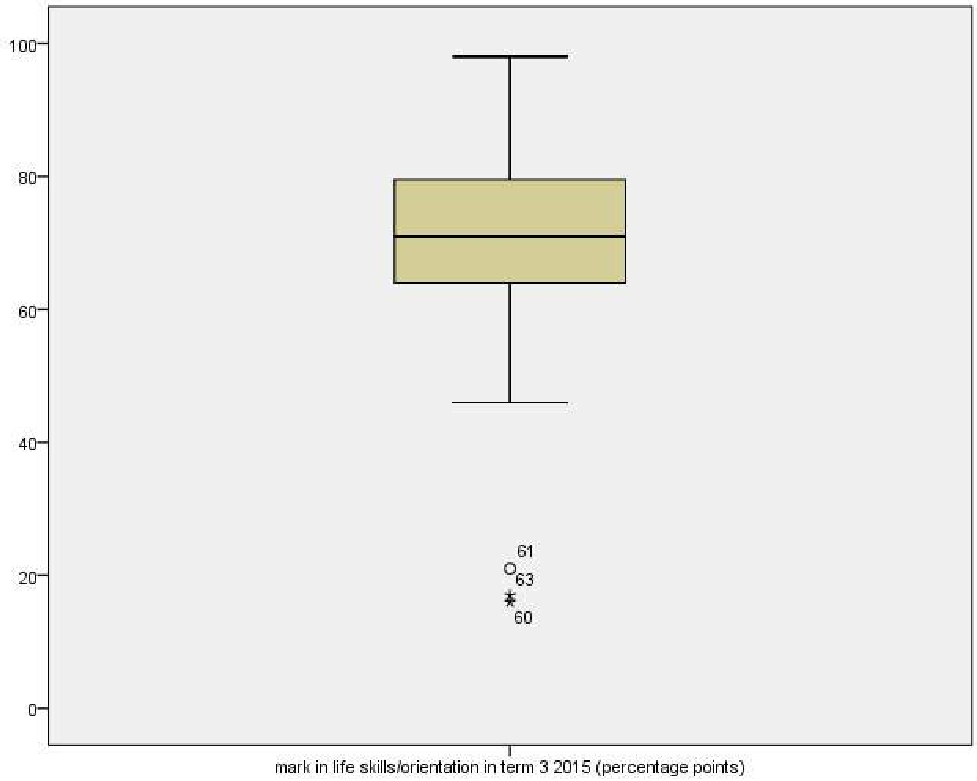


mark in life skills/orientation in term 3 2015 (percentage points)










```
EXAMINE VARIABLES=T3_HL_mark
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
mark in home language in term 3 2015 (percentage points)	79	98,8%	1	1,3%	80	100,0%

Descriptives

			Statistic	Std. Error
mark in home language in term 3 2015 (percentage points)	Mean		71,30	1,456
	95% Confidence Interval for Mean	Lower Bound	68,40	
		Upper Bound	74,20	
	5% Trimmed Mean		71,47	
	Median		70,00	
	Variance		167,548	
	Std. Deviation		12,944	
	Minimum		40	
	Maximum		95	
	Range		55	
	Interquartile Range		20	
	Skewness		-,044	,271
	Kurtosis		-,664	,535

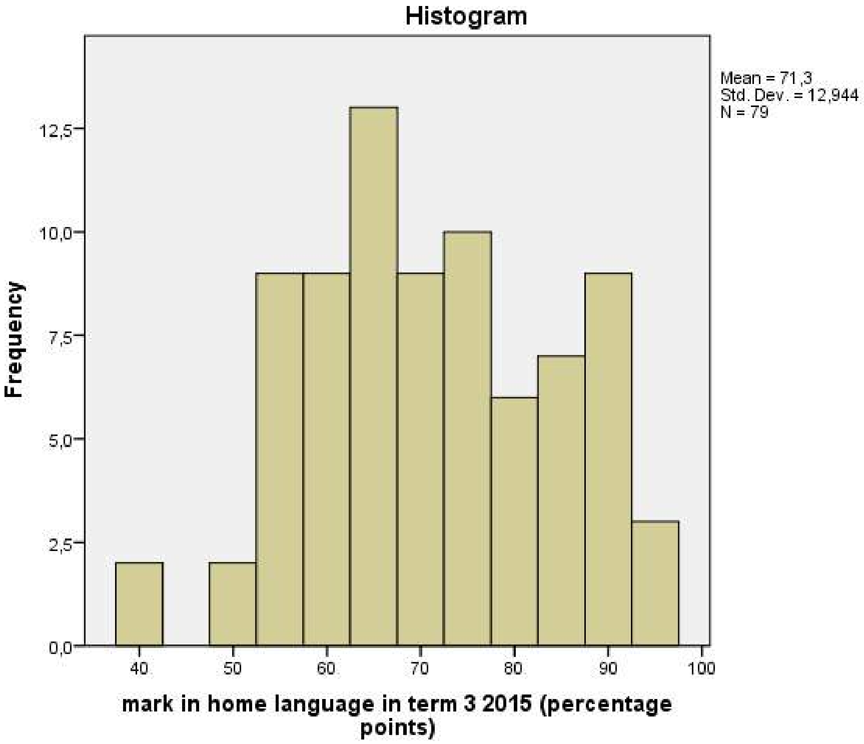
Tests of Normality

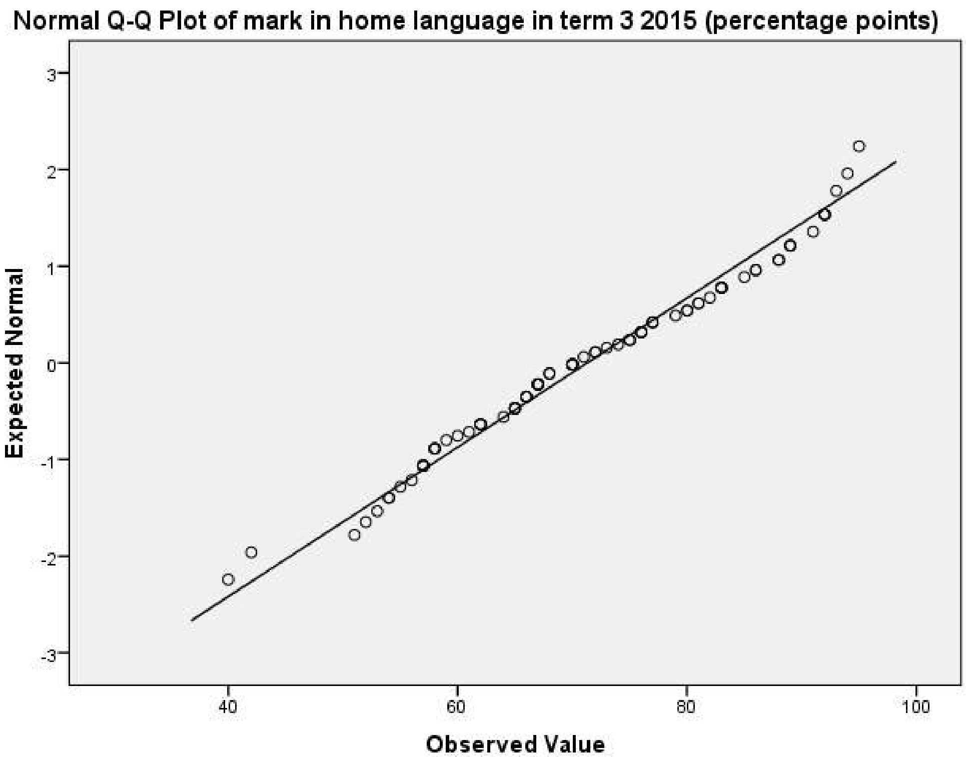
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
mark in home language in term 3 2015 (percentage points)	,073	79	,200*	,977	79	,173

*. This is a lower bound of the true significance.

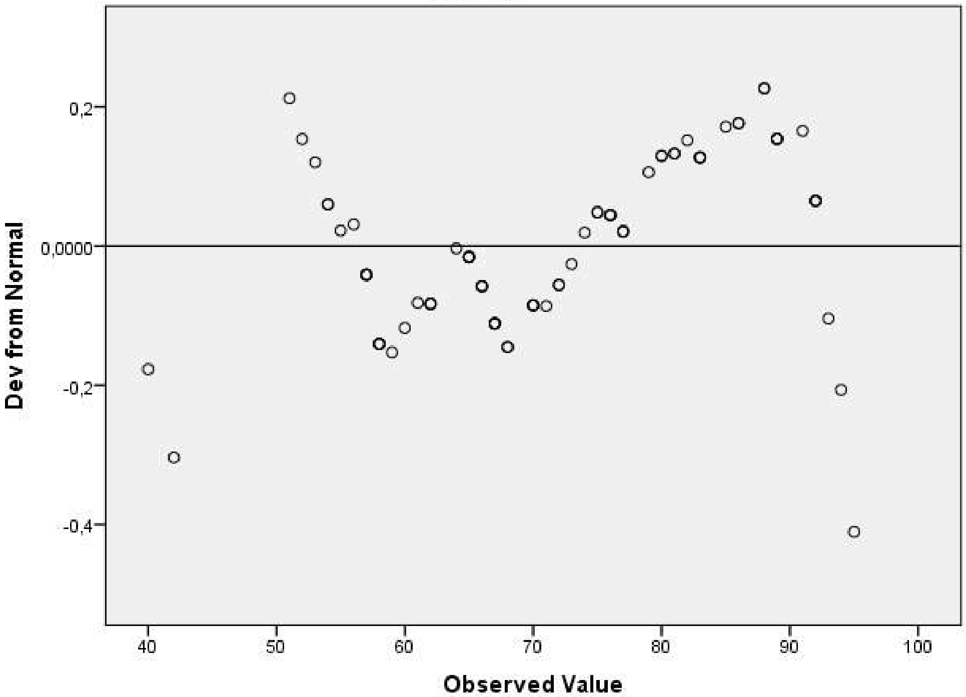
a. Lilliefors Significance Correction

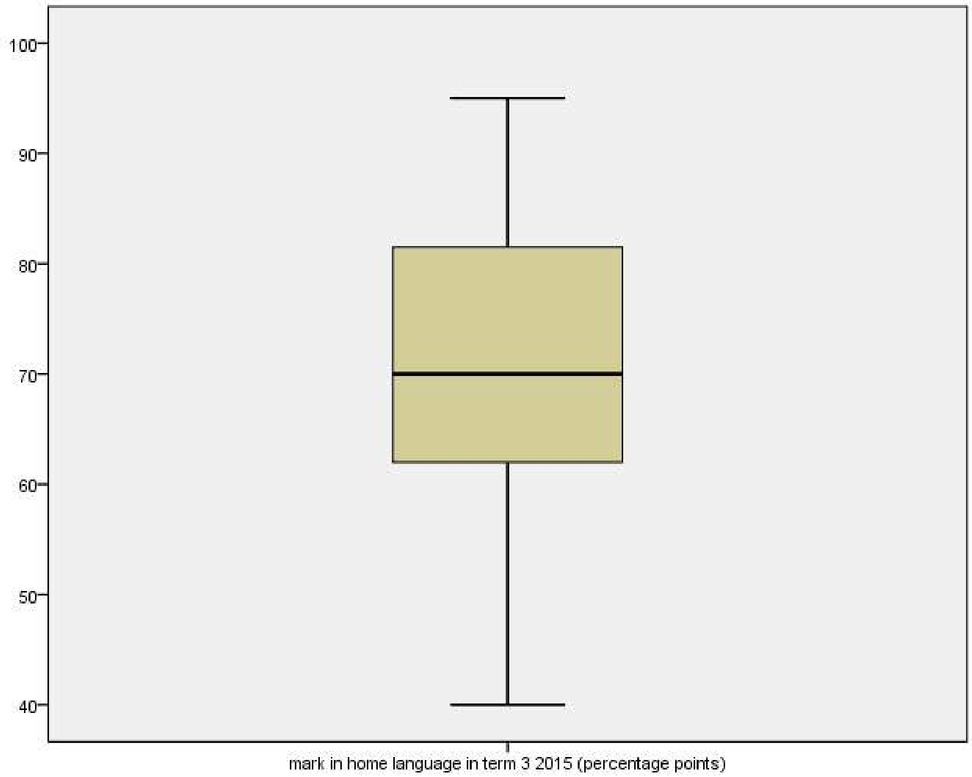
mark in home language in term 3 2015 (percentage points)





Detrended Normal Q-Q Plot of mark in home language in term 3 2015 (percentage points)





```
ONEWAY mean_N score_C_N score_A_N T3_average_mark T3_HL_mark BY NEW_group_3
  /STATISTICS HOMOGENEITY
  /MISSING ANALYSIS
  /POSTHOC=GABRIEL GT2 GH ALPHA(0.05).
```

Oneway

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
mean of N scores	,749	2	77	,476
N score of Categories subtest	,156	2	77	,855
N score of Analogies subtest	2,177	2	77	,120
average mark in term 3 2015 (percentage points)	,516	2	77	,599
mark in home language in term 3 2015 (percentage points)	,871	2	76	,423

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
mean of N scores	Between Groups	680,180	2	340,090	2,331	,104
	Within Groups	11236,207	77	145,925		
	Total	11916,387	79			
N score of Categories subtest	Between Groups	755,364	2	377,682	1,398	,253
	Within Groups	20798,636	77	270,112		
	Total	21554,000	79			
N score of Analogies subtest	Between Groups	495,068	2	247,534	1,049	,355
	Within Groups	18166,419	77	235,928		
	Total	18661,488	79			
average mark in term 3 2015 (percentage points)	Between Groups	639,583	2	319,792	2,293	,108
	Within Groups	10739,904	77	139,479		

	Total	11379,488	79			
mark in home language in term 3 2015 (percentage points)	Between Groups	186,211	2	93,105	,549	,580
	Within Groups	12882,498	76	169,507		
	Total	13068,709	78			

Post Hoc Tests

Multiple Comparisons

Dependent Variable		(I) restructured final three groups	(J) restructured final three groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
mean of N scores	Gabriel	chess	extracurriculars	4,944	3,269	,343	-2,97	12,86
			no activity, no chess	6,535	3,269	,135	-1,38	14,45
		extracurriculars	chess	-4,944	3,269	,343	-12,86	2,97
			no activity, no chess	1,591	3,642	,961	-7,29	10,47
		no activity, no chess	chess	-6,535	3,269	,135	-14,45	1,38
			extracurriculars	-1,591	3,642	,961	-10,47	7,29
	Hochberg	chess	extracurriculars	4,944	3,269	,349	-3,03	12,92
			no activity, no chess	6,535	3,269	,139	-1,44	14,51
		extracurriculars	chess	-4,944	3,269	,349	-12,92	3,03
			no activity, no chess	1,591	3,642	,961	-7,29	10,47
		no activity, no chess	chess	-6,535	3,269	,139	-14,51	1,44
			extracurriculars	-1,591	3,642	,961	-10,47	7,29
	Games-Howell	chess	extracurriculars	4,944	3,384	,319	-3,24	13,13
			no activity, no chess	6,535	3,060	,092	-,84	13,91
		extracurriculars	chess	-4,944	3,384	,319	-13,13	3,24
			no activity, no chess	1,591	3,342	,883	-6,54	9,72

		no activity, no chess	chess	-6,535	3,060	,092	-13,91	,84
			extracurriculars	-1,591	3,342	,883	-9,72	6,54
N score of Categories subtest	Gabriel	chess	extracurriculars	4,258	4,448	,707	-6,51	15,02
			no activity, no chess	7,258	4,448	,279	-3,51	18,02
		extracurriculars	chess	-4,258	4,448	,707	-15,02	6,51
			no activity, no chess	3,000	4,955	,905	-9,09	15,09
		no activity, no chess	chess	-7,258	4,448	,279	-18,02	3,51
			extracurriculars	-3,000	4,955	,905	-15,09	9,09
	Hochberg	chess	extracurriculars	4,258	4,448	,711	-6,59	15,10
			no activity, no chess	7,258	4,448	,285	-3,59	18,10
		extracurriculars	chess	-4,258	4,448	,711	-15,10	6,59
			no activity, no chess	3,000	4,955	,905	-9,09	15,09
		no activity, no chess	chess	-7,258	4,448	,285	-18,10	3,59
			extracurriculars	-3,000	4,955	,905	-15,09	9,09
	Games-Howell	chess	extracurriculars	4,258	4,560	,622	-6,81	15,33
			no activity, no chess	7,258	4,335	,226	-3,24	17,76
		extracurriculars	chess	-4,258	4,560	,622	-15,33	6,81
			no activity, no chess	3,000	4,966	,819	-9,07	15,07
		no activity, no chess	chess	-7,258	4,335	,226	-17,76	3,24
			extracurriculars	-3,000	4,966	,819	-15,07	9,07
N score of Analogies subtest	Gabriel	chess	extracurriculars	5,111	4,157	,521	-4,95	15,17
			no activity, no chess	4,884	4,157	,558	-5,18	14,95
		extracurriculars	chess	-5,111	4,157	,521	-15,17	4,95
			no activity, no chess	-,227	4,631	1,000	-11,52	11,07
		no activity, no chess	chess	-4,884	4,157	,558	-14,95	5,18
			extracurriculars	,227	4,631	1,000	-11,07	11,52

	Hochberg	chess	extracurriculars	5,111	4,157	,527	-5,03	15,25
			no activity, no chess	4,884	4,157	,564	-5,25	15,02
		extracurriculars	chess	-5,111	4,157	,527	-15,25	5,03
			no activity, no chess	-,227	4,631	1,000	-11,52	11,07
		no activity, no chess	chess	-4,884	4,157	,564	-15,02	5,25
			extracurriculars	,227	4,631	1,000	-11,07	11,52
	Games-Howell	chess	extracurriculars	5,111	3,929	,401	-4,35	14,57
			no activity, no chess	4,884	4,174	,476	-5,18	14,95
		extracurriculars	chess	-5,111	3,929	,401	-14,57	4,35
			no activity, no chess	-,227	3,883	,998	-9,67	9,21
		no activity, no chess	chess	-4,884	4,174	,476	-14,95	5,18
			extracurriculars	,227	3,883	,998	-9,21	9,67
average mark in term 3 2015 (percentage points)	Gabriel	chess	extracurriculars	4,641	3,196	,378	-3,10	12,38
			no activity, no chess	6,414	3,196	,133	-1,32	14,15
		extracurriculars	chess	-4,641	3,196	,378	-12,38	3,10
			no activity, no chess	1,773	3,561	,944	-6,91	10,46
		no activity, no chess	chess	-6,414	3,196	,133	-14,15	1,32
			extracurriculars	-1,773	3,561	,944	-10,46	6,91
	Hochberg	chess	extracurriculars	4,641	3,196	,384	-3,15	12,44
			no activity, no chess	6,414	3,196	,137	-1,38	14,21
		extracurriculars	chess	-4,641	3,196	,384	-12,44	3,15
			no activity, no chess	1,773	3,561	,944	-6,91	10,46
		no activity, no chess	chess	-6,414	3,196	,137	-14,21	1,38
			extracurriculars	-1,773	3,561	,944	-10,46	6,91
	Games-Howell	chess	extracurriculars	4,641	3,013	,281	-2,64	11,92
			no activity, no chess	6,414	3,350	,147	-1,72	14,55

		extracurriculars	chess	-4,641	3,013	,281	-11,92	2,64
			no activity, no chess	1,773	3,494	,868	-6,73	10,27
		no activity, no chess	chess	-6,414	3,350	,147	-14,55	1,72
			extracurriculars	-1,773	3,494	,868	-10,27	6,73
mark in home language in term 3 2015 (percentage points)	Gabriel	chess	extracurriculars	1,163	3,575	,983	-7,48	9,81
			no activity, no chess	3,684	3,523	,647	-4,85	12,22
		extracurriculars	chess	-1,163	3,575	,983	-9,81	7,48
			no activity, no chess	2,522	3,972	,893	-7,17	12,21
		no activity, no chess	chess	-3,684	3,523	,647	-12,22	4,85
			extracurriculars	-2,522	3,972	,893	-12,21	7,17
	Hochberg	chess	extracurriculars	1,163	3,575	,983	-7,56	9,88
			no activity, no chess	3,684	3,523	,652	-4,91	12,28
		extracurriculars	chess	-1,163	3,575	,983	-9,88	7,56
			no activity, no chess	2,522	3,972	,893	-7,17	12,21
		no activity, no chess	chess	-3,684	3,523	,652	-12,28	4,91
			extracurriculars	-2,522	3,972	,893	-12,21	7,17
	Games-Howell	chess	extracurriculars	1,163	3,692	,947	-7,88	10,20
			no activity, no chess	3,684	3,534	,555	-4,93	12,30
		extracurriculars	chess	-1,163	3,692	,947	-10,20	7,88
			no activity, no chess	2,522	4,336	,831	-8,02	13,07
		no activity, no chess	chess	-3,684	3,534	,555	-12,30	4,93
			extracurriculars	-2,522	4,336	,831	-13,07	8,02

Homogeneous Subsets

mean of N scores

	restructured final three groups	N	Subset for alpha = 0.05
			1
Gabriel[a,b]	no activity, no chess	22	69,91
	extracurriculars	22	71,50
	chess	36	76,44
	Sig.		,163
Hochberg[a,b]	no activity, no chess	22	69,91
	extracurriculars	22	71,50
	chess	36	76,44
	Sig.		,163

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 25,277.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

N score of Categories subtest

	restructured final three groups	N	Subset for alpha = 0.05
			1
Gabriel[a,b]	no activity, no chess	22	72,91
	extracurriculars	22	75,91
	chess	36	80,17
	Sig.		,317
Hochberg[a,b]	no activity, no chess	22	72,91
	extracurriculars	22	75,91
	chess	36	80,17
	Sig.		,317

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 25,277.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

N score of Analogies subtest

	restructured final three groups	N	Subset for alpha = 0.05
			1
Gabriel[a,b]	extracurriculars	22	77,50
	no activity, no chess	22	77,73
	chess	36	82,61

	Sig.		,559
Hochberg[a,b]	extracurriculars	22	77,50
	no activity, no chess	22	77,73
	chess	36	82,61
	Sig.		,559

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 25,277.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

average mark in term 3 2015 (percentage points)

	restructured final three groups	N	Subset for alpha = 0.05 1
Gabriel[a,b]	no activity, no chess	22	65,36
	extracurriculars	22	67,14
	chess	36	71,78
	Sig.		,161
Hochberg[a,b]	no activity, no chess	22	65,36
	extracurriculars	22	67,14
	chess	36	71,78
	Sig.		,161

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 25,277.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

mark in home language in term 3 2015 (percentage points)

	restructured final three groups	N	Subset for alpha = 0.05 1
Gabriel[a,b]	no activity, no chess	22	68,95
	extracurriculars	21	71,48
	chess	36	72,64
	Sig.		,685
Hochberg[a,b]	no activity, no chess	22	68,95
	extracurriculars	21	71,48
	chess	36	72,64
	Sig.		,685

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 24,824.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

```
T-TEST GROUPS=I_Chess_vs_NoChess(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=mean_N score_C_N score_A_N T3_average_mark T3_HL_mark
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	recoded into chess vs. no chess (from restructured groups, all chess)	N	Mean	Std. Deviation	Std. Error Mean
mean of N scores	no chess	44	70,70	10,983	1,656
	chess	36	76,44	13,177	2,196
N score of Categories subtest	no chess	44	74,41	16,350	2,465
	chess	36	80,17	16,391	2,732
N score of Analogies subtest	no chess	44	77,61	12,728	1,919
	chess	36	82,61	17,889	2,981
average mark in term 3 2015 (percentage points)	no chess	44	66,25	11,487	1,732
	chess	36	71,78	12,071	2,012
mark in home language in term 3 2015 (percentage points)	no chess	43	70,19	14,087	2,148
	chess	36	72,64	11,485	1,914

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means					
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference

									Lower	Upper
mean of N scores	Equal variances assumed	,606	,439	-2,125	78	,037	-5,740	2,701	-11,116	-,363
	Equal variances not assumed			-2,087	68,171	,041	-5,740	2,750	-11,228	-,252
N score of Categories subtest	Equal variances assumed	,050	,824	-1,565	78	,122	-5,758	3,678	-13,081	1,566
	Equal variances not assumed			-1,565	74,821	,122	-5,758	3,679	-13,088	1,572
N score of Analogies subtest	Equal variances assumed	3,575	,062	-1,457	78	,149	-4,997	3,430	-11,826	1,831
	Equal variances not assumed			-1,409	61,422	,164	-4,997	3,546	-12,086	2,091
average mark in term 3 2015 (percentage points)	Equal variances assumed	,556	,458	-2,093	78	,040	-5,528	2,641	-10,786	-,269
	Equal variances not assumed			-2,082	73,317	,041	-5,528	2,655	-10,818	-,238
mark in home language in term 3 2015 (percentage points)	Equal variances assumed	2,204	,142	-,837	77	,405	-2,453	2,930	-8,287	3,381
	Equal variances not assumed			-,852	76,955	,397	-2,453	2,877	-8,182	3,277

```
T-TEST GROUPS=chess_knowledge(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=mean_N score_C_N score_A_N T3_average_mark T3_HL_mark
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	knowledge of chess in general	N	Mean	Std. Deviation	Std. Error Mean
mean of N scores	no	16	73,69	9,457	2,364

	yes	53	73,66	13,419	1,843
N score of Categories subtest	no	16	75,94	12,567	3,142
	yes	53	77,79	17,094	2,348
N score of Analogies subtest	no	16	81,06	13,005	3,251
	yes	53	80,00	16,724	2,297
average mark in term 3 2015 (percentage points)	no	16	71,06	11,000	2,750
	yes	53	68,08	12,394	1,702
mark in home language in term 3 2015 (percentage points)	no	16	77,19	12,183	3,046
	yes	52	70,13	12,460	1,728

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
mean of N scores	Equal variances assumed	2,381	,128	,008	67	,994	,027	3,606	-7,170	7,224
	Equal variances not assumed			,009	35,044	,993	,027	2,998	-6,059	6,113
N score of Categories subtest	Equal variances assumed	1,788	,186	-,402	67	,689	-1,855	4,618	-11,073	7,364
	Equal variances not assumed			-,473	33,428	,639	-1,855	3,922	-9,831	6,121
N score of Analogies subtest	Equal variances assumed	2,142	,148	,233	67	,816	1,063	4,555	-8,028	10,153
	Equal variances not assumed			,267	31,454	,791	1,063	3,981	-7,052	9,177

average mark in term 3 2015 (percentage points)	Equal variances assumed	,726	,397	,866	67	,390	2,987	3,450	-3,900	9,874
	Equal variances not assumed			,924	27,534	,364	2,987	3,234	-3,643	9,617
mark in home language in term 3 2015 (percentage points)	Equal variances assumed	,054	,816	1,990	66	,051	7,053	3,544	-,024	14,129
	Equal variances not assumed			2,014	25,434	,055	7,053	3,502	-,153	14,259

```
T-TEST GROUPS=chess_home_total(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=mean_N score_C_N score_A_N T3_average_mark T3_HL_mark
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	students playing chess at home (all students)	N	Mean	Std. Deviation	Std. Error Mean
mean of N scores	no	41	70,32	10,093	1,576
	yes	39	76,41	13,668	2,189
N score of Categories subtest	no	41	73,49	15,168	2,369
	yes	39	80,69	17,255	2,763
N score of Analogies subtest	no	41	77,71	13,735	2,145
	yes	39	82,13	16,799	2,690
average mark in term 3 2015 (percentage points)	no	41	68,39	11,899	1,858
	yes	39	69,10	12,253	1,962
mark in home language in term 3 2015 (percentage points)	no	40	72,18	13,765	2,176
	yes	39	70,41	12,158	1,947

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
mean of N scores	Equal variances assumed	3,456	,067	-2,276	78	,026	-6,093	2,677	-11,423	-,763
	Equal variances not assumed			-2,259	69,803	,027	-6,093	2,697	-11,473	-,713
N score of Categories subtest	Equal variances assumed	,474	,493	-1,986	78	,051	-7,205	3,628	-14,427	,018
	Equal variances not assumed			-1,980	75,593	,051	-7,205	3,639	-14,454	,045
N score of Analogies subtest	Equal variances assumed	1,040	,311	-1,291	78	,200	-4,421	3,423	-11,236	2,395
	Equal variances not assumed			-1,285	73,470	,203	-4,421	3,441	-11,277	2,436
average mark in term 3 2015 (percentage points)	Equal variances assumed	,086	,769	-,264	78	,793	-,712	2,700	-6,089	4,664
	Equal variances not assumed			-,264	77,505	,793	-,712	2,702	-6,093	4,668
mark in home language in term 3 2015 (percentage points)	Equal variances assumed	,722	,398	,603	77	,548	1,765	2,925	-4,059	7,589
	Equal variances not assumed			,604	76,267	,547	1,765	2,920	-4,051	7,580

```
T-TEST GROUPS=I_Extra_vs_NoExtra(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=mean_N score_C_N score_A_N T3_average_mark T3_HL_mark
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)	N	Mean	Std. Deviation	Std. Error Mean
mean of N scores	no extracurriculars	25	70,52	9,514	1,903
	extracurriculars	55	74,55	13,240	1,785
N score of Categories subtest	no extracurriculars	25	74,12	15,640	3,128
	extracurriculars	55	78,31	16,877	2,276
N score of Analogies subtest	no extracurriculars	25	77,16	12,931	2,586
	extracurriculars	55	81,09	16,320	2,201
average mark in term 3 2015 (percentage points)	no extracurriculars	25	66,16	12,175	2,435
	extracurriculars	55	69,91	11,848	1,598
mark in home language in term 3 2015 (percentage points)	no extracurriculars	25	68,72	13,075	2,615
	extracurriculars	54	72,50	12,828	1,746

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means					
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference

									Lower	Upper
mean of N scores	Equal variances assumed	3,701	,058	-1,366	78	,176	-4,025	2,946	-9,891	1,840
	Equal variances not assumed			-1,543	63,115	,128	-4,025	2,609	-9,239	1,188
N score of Categories subtest	Equal variances assumed	,354	,554	-1,052	78	,296	-4,189	3,982	-12,116	3,738
	Equal variances not assumed			-1,083	49,916	,284	-4,189	3,868	-11,959	3,581
N score of Analogies subtest	Equal variances assumed	,826	,366	-1,061	78	,292	-3,931	3,704	-11,306	3,444
	Equal variances not assumed			-1,158	57,853	,252	-3,931	3,396	-10,729	2,867
average mark in term 3 2015 (percentage points)	Equal variances assumed	,121	,729	-1,301	78	,197	-3,749	2,882	-9,487	1,989
	Equal variances not assumed			-1,287	45,374	,205	-3,749	2,912	-9,613	2,115
mark in home language in term 3 2015 (percentage points)	Equal variances assumed	,100	,752	-1,211	77	,230	-3,780	3,122	-9,997	2,437
	Equal variances not assumed			-1,202	46,018	,235	-3,780	3,144	-10,109	2,549

```
*Nonparametric Tests: Independent Samples.
NPTESTS
  /INDEPENDENT TEST (mean_N score_C_N score_S_N score_A_N T3_average_mark
T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO) GROUP (I_Chess_vs_NoChess) MANN_WHITNEY
  /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE
  /CRITERIA ALPHA=0.05  CILEVEL=95.
```

Nonparametric Tests

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of mean of N scores is the same across categories of recoded into chess vs. no chess (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,044	Reject the null hypothesis.
2	The distribution of N score of Categories subtest is the same across categories of recoded into chess vs. no chess (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,156	Retain the null hypothesis.
3	The distribution of N score of Situations subtest is the same across categories of recoded into chess vs. no chess (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,103	Retain the null hypothesis.
4	The distribution of N score of Analogies subtest is the same across categories of recoded into chess vs. no chess (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,153	Retain the null hypothesis.
5	The distribution of average mark in term 3 2015 (percentage points) is the same across categories of recoded into chess vs. no chess (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,059	Retain the null hypothesis.
6	The distribution of mark in home language in term 3 2015 (percentage points) is the same across categories of recoded into chess vs. no chess (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,431	Retain the null hypothesis.
7	The distribution of mark in first additional language in term 3 2015 (percentage points) is the same across categories of recoded into chess vs. no chess (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,331	Retain the null hypothesis.
8	The distribution of mark in mathematics in term 3 2015 (percentage points) is the same across categories of recoded into chess vs. no chess (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,128	Retain the null hypothesis.
9	The distribution of mark in life skills/orientation in term 3 2015 (percentage points) is the same across categories of recoded into chess vs. no chess (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,049	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

```
*Nonparametric Tests: Independent Samples.
NPTESTS
  /INDEPENDENT TEST (mean_N score_C_N score_S_N score_A_N T3_average_mark
T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO) GROUP (chess_knowledge) MANN_WHITNEY
  /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE
  /CRITERIA ALPHA=0.05  CILEVEL=95.
```

Nonparametric Tests

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of mean of N scores is the same across categories of knowledge of chess in general.	Independent-Samples Mann-Whitney U Test	,870	Retain the null hypothesis.
2	The distribution of N score of Categories subtest is the same across categories of knowledge of chess in general.	Independent-Samples Mann-Whitney U Test	,864	Retain the null hypothesis.
3	The distribution of N score of Situations subtest is the same across categories of knowledge of chess in general.	Independent-Samples Mann-Whitney U Test	,770	Retain the null hypothesis.
4	The distribution of N score of Analogies subtest is the same across categories of knowledge of chess in general.	Independent-Samples Mann-Whitney U Test	,926	Retain the null hypothesis.
5	The distribution of average mark in term 3 2015 (percentage points) is the same across categories of knowledge of chess in general.	Independent-Samples Mann-Whitney U Test	,309	Retain the null hypothesis.
6	The distribution of mark in home language in term 3 2015 (percentage points) is the same across categories of knowledge of chess in general.	Independent-Samples Mann-Whitney U Test	,050	Reject the null hypothesis.
7	The distribution of mark in first additional language in term 3 2015 (percentage points) is the same across categories of knowledge of chess in general.	Independent-Samples Mann-Whitney U Test	,545	Retain the null hypothesis.
8	The distribution of mark in mathematics in term 3 2015 (percentage points) is the same across categories of knowledge of chess in general.	Independent-Samples Mann-Whitney U Test	,306	Retain the null hypothesis.
9	The distribution of mark in life skills/orientation in term 3 2015 (percentage points) is the same across categories of knowledge of chess in general.	Independent-Samples Mann-Whitney U Test	,302	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

```
*Nonparametric Tests: Independent Samples.
NPTESTS
  /INDEPENDENT TEST (mean_N score_C_N score_S_N score_A_N T3_average_mark
T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO) GROUP (chess_home_total) MANN_WHITNEY
  /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE
  /CRITERIA ALPHA=0.05  CILEVEL=95.
```

Nonparametric Tests

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of mean of N scores is the same across categories of students playing chess at home (all students).	Independent-Samples Mann-Whitney U Test	,042	Reject the null hypothesis.
2	The distribution of N score of Categories subtest is the same across categories of students playing chess at home (all students).	Independent-Samples Mann-Whitney U Test	,055	Retain the null hypothesis.
3	The distribution of N score of Situations subtest is the same across categories of students playing chess at home (all students).	Independent-Samples Mann-Whitney U Test	,037	Reject the null hypothesis.
4	The distribution of N score of Analogies subtest is the same across categories of students playing chess at home (all students).	Independent-Samples Mann-Whitney U Test	,218	Retain the null hypothesis.
5	The distribution of average mark in term 3 2015 (percentage points) is the same across categories of students playing chess at home (all students).	Independent-Samples Mann-Whitney U Test	,784	Retain the null hypothesis.
6	The distribution of mark in home language in term 3 2015 (percentage points) is the same across categories of students playing chess at home (all students).	Independent-Samples Mann-Whitney U Test	,596	Retain the null hypothesis.
7	The distribution of mark in first additional language in term 3 2015 (percentage points) is the same across categories of students playing chess at home (all students).	Independent-Samples Mann-Whitney U Test	,946	Retain the null hypothesis.
8	The distribution of mark in mathematics in term 3 2015 (percentage points) is the same across categories of students playing chess at home (all students).	Independent-Samples Mann-Whitney U Test	,919	Retain the null hypothesis.
9	The distribution of mark in life skills/orientation in term 3 2015 (percentage points) is the same across categories of students playing chess at home (all students).	Independent-Samples Mann-Whitney U Test	,307	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

```
*Nonparametric Tests: Independent Samples.
NPTESTS
  /INDEPENDENT TEST (mean_N score_C_N score_S_N score_A_N T3_average_mark
T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO) GROUP (I_Extra_vs_NoExtra) MANN_WHITNEY
  /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE
  /CRITERIA ALPHA=0.05  CILEVEL=95.
```

Nonparametric Tests

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of mean of N scores is the same across categories of recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,230	Retain the null hypothesis.
2	The distribution of N score of Categories subtest is the same across categories of recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,324	Retain the null hypothesis.
3	The distribution of N score of Situations subtest is the same across categories of recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,382	Retain the null hypothesis.
4	The distribution of N score of Analogies subtest is the same across categories of recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,241	Retain the null hypothesis.
5	The distribution of average mark in term 3 2015 (percentage points) is the same across categories of recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,205	Retain the null hypothesis.
6	The distribution of mark in home language in term 3 2015 (percentage points) is the same across categories of recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,195	Retain the null hypothesis.
7	The distribution of mark in first additional language in term 3 2015 (percentage points) is the same across categories of recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,311	Retain the null hypothesis.
8	The distribution of mark in mathematics in term 3 2015 (percentage points) is the same across categories of recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,720	Retain the null hypothesis.
9	The distribution of mark in life skills/orientation in term 3 2015 (percentage points) is the same across categories of recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess).	Independent-Samples Mann-Whitney U Test	,140	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

```
FILTER OFF.
USE ALL.
EXECUTE.
MEANS TABLES=mean_N score_C_N score_S_N score_A_N BY groups_longterm
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
mean of N scores * restructured groups only considering more than three months of chess instruction	85	100,0%	0	0,0%	85	100,0%
N score of Categories subtest * restructured groups only considering more than three months of chess instruction	85	100,0%	0	0,0%	85	100,0%
N score of Situations subtest * restructured groups only considering more than three months of chess instruction	85	100,0%	0	0,0%	85	100,0%
N score of Analogies subtest * restructured groups only considering more than three months of chess instruction	85	100,0%	0	0,0%	85	100,0%

Report

restructured groups only considering more than three months of chess instruction		mean of N scores	N score of Categories subtest	N score of Situations subtest	N score of Analogies subtest
chess	Mean	77,50	81,46	68,13	83,17
	N	24	24	24	24
	Std. Deviation	14,932	17,530	17,429	19,078
other extracurricular activities	Mean	72,15	76,44	62,93	77,26
	N	27	27	27	27
	Std. Deviation	12,092	17,190	17,016	11,785
no extracurricular activities	Mean	71,47	74,56	60,85	79,06
	N	34	34	34	34
	Std. Deviation	9,721	15,196	15,549	14,416
Total	Mean	73,39	77,11	63,56	79,65

	N	85	85	85	85
	Std. Deviation	12,257	16,568	16,638	15,159

```
MEANS TABLES=mean_N score_C_N score_S_N score_A_N BY II_Chess_vs_NoChess
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
mean of N scores * recoded into chess vs. no chess (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%
N score of Categories subtest * recoded into chess vs. no chess (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%
N score of Situations subtest * recoded into chess vs. no chess (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%
N score of Analogies subtest * recoded into chess vs. no chess (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%

Report

recoded into chess vs. no chess (from restructured groups, only chess > 3m)		mean of N scores	N score of Categories subtest	N score of Situations subtest	N score of Analogies subtest
no chess	Mean	71,77	75,39	61,77	78,26
	N	61	61	61	61
	Std. Deviation	10,745	15,998	16,109	13,240
chess	Mean	77,50	81,46	68,13	83,17
	N	24	24	24	24
	Std. Deviation	14,932	17,530	17,429	19,078
Total	Mean	73,39	77,11	63,56	79,65
	N	85	85	85	85
	Std. Deviation	12,257	16,568	16,638	15,159

```
MEANS TABLES=mean_N score_C_N score_S_N score_A_N BY II_Extra_vs_NoExtra
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
mean of N scores * recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%
N score of Categories subtest * recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%
N score of Situations subtest * recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%
N score of Analogies subtest * recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%

Report

recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)		mean of N scores	N score of Categories subtest	N score of Situations subtest	N score of Analogies subtest
no extracurricular	Mean	71,47	74,56	60,85	79,06
	N	34	34	34	34
	Std. Deviation	9,721	15,196	15,549	14,416
extracurricular	Mean	74,67	78,80	65,37	80,04
	N	51	51	51	51
	Std. Deviation	13,633	17,361	17,238	15,764
Total	Mean	73,39	77,11	63,56	79,65
	N	85	85	85	85
	Std. Deviation	12,257	16,568	16,638	15,159

```
MEANS TABLES=T3_average_mark T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO BY
groups_longterm
```

```
/CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
average mark in term 3 2015 (percentage points) * restructured groups only considering more than three months of chess instruction	85	100,0%	0	0,0%	85	100,0%
mark in home language in term 3 2015 (percentage points) * restructured groups only considering more than three months of chess instruction	84	98,8%	1	1,2%	85	100,0%
mark in first additional language in term 3 2015 (percentage points) * restructured groups only considering more than three months of chess instruction	85	100,0%	0	0,0%	85	100,0%
mark in mathematics in term 3 2015 (percentage points) * restructured groups only considering more than three months of chess instruction	85	100,0%	0	0,0%	85	100,0%
mark in life skills/orientation in term 3 2015 (percentage points) * restructured groups only considering more than three months of chess instruction	85	100,0%	0	0,0%	85	100,0%

Report

restructured groups only considering more than three months of chess instruction		average mark in term 3 2015 (percentage points)	mark in home language in term 3 2015 (percentage points)	mark in first additional language in term 3 2015 (percentage points)	mark in mathematics in term 3 2015 (percentage points)	mark in life skills/orientation in term 3 2015 (percentage points)
chess	Mean	72,17	73,50	70,58	69,46	75,96
	N	24	24	24	24	24

	Std. Deviation	12,706	11,832	15,450	18,451	12,919
other extracurricular activities	Mean	67,48	72,04	69,74	63,56	70,15
	N	27	26	27	27	27
	Std. Deviation	9,553	13,058	12,739	13,051	11,644
no extracurricular activities	Mean	67,35	69,65	66,79	66,71	65,94
	N	34	34	34	34	34
	Std. Deviation	12,232	12,853	15,464	16,325	18,532
Total	Mean	68,75	71,49	68,80	66,48	70,11
	N	85	84	85	85	85
	Std. Deviation	11,657	12,589	14,572	15,998	15,473

```
MEANS TABLES=T3_average_mark T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO BY
II_Chess_vs_NoChess
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
average mark in term 3 2015 (percentage points) * recoded into chess vs. no chess (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%
mark in home language in term 3 2015 (percentage points) * recoded into chess vs. no chess (from restructured groups, only chess > 3m)	84	98,8%	1	1,2%	85	100,0%
mark in first additional language in term 3 2015 (percentage points) * recoded into chess vs. no chess (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%

	N	Percent	N	Percent	N	Percent
mark in mathematics in term 3 2015 (percentage points) * recoded into chess vs. no chess (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%
mark in life skills/orientation in term 3 2015 (percentage points) * recoded into chess vs. no chess (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%

Report

recoded into chess vs. no chess (from restructured groups, only chess > 3m)		average mark in term 3 2015 (percentage points)	mark in home language in term 3 2015 (percentage points)	mark in first additional language in term 3 2015 (percentage points)	mark in mathematics in term 3 2015 (percentage points)	mark in life skills/orientation in term 3 2015 (percentage points)
no chess	Mean	67,41	70,68	68,10	65,31	67,80
	N	61	60	61	61	61
	Std. Deviation	11,038	12,887	14,284	14,929	15,877
chess	Mean	72,17	73,50	70,58	69,46	75,96
	N	24	24	24	24	24
	Std. Deviation	12,706	11,832	15,450	18,451	12,919
Total	Mean	68,75	71,49	68,80	66,48	70,11
	N	85	84	85	85	85
	Std. Deviation	11,657	12,589	14,572	15,998	15,473

```
MEANS TABLES=T3_average_mark T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO BY
II_Extra_vs_NoExtra
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
average mark in term 3 2015 (percentage points) * recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%

mark in home language in term 3 2015 (percentage points) * recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)	84	98,8%	1	1,2%	85	100,0%
mark in first additional language in term 3 2015 (percentage points) * recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%
mark in mathematics in term 3 2015 (percentage points) * recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%
mark in life skills/orientation in term 3 2015 (percentage points) * recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)	85	100,0%	0	0,0%	85	100,0%

Report

recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)		average mark in term 3 2015 (percentage points)	mark in home language in term 3 2015 (percentage points)	mark in first additional language in term 3 2015 (percentage points)	mark in mathematics in term 3 2015 (percentage points)	mark in life skills/orientation in term 3 2015 (percentage points)
no extracurricular	Mean	67,35	69,65	66,79	66,71	65,94
	N	34	34	34	34	34
	Std. Deviation	12,232	12,853	15,464	16,325	18,532
extracurricular	Mean	69,69	72,74	70,14	66,33	72,88
	N	51	50	51	51	51
	Std. Deviation	11,283	12,380	13,941	15,938	12,485
Total	Mean	68,75	71,49	68,80	66,48	70,11
	N	85	84	85	85	85
	Std. Deviation	11,657	12,589	14,572	15,998	15,473

```
EXAMINE VARIABLES=mean_N score_C_N score_S_N score_A_N
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
mean of N scores	85	100,0%	0	0,0%	85	100,0%
N score of Categories subtest	85	100,0%	0	0,0%	85	100,0%
N score of Situations subtest	85	100,0%	0	0,0%	85	100,0%
N score of Analogies subtest	85	100,0%	0	0,0%	85	100,0%

Descriptives

			Statistic	Std. Error
mean of N scores	Mean		73,39	1,329
	95% Confidence Interval for Mean	Lower Bound	70,74	
		Upper Bound	76,03	
	5% Trimmed Mean		72,86	
	Median		73,00	
	Variance		150,240	
	Std. Deviation		12,257	
	Minimum		50	
	Maximum		112	
	Range		62	
	Interquartile Range		17	
	Skewness		,607	,261
	Kurtosis		,426	,517
N score of Categories subtest	Mean		77,11	1,797
	95% Confidence Interval for Mean	Lower Bound	73,53	
		Upper Bound	80,68	
	5% Trimmed Mean		76,71	
	Median		76,00	
	Variance		274,501	
	Std. Deviation		16,568	
	Minimum		47	
	Maximum		123	

	Range		76	
	Interquartile Range		23	
	Skewness		,307	,261
	Kurtosis		-,274	,517
N score of Situations subtest	Mean		63,56	1,805
	95% Confidence Interval for Mean	Lower Bound	59,98	
		Upper Bound	67,15	
	5% Trimmed Mean		62,53	
	Median		59,00	
	Variance		276,820	
	Std. Deviation		16,638	
	Minimum		45	
	Maximum		111	
	Range		66	
	Interquartile Range		29	
	Skewness		,733	,261
	Kurtosis		-,372	,517
N score of Analogies subtest	Mean		79,65	1,644
	95% Confidence Interval for Mean	Lower Bound	76,38	
		Upper Bound	82,92	
	5% Trimmed Mean		79,46	
	Median		79,00	
	Variance		229,803	
	Std. Deviation		15,159	
	Minimum		49	
	Maximum		125	
	Range		76	
	Interquartile Range		20	
	Skewness		,213	,261
	Kurtosis		-,059	,517

Tests of Normality

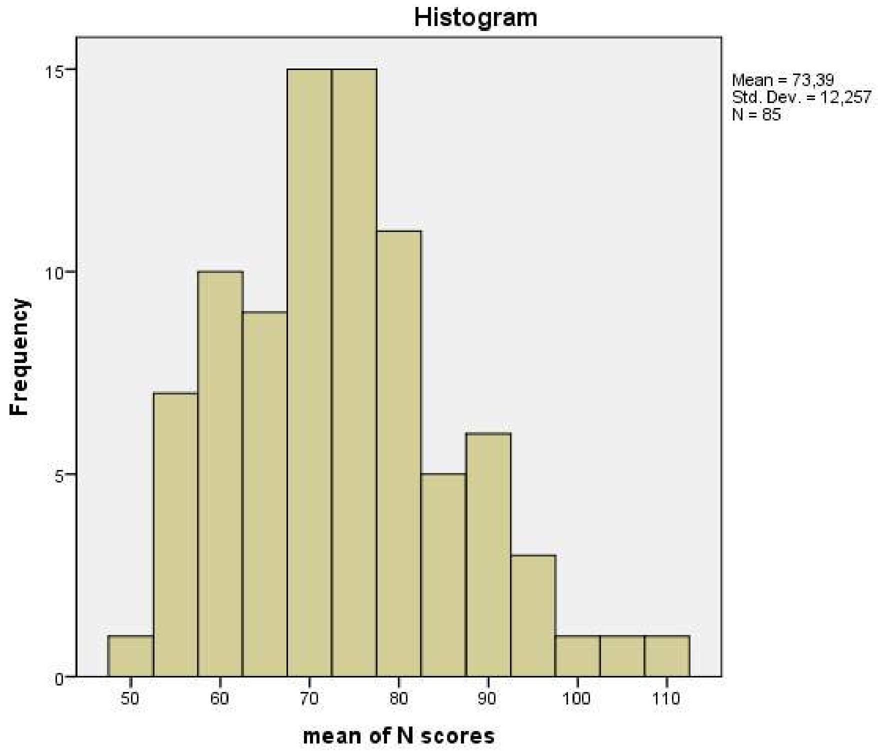
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
mean of N scores	,074	85	,200*	,974	85	,079
N score of Categories subtest	,068	85	,200*	,984	85	,377

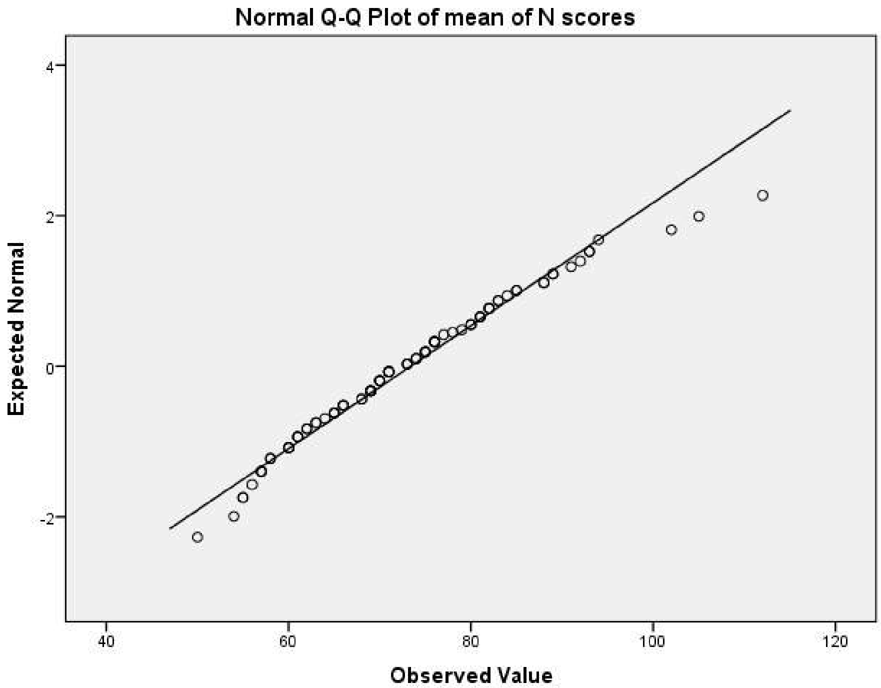
N score of Situations subtest	,136	85	,001	,903	85	,000
N score of Analogies subtest	,059	85	,200*	,986	85	,474

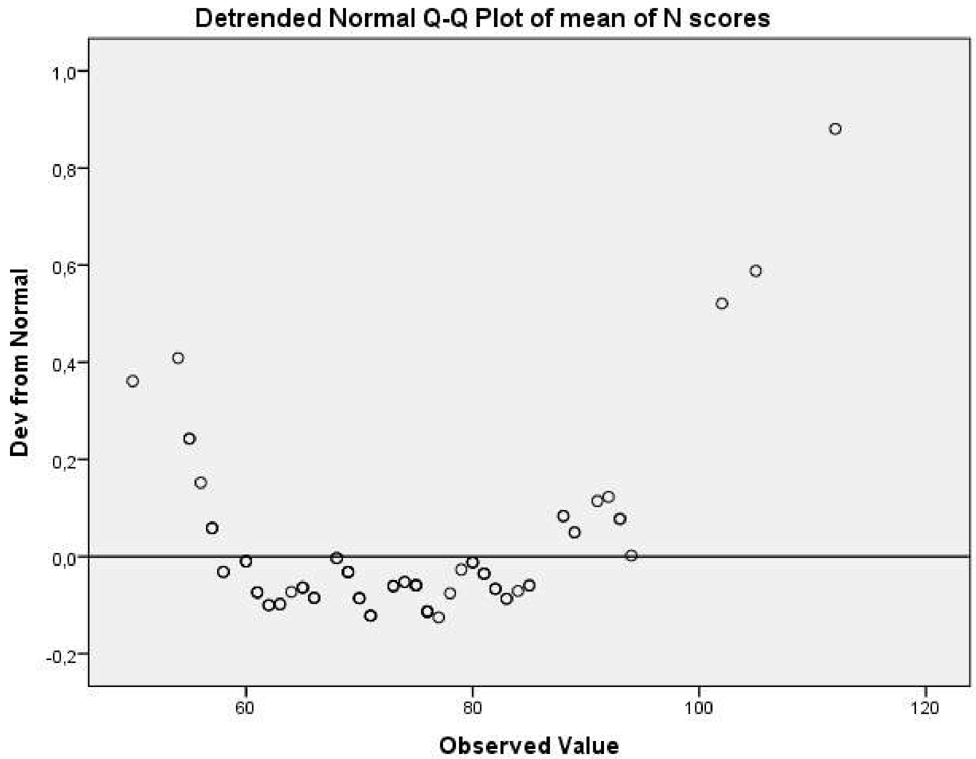
*. This is a lower bound of the true significance.

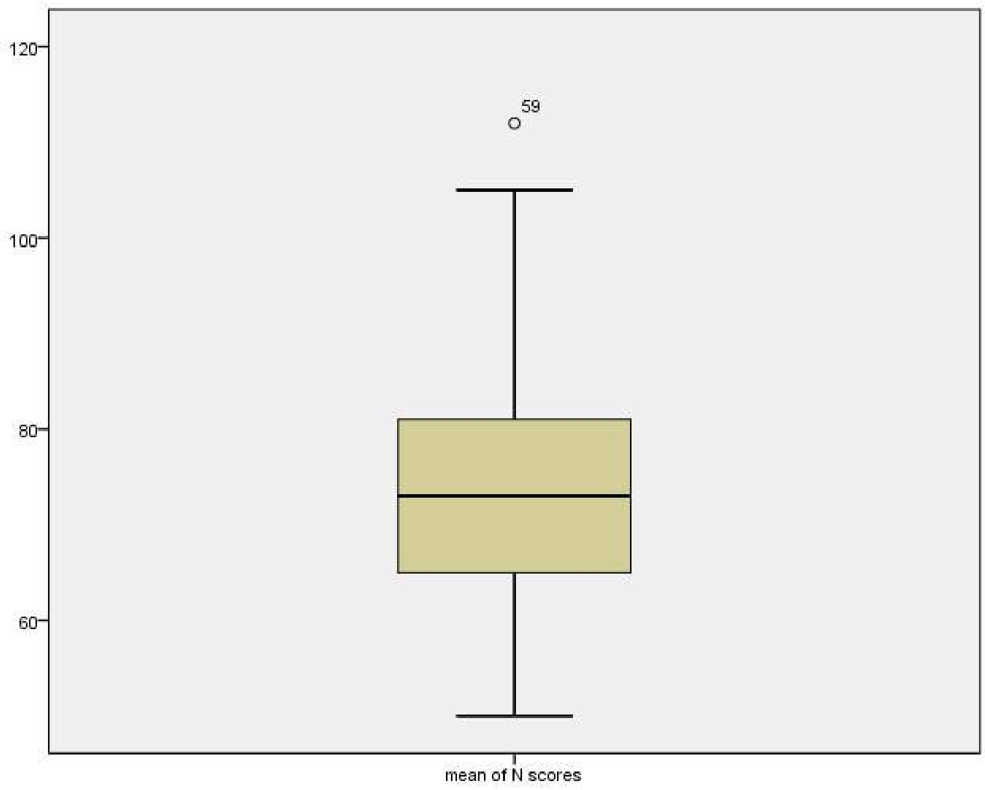
a. Lilliefors Significance Correction

mean of N scores

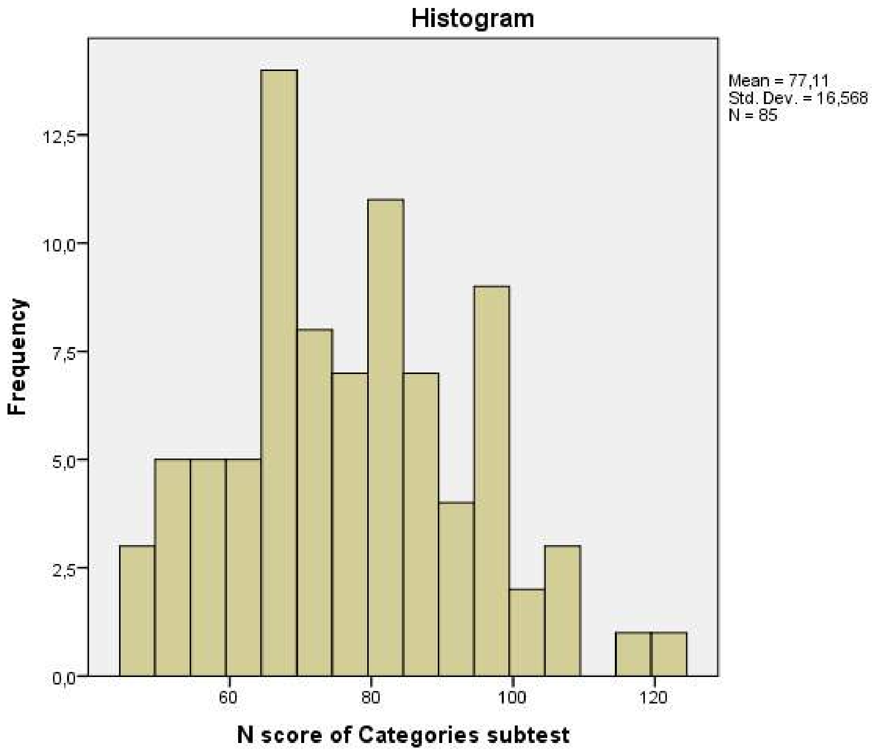


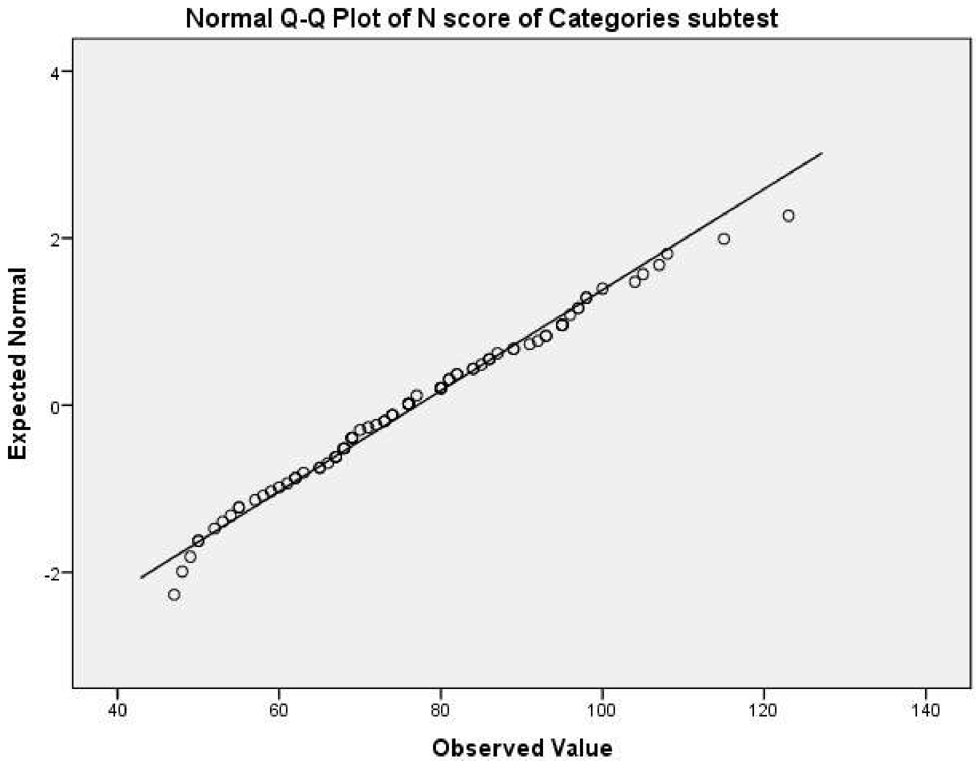


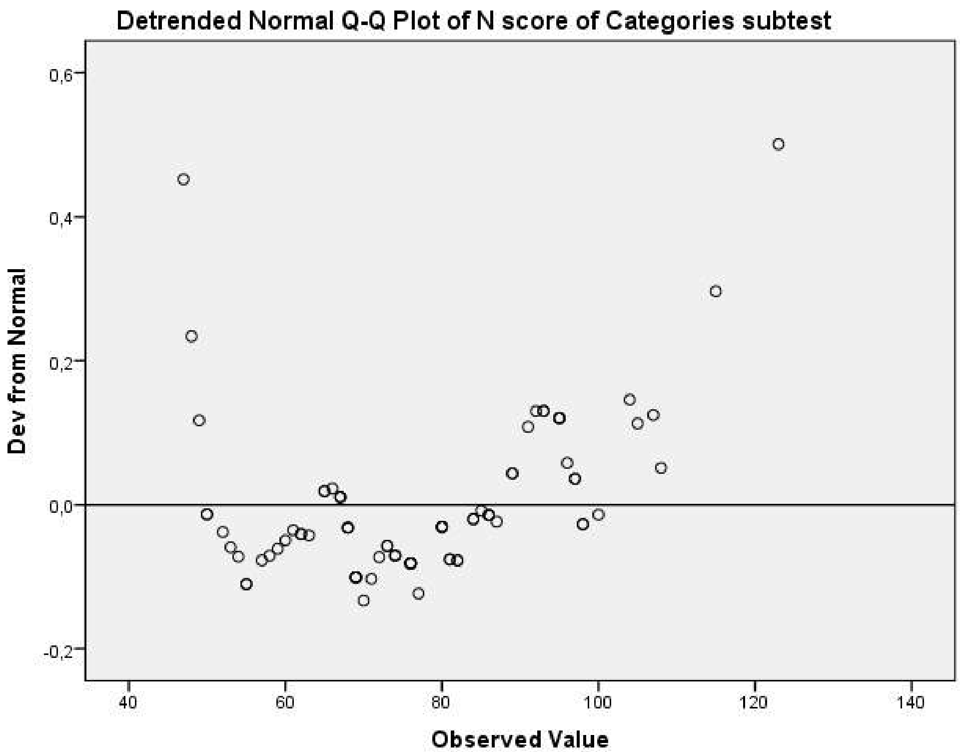

Detrended Normal Q-Q Plot of mean of N scores
1,0
0,8
0,6
0,4
0,2
0,0
-0,2
Dev from Normal
60
80
100
120
Observed Value


120
100
80
60
59
mean of N scores

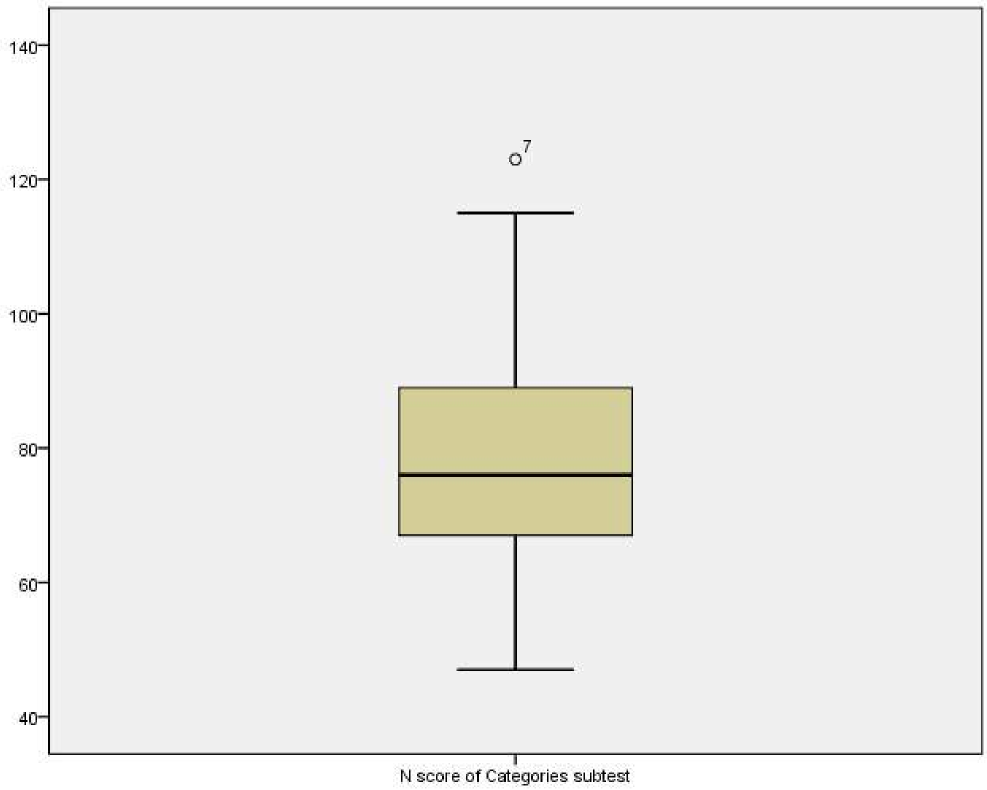
N score of Categories subtest





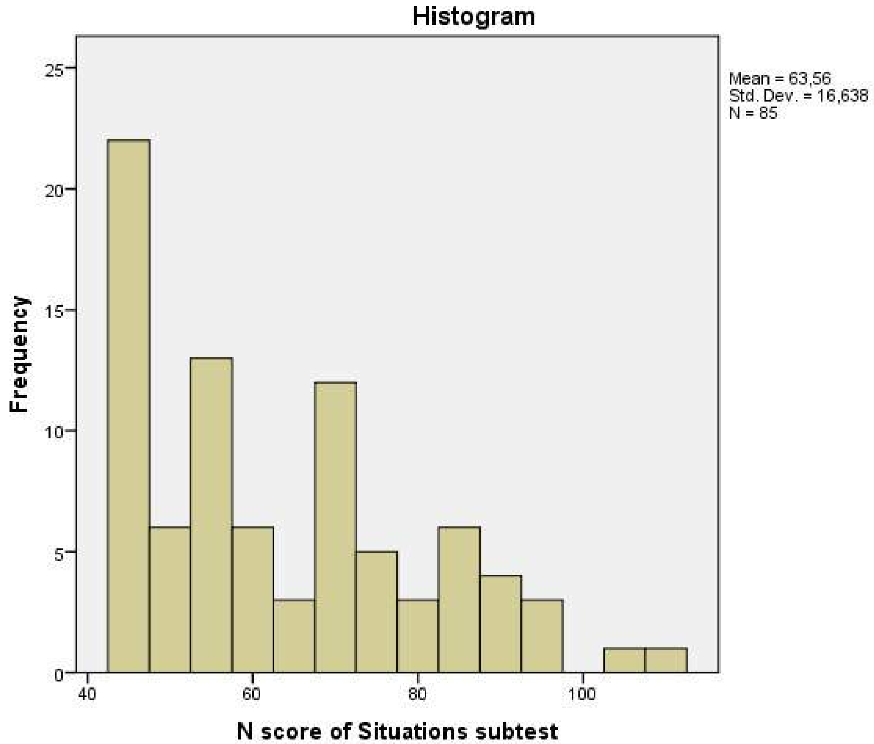


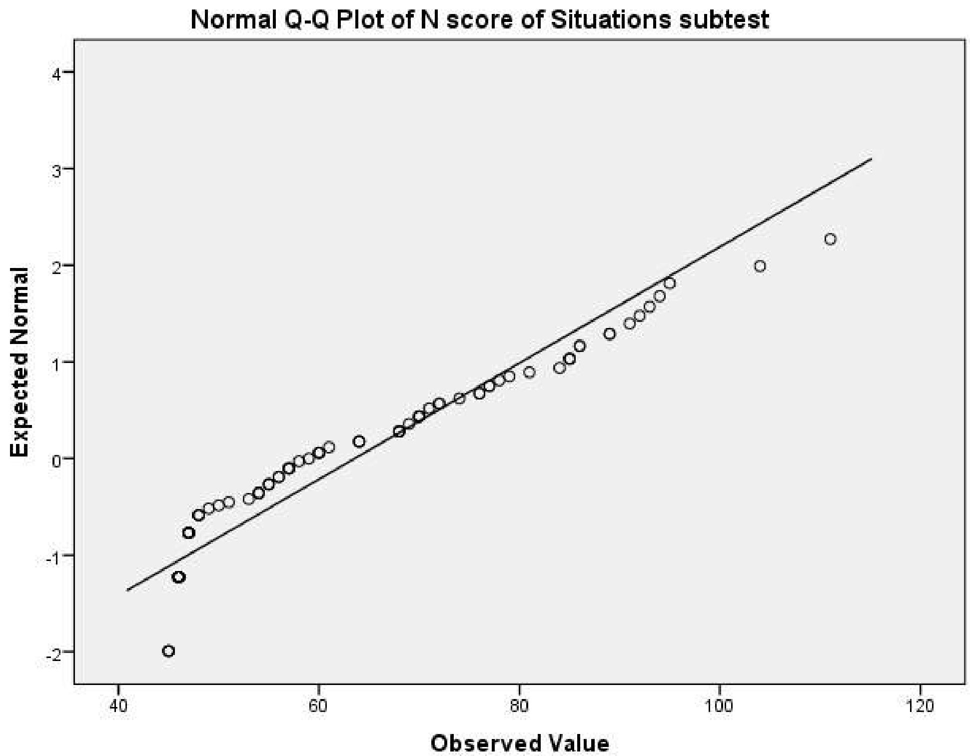
Detrended Normal Q-Q Plot of N score of Categories subtest
Dev from Normal
Observed Value
0,6
0,4
0,2
0,0
-0,2
40
60
80
100
120
140

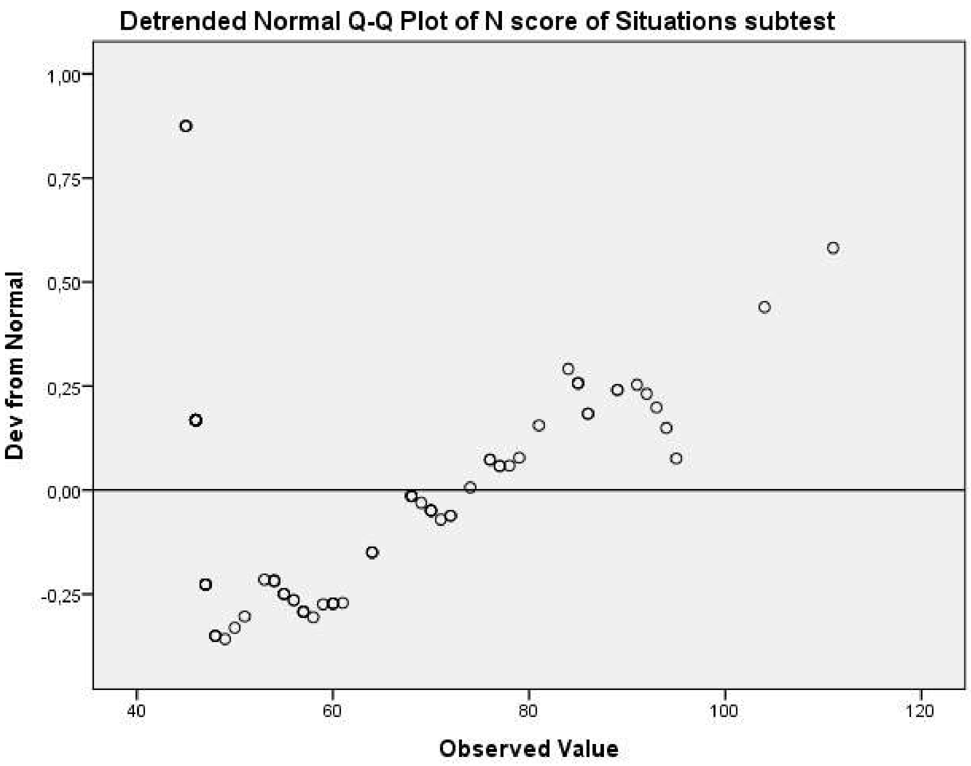


140
120
100
80
60
40
7
N score of Categories subtest

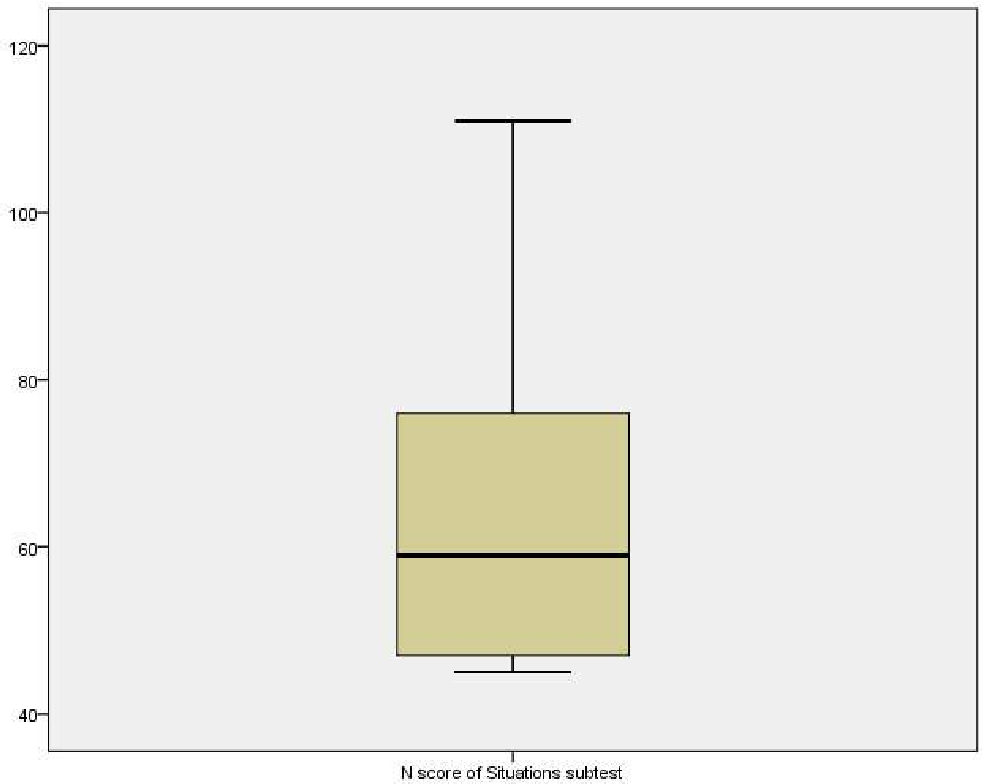
N score of Situations subtest





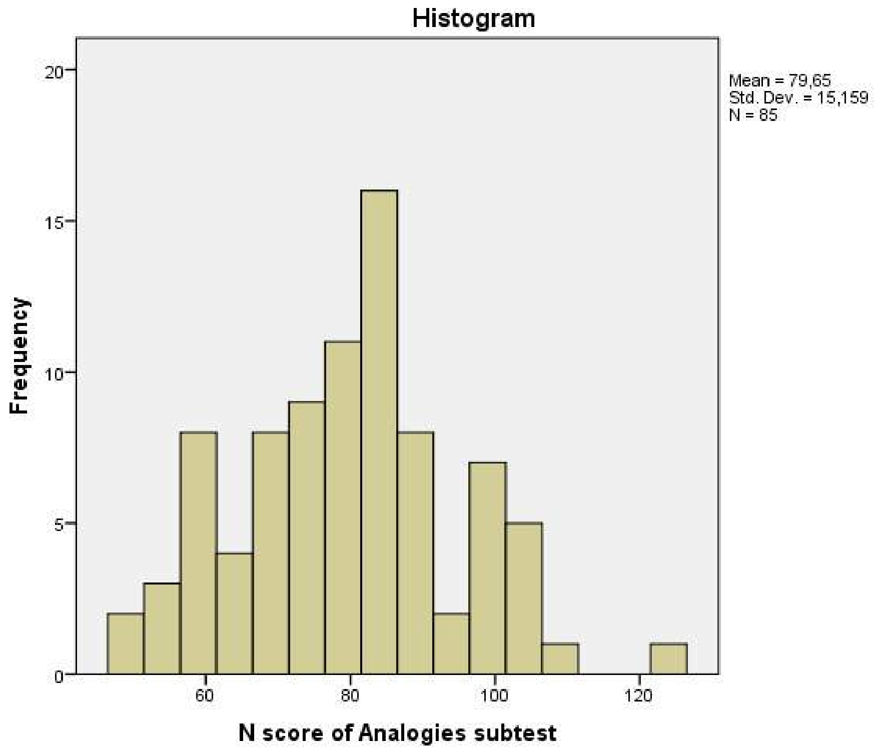


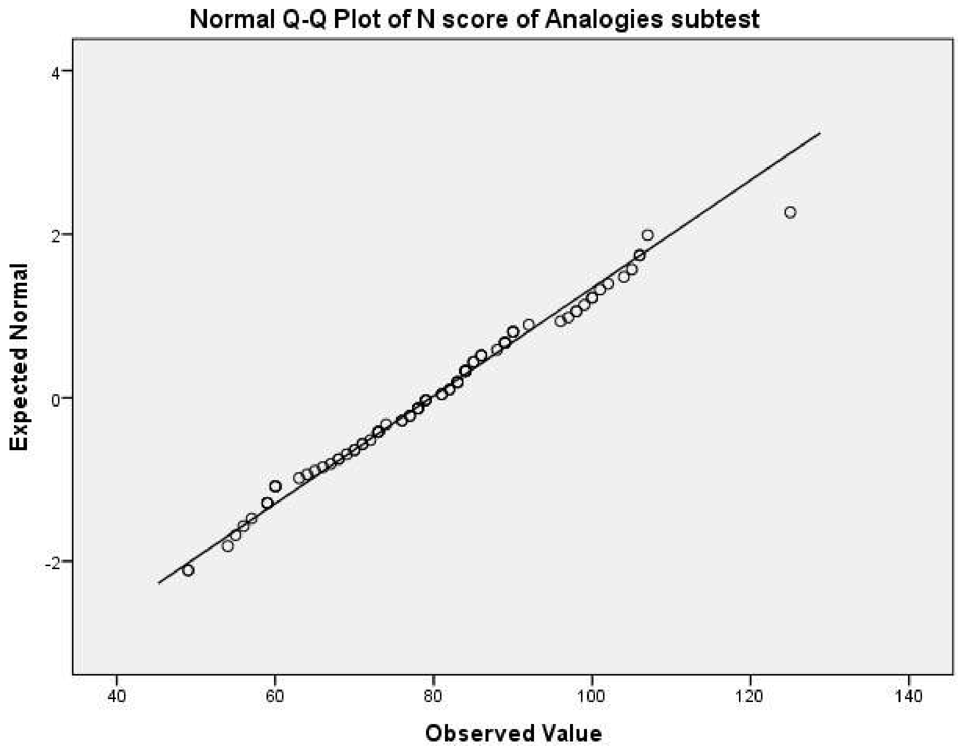
Detrended Normal Q-Q Plot of N score of Situations subtest
1,00
0,75
0,50
0,25
0,00
-0,25
Dev from Normal
40
60
80
100
120
Observed Value

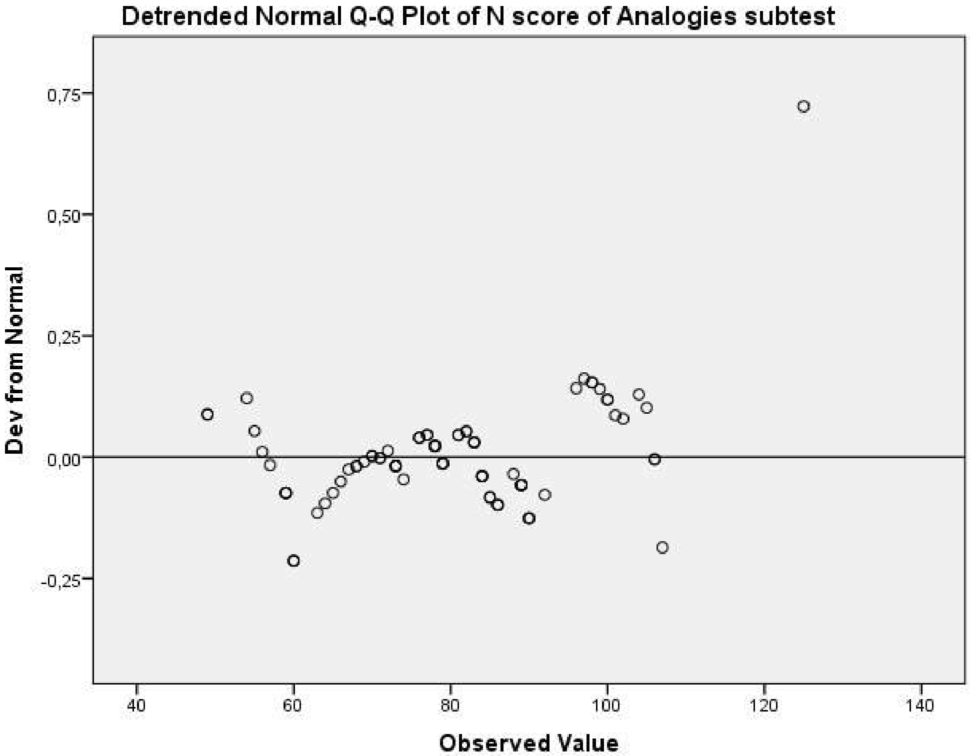


120
100
80
60
40
N score of Situations subtest

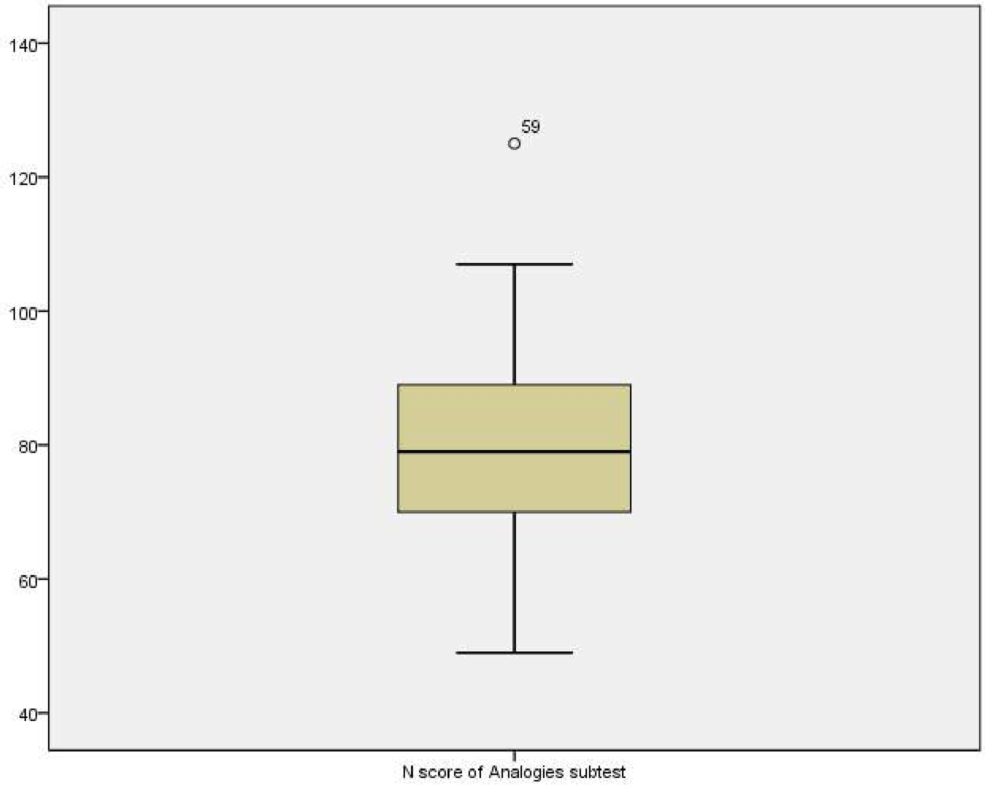
N score of Analogies subtest







Detrended Normal Q-Q Plot of N score of Analogies subtest
Dev from Normal
0,75
0,50
0,25
0,00
-0,25
40
60
80
100
120
140
Observed Value



140
120
100
80
60
40
59
N score of Analogies subtest

```
EXAMINE VARIABLES=T3_average_mark T3_FAL_mark T3_M_mark T3_LSorLO
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
average mark in term 3 2015 (percentage points)	85	100,0%	0	0,0%	85	100,0%
mark in first additional language in term 3 2015 (percentage points)	85	100,0%	0	0,0%	85	100,0%
mark in mathematics in term 3 2015 (percentage points)	85	100,0%	0	0,0%	85	100,0%
mark in life skills/orientation in term 3 2015 (percentage points)	85	100,0%	0	0,0%	85	100,0%

Descriptives

			Statistic	Std. Error
average mark in term 3 2015 (percentage points)	Mean		68,75	1,264
	95% Confidence Interval for Mean	Lower Bound	66,24	
		Upper Bound	71,27	
	5% Trimmed Mean		68,75	
	Median		68,00	
	Variance		135,879	
	Std. Deviation		11,657	
	Minimum		46	
	Maximum		93	
	Range		47	
	Interquartile Range		17	
	Skewness		,097	,261
	Kurtosis		-,788	,517
mark in first additional language in term 3 2015 (percentage points)	Mean		68,80	1,581
	95% Confidence Interval for Mean	Lower Bound	65,66	
		Upper Bound	71,94	
	5% Trimmed Mean		68,66	
	Median		70,00	

	Variance		212,352	
	Std. Deviation		14,572	
	Minimum		43	
	Maximum		99	
	Range		56	
	Interquartile Range		24	
	Skewness		,021	,261
	Kurtosis		-,959	,517
mark in mathematics in term 3 2015 (percentage points)	Mean		66,48	1,735
	95% Confidence Interval for Mean	Lower Bound	63,03	
		Upper Bound	69,93	
	5% Trimmed Mean		66,19	
	Median		66,00	
	Variance		255,943	
	Std. Deviation		15,998	
	Minimum		41	
	Maximum		98	
	Range		57	
	Interquartile Range		22	
	Skewness		,249	,261
	Kurtosis		-,876	,517
mark in life skills/orientation in term 3 2015 (percentage points)	Mean		70,11	1,678
	95% Confidence Interval for Mean	Lower Bound	66,77	
		Upper Bound	73,44	
	5% Trimmed Mean		71,07	
	Median		71,00	
	Variance		239,405	
	Std. Deviation		15,473	
	Minimum		16	
	Maximum		98	
	Range		82	
	Interquartile Range		16	
	Skewness		-1,176	,261
	Kurtosis		2,943	,517

Tests of Normality

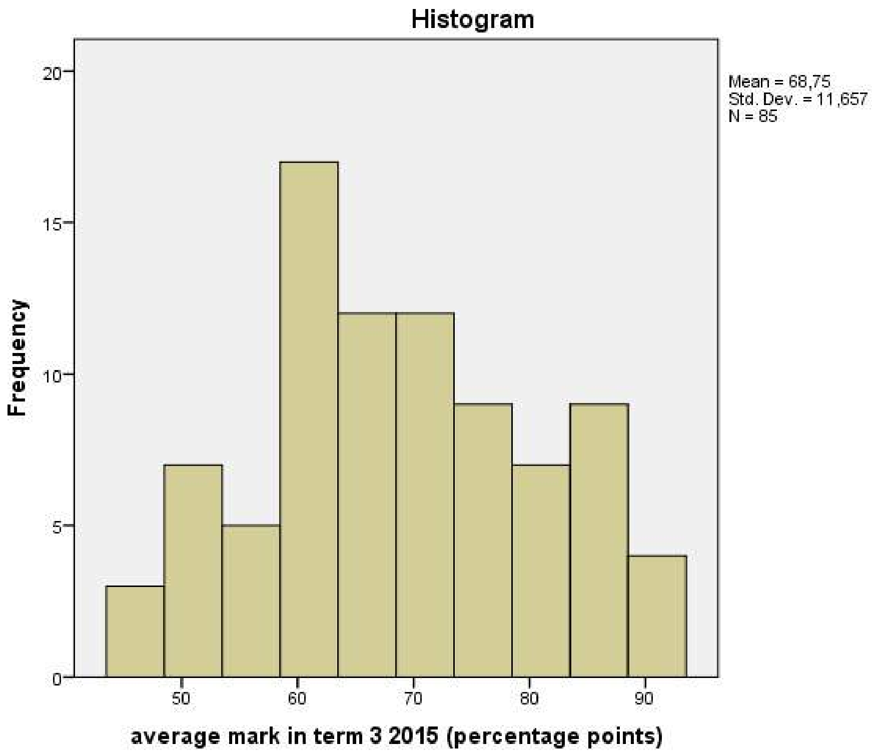
	Kolmogorov-Smirnov[a]	Shapiro-Wilk

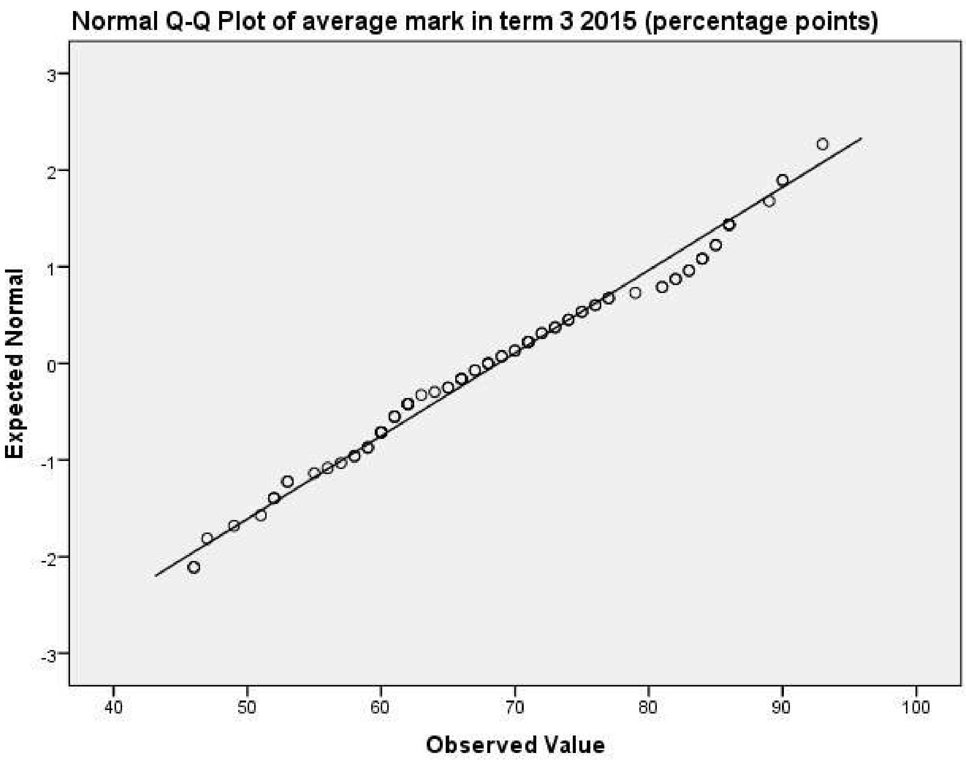
	Statistic	df	Sig.	Statistic	df	Sig.
average mark in term 3 2015 (percentage points)	,084	85	,200*	,977	85	,129
mark in first additional language in term 3 2015 (percentage points)	,085	85	,188	,967	85	,028
mark in mathematics in term 3 2015 (percentage points)	,069	85	,200*	,961	85	,012
mark in life skills/orientation in term 3 2015 (percentage points)	,128	85	,001	,918	85	,000

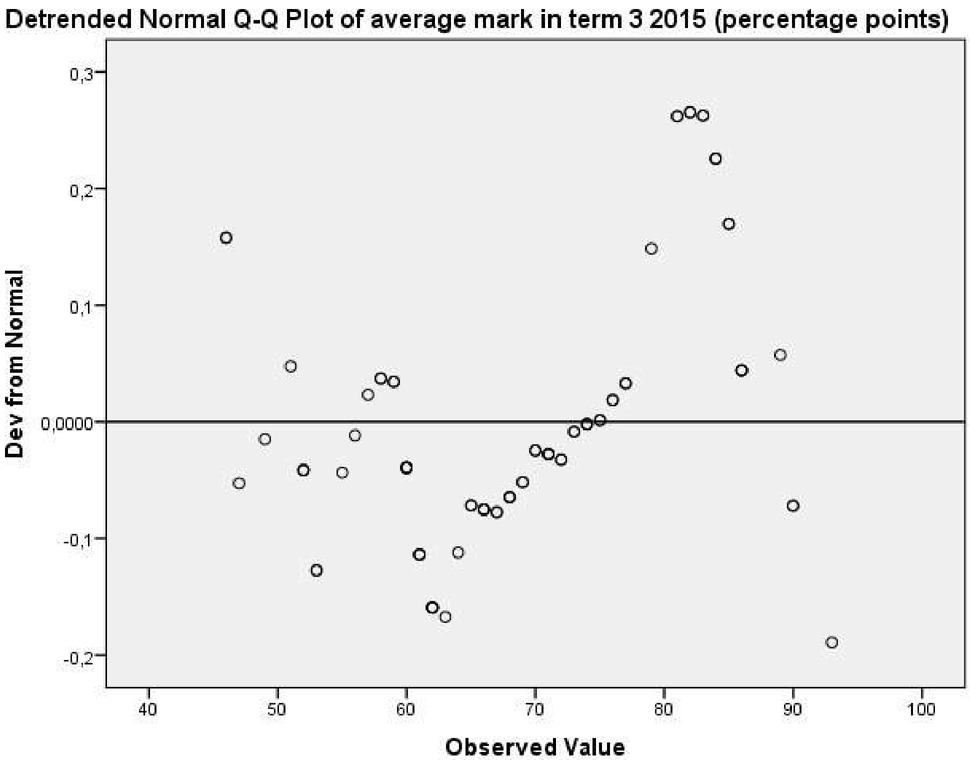
*. This is a lower bound of the true significance.

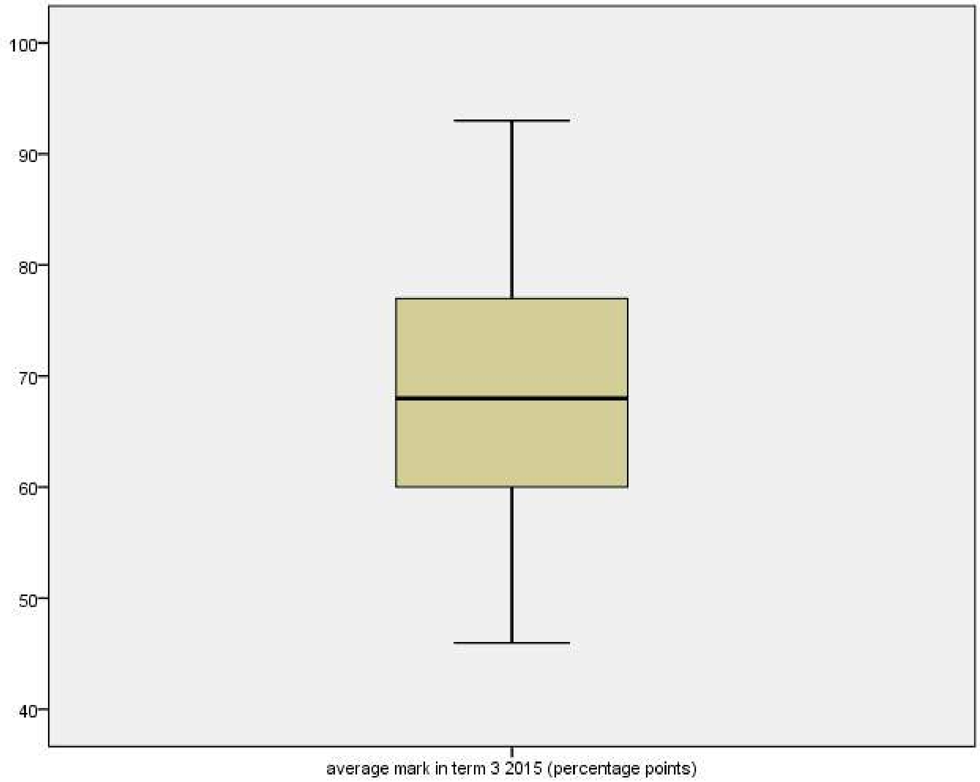
a. Lilliefors Significance Correction

average mark in term 3 2015 (percentage points)

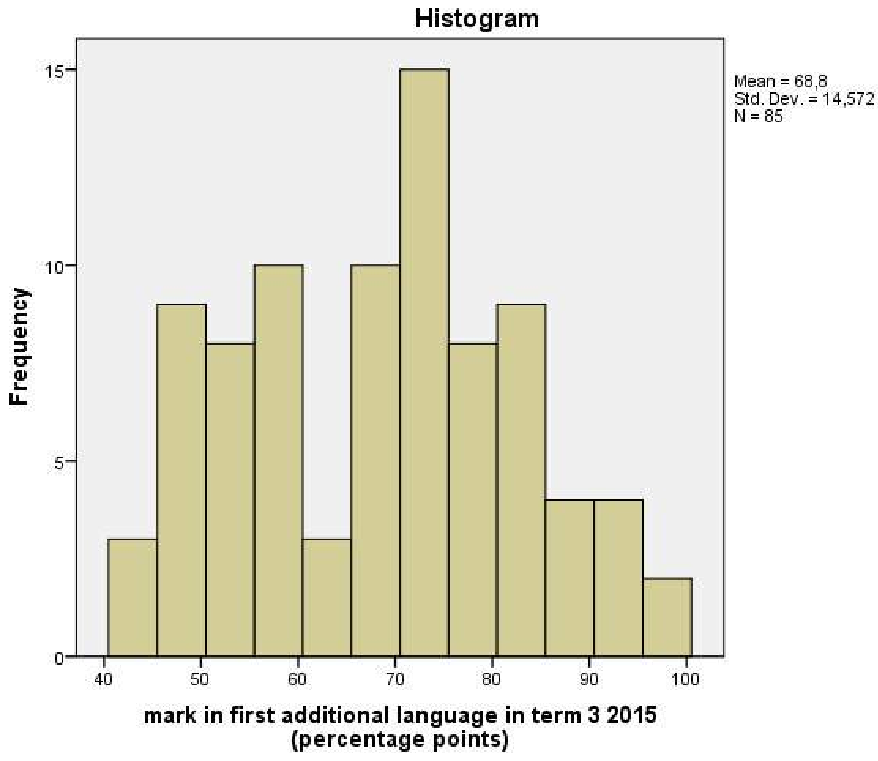


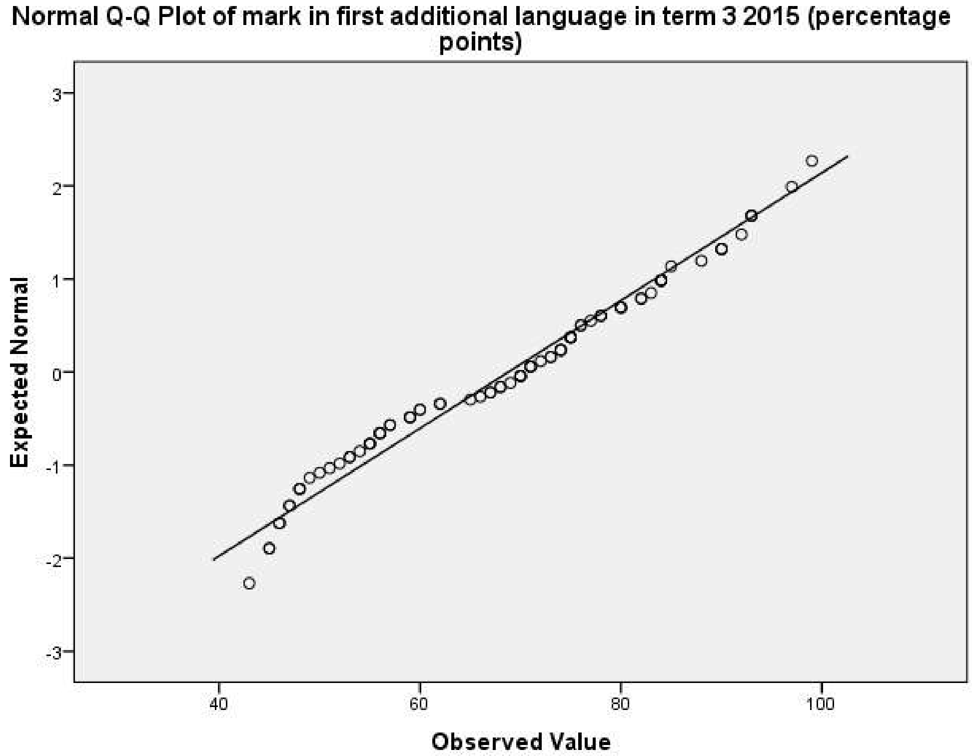

Normal Q-Q Plot of average mark in term 3 2015 (percentage points)
Expected Normal
3
2
1
0
-1
-2
-3
40
50
60
70
80
90
100
Observed Value

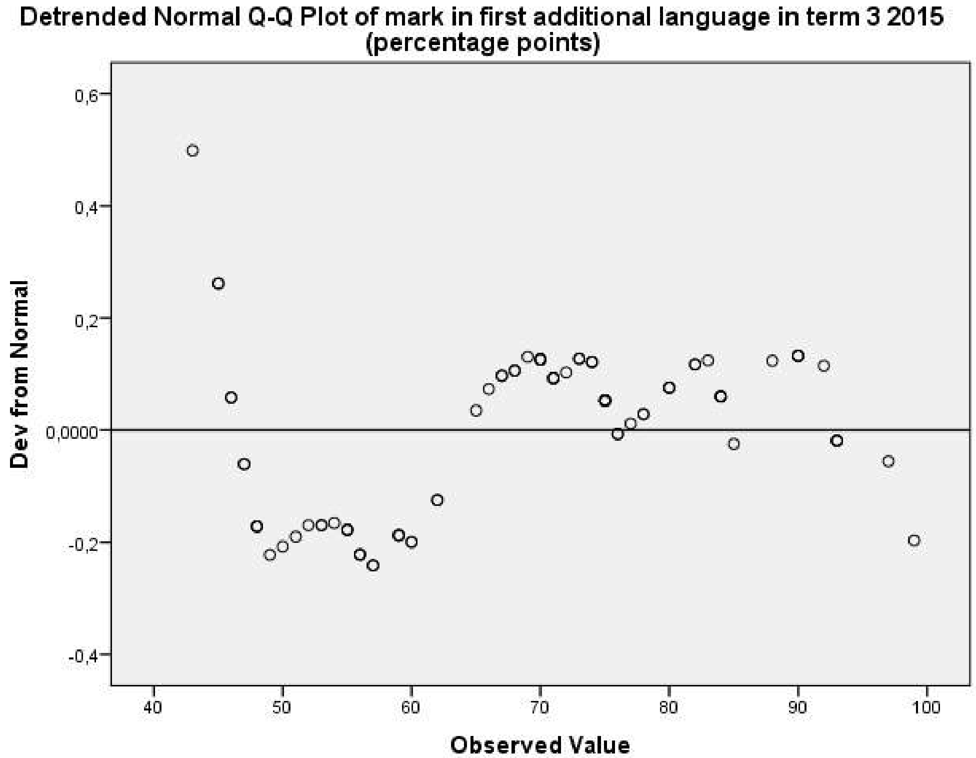

Detrended Normal Q-Q Plot of average mark in term 3 2015 (percentage points)
Dev from Normal
0,3
0,2
0,1
0,0000
-0,1
-0,2
40
50
60
70
80
90
100
Observed Value

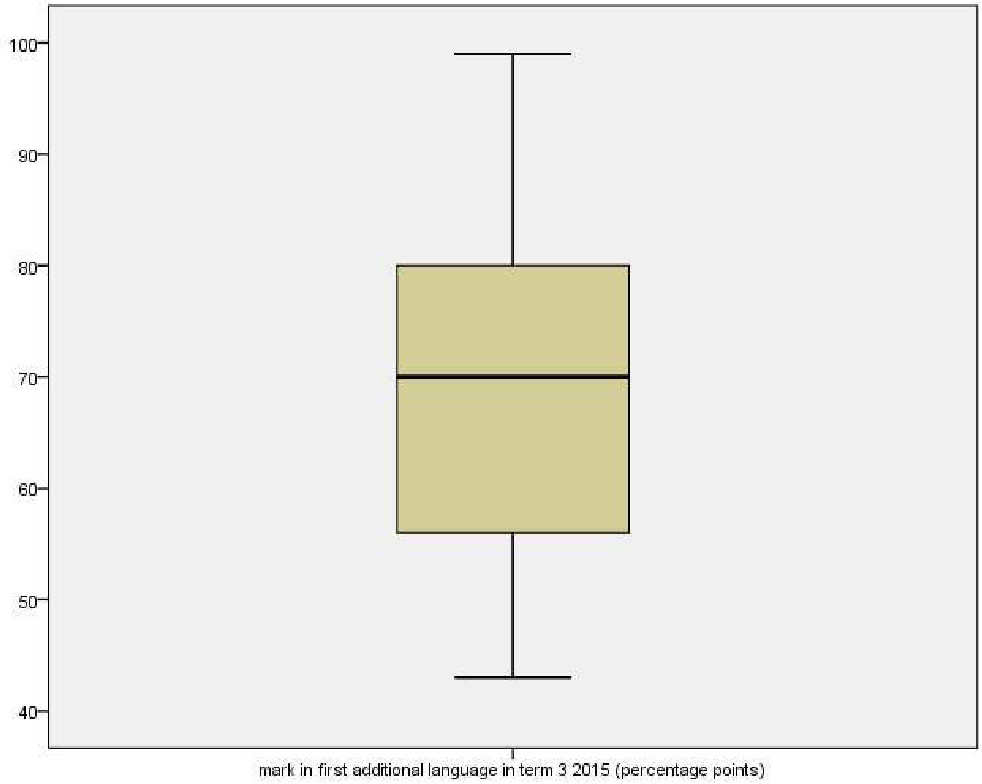


mark in first additional language in term 3 2015 (percentage points)

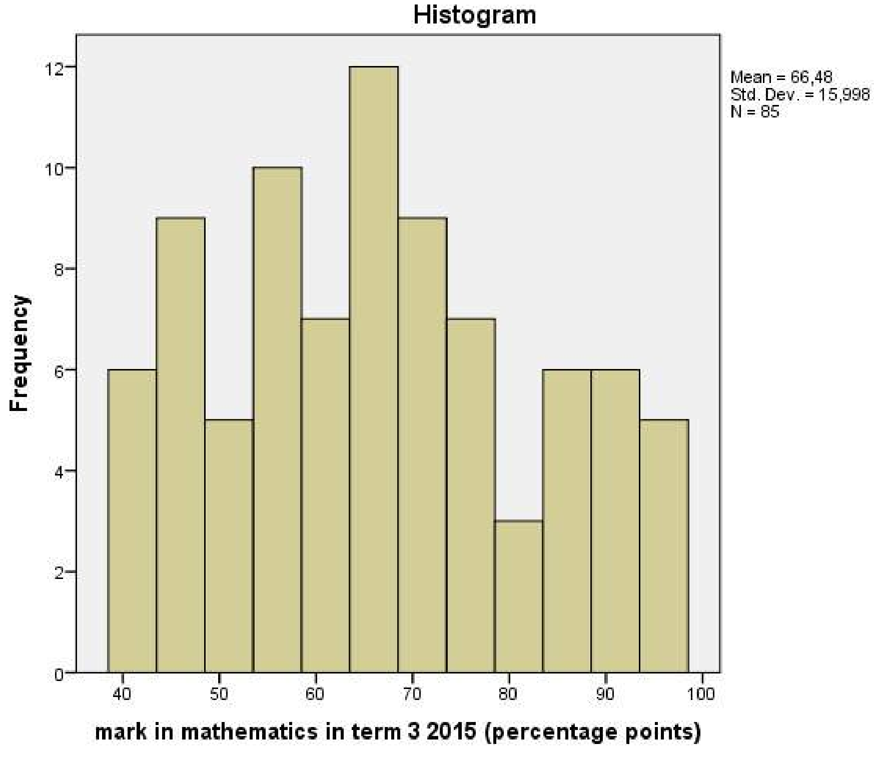


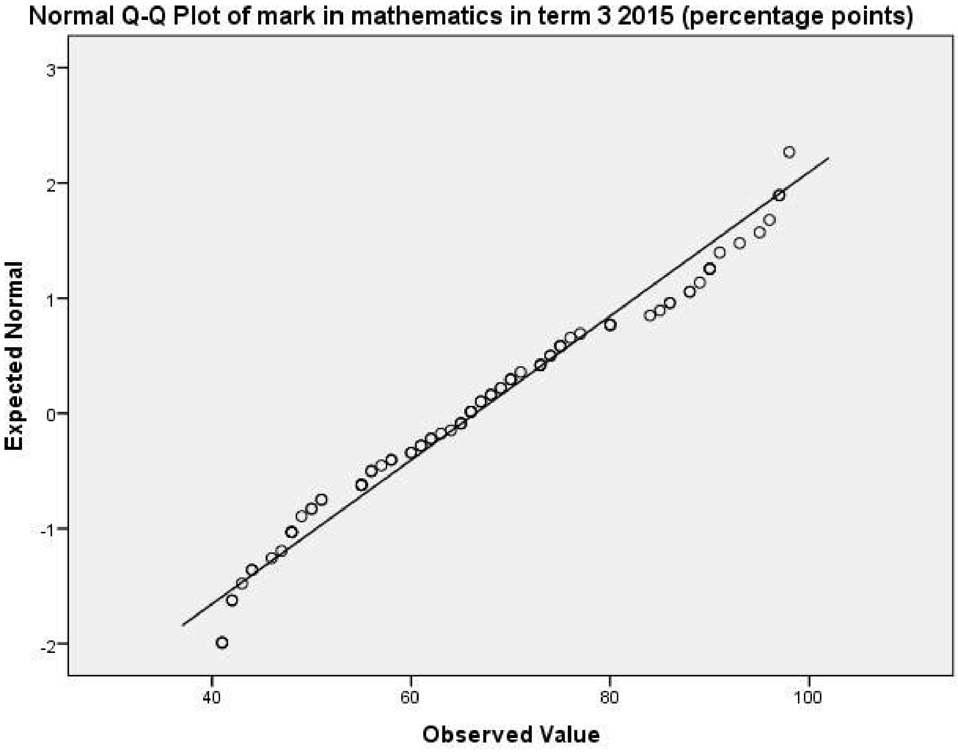

Normal Q-Q Plot of mark in first additional language in term 3 2015 (percentage points)
Expected Normal
3
2
1
0
-1
-2
-3
40
60
80
100
Observed Value

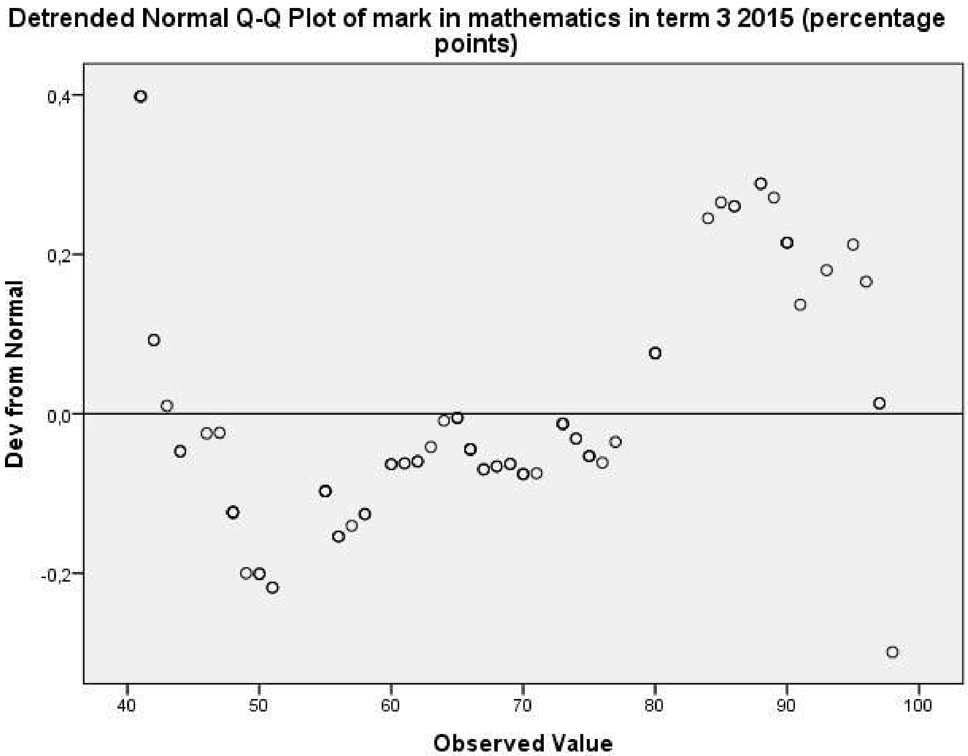

Detrended Normal Q-Q Plot of mark in first additional language in term 3 2015 (percentage points)
Dev from Normal
0,6
0,4
0,2
0,0000
-0,2
-0,4
40
50
60
70
80
90
100
Observed Value

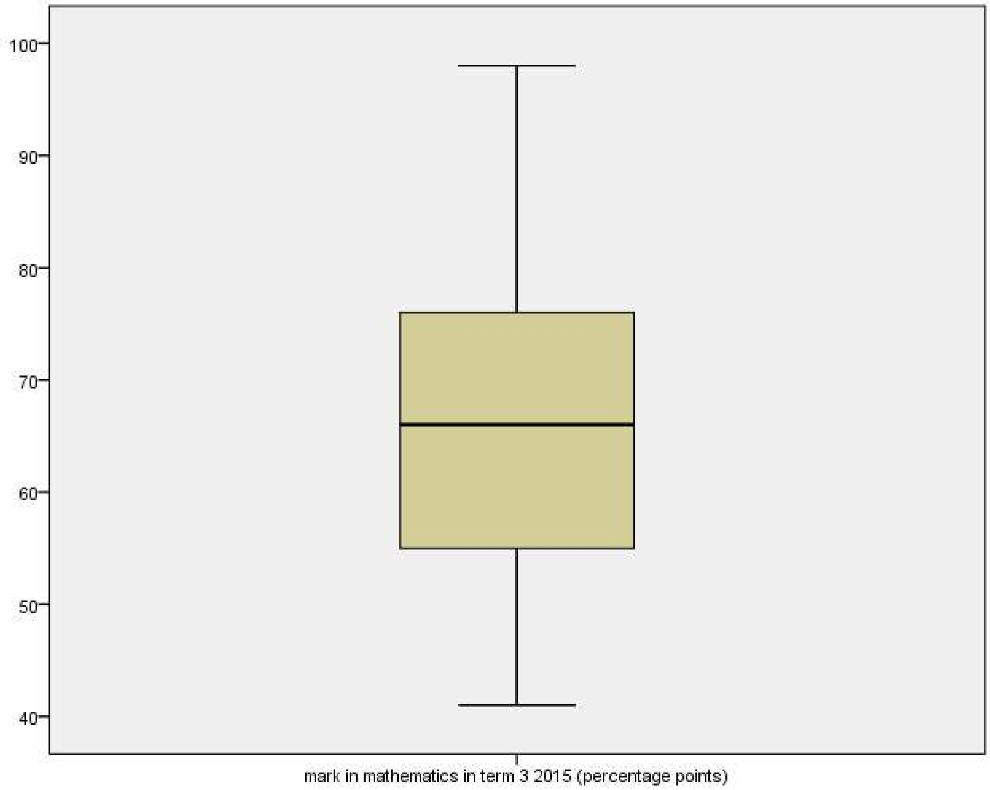


mark in mathematics in term 3 2015 (percentage points)

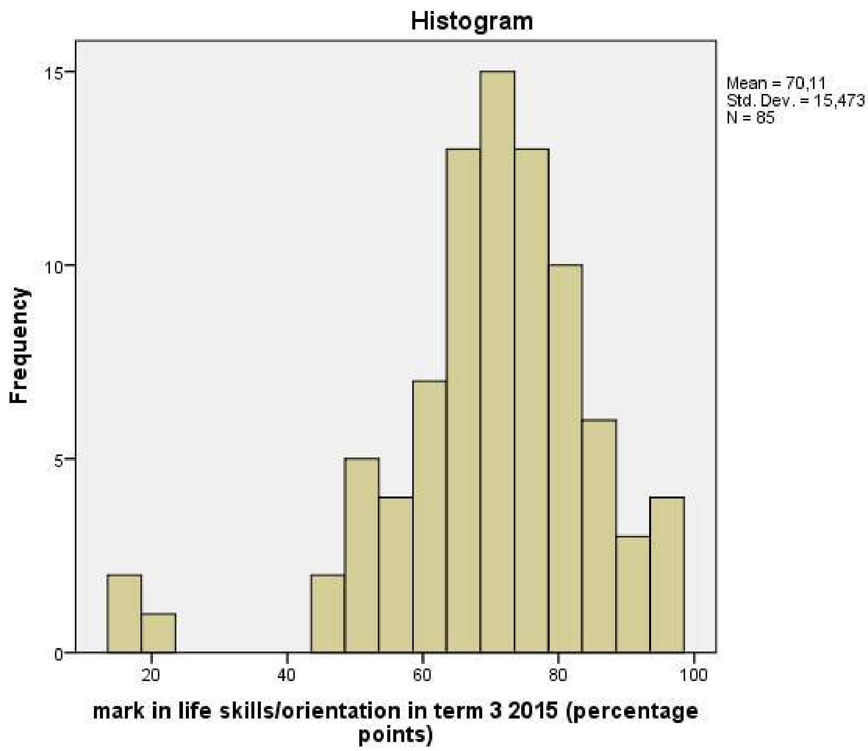


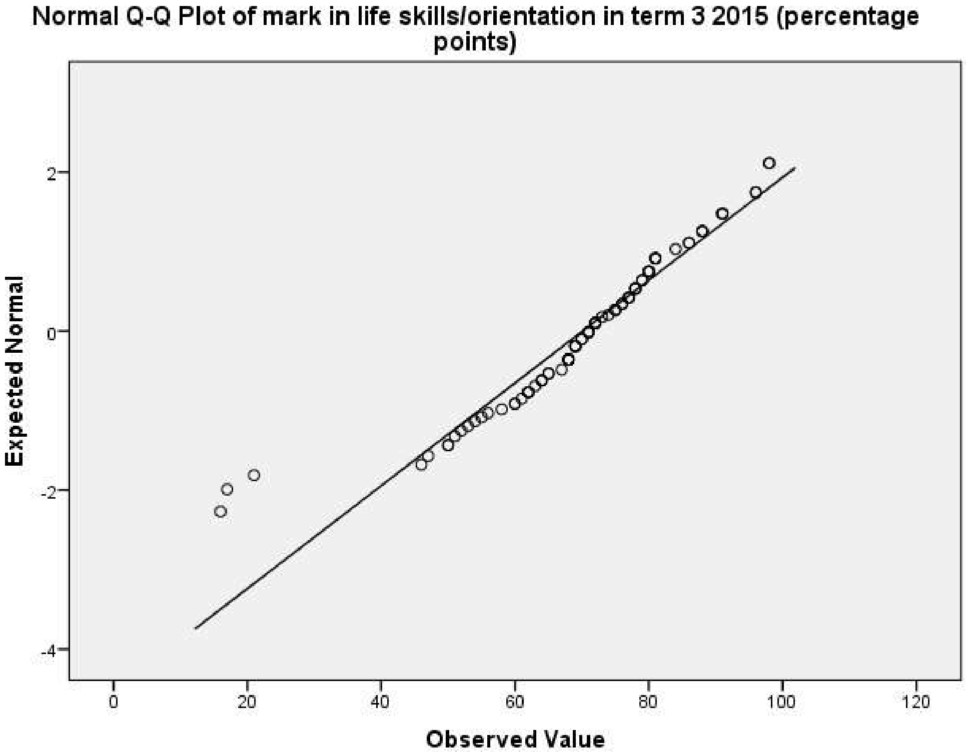

Normal Q-Q Plot of mark in mathematics in term 3 2015 (percentage points)
Expected Normal
Observed Value
3
2
1
0
-1
-2
40
60
80
100

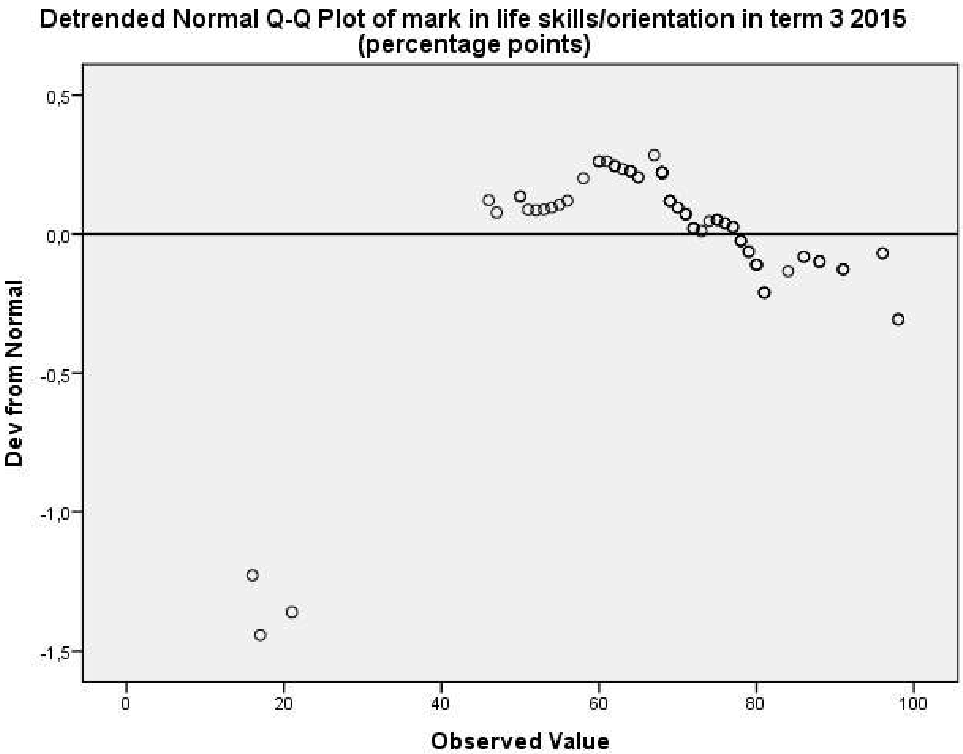

Detrended Normal Q-Q Plot of mark in mathematics in term 3 2015 (percentage points)
Dev from Normal
Observed Value
0,4
0,2
0,0
-0,2
40
50
60
70
80
90
100

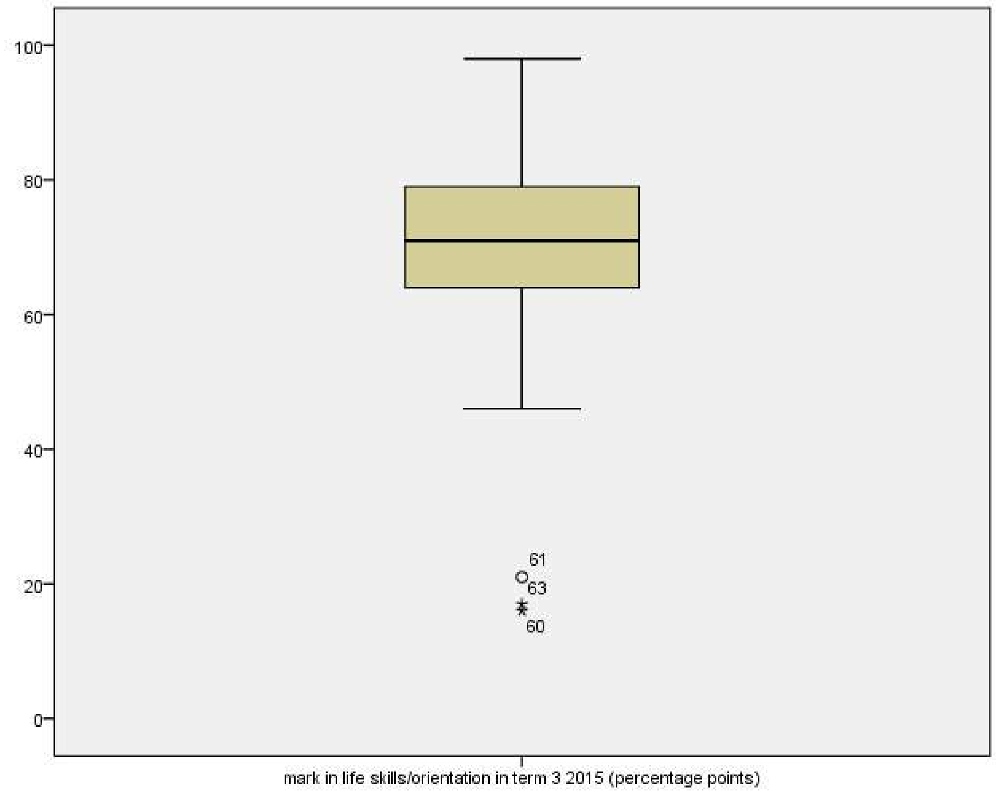


mark in life skills/orientation in term 3 2015 (percentage points)




Normal Q-Q Plot of mark in life skills/orientation in term 3 2015 (percentage points)
Expected Normal
2
0
-2
-4
0
20
40
60
80
100
120
Observed Value


Detrended Normal Q-Q Plot of mark in life skills/orientation in term 3 2015 (percentage points)
Dev from Normal
0,5
0,0
-0,5
-1,0
-1,5
0
20
40
60
80
100
Observed Value




```
EXAMINE VARIABLES=T3_HL_mark
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
mark in home language in term 3 2015 (percentage points)	84	98,8%	1	1,2%	85	100,0%

Descriptives

			Statistic	Std. Error
mark in home language in term 3 2015 (percentage points)	Mean		71,49	1,374
	95% Confidence Interval for Mean	Lower Bound	68,76	
		Upper Bound	74,22	
	5% Trimmed Mean		71,65	
	Median		70,50	

	Variance	158,494	
	Std. Deviation	12,589	
	Minimum	40	
	Maximum	95	
	Range	55	
	Interquartile Range	19	
	Skewness	-,086	,263
	Kurtosis	-,539	,520

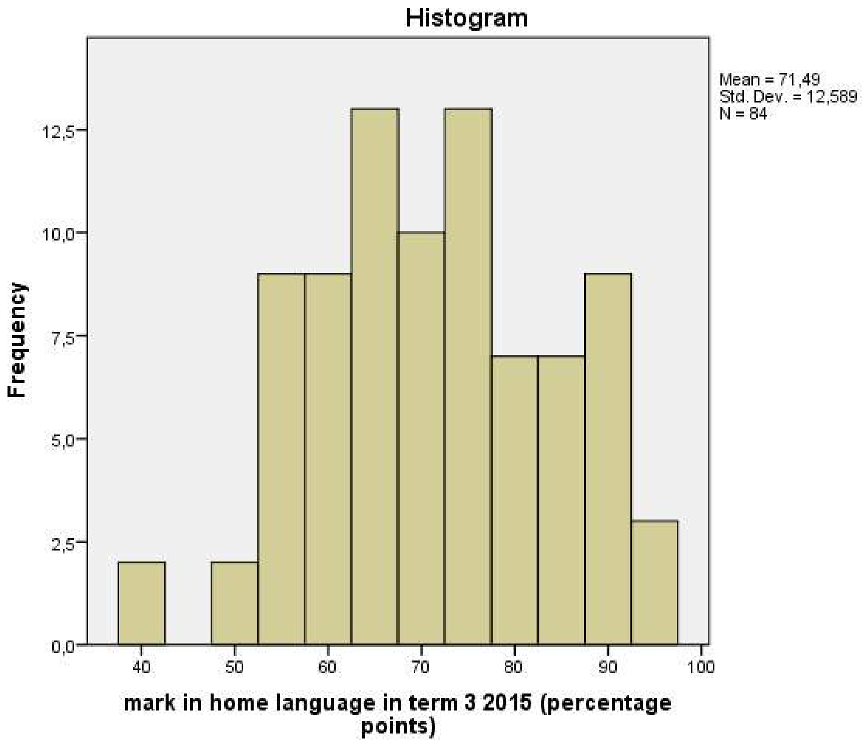
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
mark in home language in term 3 2015 (percentage points)	,056	84	,200*	,982	84	,300

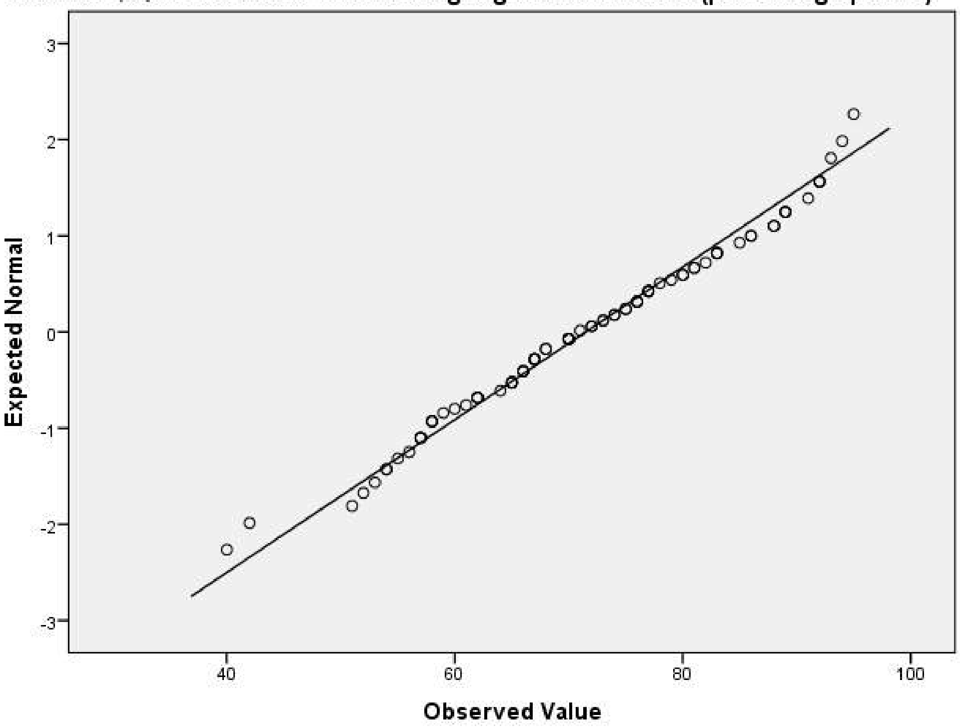
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

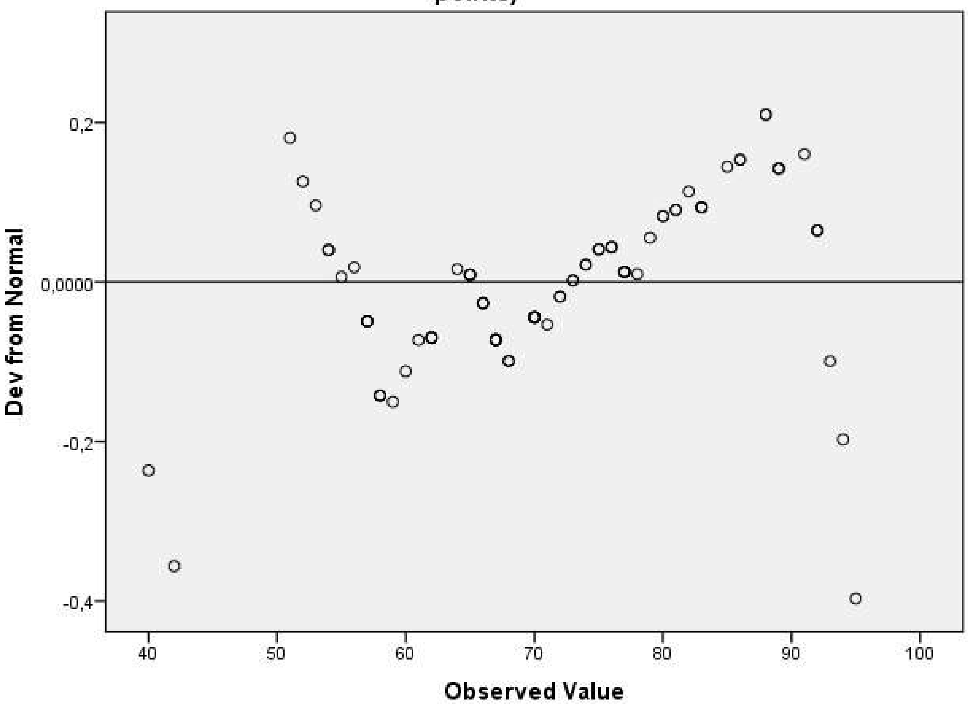
mark in home language in term 3 2015 (percentage points)

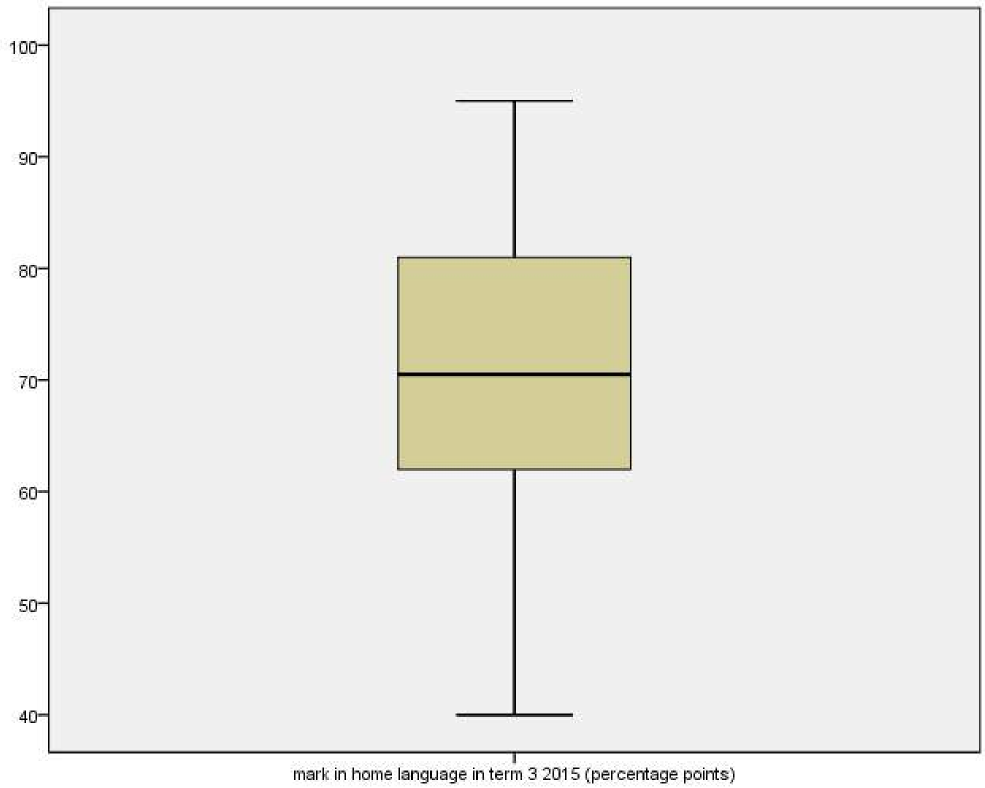


Normal Q-Q Plot of mark in home language in term 3 2015 (percentage points)



Detrended Normal Q-Q Plot of mark in home language in term 3 2015 (percentage points)




100
90
80
70
60
50
40
mark in home language in term 3 2015 (percentage points)

```
ONEWAY mean_N score_C_N score_A_N T3_average_mark T3_HL_mark BY groups_longterm
  /STATISTICS HOMOGENEITY
  /MISSING ANALYSIS
  /POSTHOC=GABRIEL GT2 GH ALPHA(0.05).
```

Oneway

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
mean of N scores	1,788	2	82	,174
N score of Categories subtest	,753	2	82	,474
N score of Analogies subtest	2,078	2	82	,132
average mark in term 3 2015 (percentage points)	2,145	2	82	,124
mark in home language in term 3 2015 (percentage points)	,045	2	81	,956

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
mean of N scores	Between Groups	572,310	2	286,155	1,948	,149
	Within Groups	12047,878	82	146,925		
	Total	12620,188	84			
N score of Categories subtest	Between Groups	687,040	2	343,520	1,259	,289
	Within Groups	22371,007	82	272,817		
	Total	23058,047	84			
N score of Analogies subtest	Between Groups	463,011	2	231,505	1,008	,370
	Within Groups	18840,401	82	229,761		
	Total	19303,412	84			
average mark in term 3 2015 (percentage points)	Between Groups	389,973	2	194,986	1,450	,240
	Within Groups	11023,839	82	134,437		

	Total	11413,812	84			
mark in home language in term 3 2015 (percentage points)	Between Groups	220,262	2	110,131	,690	,505
	Within Groups	12934,726	81	159,688		
	Total	13154,988	83			

Post Hoc Tests

Multiple Comparisons

Dependent Variable		(I) restructured groups only considering more than three months of chess instruction	(J) restructured groups only considering more than three months of chess instruction	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
mean of N scores	Gabriel	chess	other extracurricular activities	5,352	3,401	,315	-2,93	13,63
			no extracurricular activities	6,029	3,232	,180	-1,81	13,87
		other extracurricular activities	chess	-5,352	3,401	,315	-13,63	2,93
			no extracurricular activities	,678	3,125	,995	-6,92	8,28
		no extracurricular activities	chess	-6,029	3,232	,180	-13,87	1,81
			other extracurricular activities	-,678	3,125	,995	-8,28	6,92
	Hochberg	chess	other extracurricular activities	5,352	3,401	,315	-2,93	13,63
			no extracurricular activities	6,029	3,232	,183	-1,84	13,90
		other extracurricular activities	chess	-5,352	3,401	,315	-13,63	2,93
			no extracurricular activities	,678	3,125	,995	-6,93	8,29
		no extracurricular activities	chess	-6,029	3,232	,183	-13,90	1,84
			other extracurricular activities	-,678	3,125	,995	-8,29	6,93
	Games-Howell	chess	other extracurricular activities	5,352	3,835	,352	-3,95	14,65
			no extracurricular activities	6,029	3,474	,206	-2,46	14,52
		other extracurricular activities	chess	-5,352	3,835	,352	-14,65	3,95

			no extracurricular activities	,678	2,863	,970	-6,24	7,59
		no extracurricular activities	chess	-6,029	3,474	,206	-14,52	2,46
			other extracurricular activities	-,678	2,863	,970	-7,59	6,24
N score of Categories subtest	Gabriel	chess	other extracurricular activities	5,014	4,634	,627	-6,27	16,30
			no extracurricular activities	6,900	4,404	,315	-3,79	17,58
		other extracurricular activities	chess	-5,014	4,634	,627	-16,30	6,27
			no extracurricular activities	1,886	4,258	,960	-8,47	12,24
		no extracurricular activities	chess	-6,900	4,404	,315	-17,58	3,79
			other extracurricular activities	-1,886	4,258	,960	-12,24	8,47
	Hochberg	chess	other extracurricular activities	5,014	4,634	,627	-6,27	16,30
			no extracurricular activities	6,900	4,404	,319	-3,83	17,63
		other extracurricular activities	chess	-5,014	4,634	,627	-16,30	6,27
			no extracurricular activities	1,886	4,258	,960	-8,48	12,26
		no extracurricular activities	chess	-6,900	4,404	,319	-17,63	3,83
			other extracurricular activities	-1,886	4,258	,960	-12,26	8,48
	Games-Howell	chess	other extracurricular activities	5,014	4,873	,562	-6,77	16,80
			no extracurricular activities	6,900	4,427	,274	-3,83	17,63
		other extracurricular activities	chess	-5,014	4,873	,562	-16,80	6,77
			no extracurricular activities	1,886	4,211	,896	-8,27	12,04
		no extracurricular activities	chess	-6,900	4,427	,274	-17,63	3,83
			other extracurricular activities	-1,886	4,211	,896	-12,04	8,27
N score of Analogies subtest	Gabriel	chess	other extracurricular activities	5,907	4,252	,422	-4,45	16,26
			no extracurricular activities	4,108	4,041	,669	-5,70	13,91
		other extracurricular activities	chess	-5,907	4,252	,422	-16,26	4,45
			no extracurricular activities	-1,800	3,907	,955	-11,30	7,70
		no extracurricular activities	chess	-4,108	4,041	,669	-13,91	5,70

			other extracurricular activities	1,800	3,907	,955	-7,70	11,30
	Hochberg	chess	other extracurricular activities	5,907	4,252	,422	-4,45	16,26
			no extracurricular activities	4,108	4,041	,672	-5,74	13,95
		other extracurricular activities	chess	-5,907	4,252	,422	-16,26	4,45
			no extracurricular activities	-1,800	3,907	,955	-11,32	7,72
		no extracurricular activities	chess	-4,108	4,041	,672	-13,95	5,74
			other extracurricular activities	1,800	3,907	,955	-7,72	11,32
	Games-Howell	chess	other extracurricular activities	5,907	4,507	,398	-5,09	16,90
			no extracurricular activities	4,108	4,613	,649	-7,11	15,33
		other extracurricular activities	chess	-5,907	4,507	,398	-16,90	5,09
			no extracurricular activities	-1,800	3,355	,854	-9,87	6,27
		no extracurricular activities	chess	-4,108	4,613	,649	-15,33	7,11
			other extracurricular activities	1,800	3,355	,854	-6,27	9,87
average mark in term 3 2015 (percentage points)	Gabriel	chess	other extracurricular activities	4,685	3,253	,391	-3,23	12,60
			no extracurricular activities	4,814	3,091	,321	-2,69	12,31
		other extracurricular activities	chess	-4,685	3,253	,391	-12,60	3,23
			no extracurricular activities	,129	2,989	1,000	-7,14	7,40
		no extracurricular activities	chess	-4,814	3,091	,321	-12,31	2,69
			other extracurricular activities	-,129	2,989	1,000	-7,40	7,14
	Hochberg	chess	other extracurricular activities	4,685	3,253	,391	-3,24	12,61
			no extracurricular activities	4,814	3,091	,324	-2,72	12,34
		other extracurricular activities	chess	-4,685	3,253	,391	-12,61	3,24
			no extracurricular activities	,129	2,989	1,000	-7,15	7,41
		no extracurricular activities	chess	-4,814	3,091	,324	-12,34	2,72
			other extracurricular activities	-,129	2,989	1,000	-7,41	7,15
	Games-Howell	chess	other extracurricular activities	4,685	3,179	,314	-3,04	12,41

			no extracurricular activities	4,814	3,336	,327	-3,25	12,88
		other extracurricular activities	chess	-4,685	3,179	,314	-12,41	3,04
			no extracurricular activities	,129	2,789	,999	-6,58	6,84
		no extracurricular activities	chess	-4,814	3,336	,327	-12,88	3,25
			other extracurricular activities	-,129	2,789	,999	-6,84	6,58
mark in home language in term 3 2015 (percentage points)	Gabriel	chess	other extracurricular activities	1,462	3,577	,968	-7,25	10,17
			no extracurricular activities	3,853	3,369	,582	-4,32	12,03
		other extracurricular activities	chess	-1,462	3,577	,968	-10,17	7,25
			no extracurricular activities	2,391	3,292	,848	-5,61	10,39
		no extracurricular activities	chess	-3,853	3,369	,582	-12,03	4,32
			other extracurricular activities	-2,391	3,292	,848	-10,39	5,61
	Hochberg	chess	other extracurricular activities	1,462	3,577	,968	-7,25	10,18
			no extracurricular activities	3,853	3,369	,585	-4,35	12,06
		other extracurricular activities	chess	-1,462	3,577	,968	-10,18	7,25
			no extracurricular activities	2,391	3,292	,849	-5,63	10,41
		no extracurricular activities	chess	-3,853	3,369	,585	-12,06	4,35
			other extracurricular activities	-2,391	3,292	,849	-10,41	5,63
	Games-Howell	chess	other extracurricular activities	1,462	3,520	,910	-7,05	9,98
			no extracurricular activities	3,853	3,270	,471	-4,04	11,74
		other extracurricular activities	chess	-1,462	3,520	,910	-9,98	7,05
			no extracurricular activities	2,391	3,379	,760	-5,75	10,54
		no extracurricular activities	chess	-3,853	3,270	,471	-11,74	4,04
			other extracurricular activities	-2,391	3,379	,760	-10,54	5,75

Homogeneous Subsets

mean of N scores

	restructured groups only considering more than three months of chess instruction	N	Subset for alpha = 0.05
			1
Gabriel[a,b]	no extracurricular activities	34	71,47
	other extracurricular activities	27	72,15
	chess	24	77,50
	Sig.		,188
Hochberg[a,b]	no extracurricular activities	34	71,47
	other extracurricular activities	27	72,15
	chess	24	77,50
	Sig.		,188

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 27,748.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

N score of Categories subtest

	restructured groups only considering more than three months of chess instruction	N	Subset for alpha = 0.05
			1
Gabriel[a,b]	no extracurricular activities	34	74,56
	other extracurricular activities	27	76,44
	chess	24	81,46
	Sig.		,325
Hochberg[a,b]	no extracurricular activities	34	74,56
	other extracurricular activities	27	76,44
	chess	24	81,46
	Sig.		,325

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 27,748.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

N score of Analogies subtest

	restructured groups only considering more than three months of chess instruction	N	Subset for alpha = 0.05
			1
Gabriel[a,b]	other extracurricular activities	27	77,26
	no extracurricular activities	34	79,06
	chess	24	83,17

	Sig.		,384
Hochberg[a,b]	other extracurricular activities	27	77,26
	no extracurricular activities	34	79,06
	chess	24	83,17
	Sig.		,384

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 27,748.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

average mark in term 3 2015 (percentage points)

	restructured groups only considering more than three months of chess instruction	N	Subset for alpha = 0.05
			1
Gabriel[a,b]	no extracurricular activities	34	67,35
	other extracurricular activities	27	67,48
	chess	24	72,17
	Sig.		,330
Hochberg[a,b]	no extracurricular activities	34	67,35
	other extracurricular activities	27	67,48
	chess	24	72,17
	Sig.		,330

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 27,748.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

mark in home language in term 3 2015 (percentage points)

	restructured groups only considering more than three months of chess instruction	N	Subset for alpha = 0.05
			1
Gabriel[a,b]	no extracurricular activities	34	69,65
	other extracurricular activities	26	72,04
	chess	24	73,50
	Sig.		,596
Hochberg[a,b]	no extracurricular activities	34	69,65
	other extracurricular activities	26	72,04
	chess	24	73,50
	Sig.		,596

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 27,387.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

```
T-TEST GROUPS=II_Chess_vs_NoChess(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=mean_N score_C_N score_A_N T3_average_mark T3_HL_mark
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	recoded into chess vs. no chess (from restructured groups, only chess > 3m)	N	Mean	Std. Deviation	Std. Error Mean
mean of N scores	no chess	61	71,77	10,745	1,376
	chess	24	77,50	14,932	3,048
N score of Categories subtest	no chess	61	75,39	15,998	2,048
	chess	24	81,46	17,530	3,578
N score of Analogies subtest	no chess	61	78,26	13,240	1,695
	chess	24	83,17	19,078	3,894
average mark in term 3 2015 (percentage points)	no chess	61	67,41	11,038	1,413
	chess	24	72,17	12,706	2,594
mark in home language in term 3 2015 (percentage points)	no chess	60	70,68	12,887	1,664
	chess	24	73,50	11,832	2,415

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper

mean of N scores	Equal variances assumed	2,669	,106	-1,973	83	,052	-5,730	2,904	-11,505	,046
	Equal variances not assumed			-1,713	32,804	,096	-5,730	3,344	-12,534	1,075
N score of Categories subtest	Equal variances assumed	,694	,407	-1,531	83	,129	-6,065	3,961	-13,942	1,813
	Equal variances not assumed			-1,471	38,940	,149	-6,065	4,123	-14,405	2,275
N score of Analogies subtest	Equal variances assumed	2,463	,120	-1,349	83	,181	-4,904	3,635	-12,134	2,326
	Equal variances not assumed			-1,155	32,101	,257	-4,904	4,247	-13,555	3,746
average mark in term 3 2015 (percentage points)	Equal variances assumed	1,752	,189	-1,713	83	,090	-4,757	2,777	-10,280	,766
	Equal variances not assumed			-1,610	37,422	,116	-4,757	2,954	-10,739	1,226
mark in home language in term 3 2015 (percentage points)	Equal variances assumed	,197	,658	-,926	82	,357	-2,817	3,043	-8,871	3,237
	Equal variances not assumed			-,960	45,972	,342	-2,817	2,933	-8,720	3,087

```
T-TEST GROUPS=II_Extra_vs_NoExtra(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=mean_N score_C_N score_A_N T3_average_mark T3_HL_mark
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)	N	Mean	Std. Deviation	Std. Error Mean

mean of N scores	no extracurricular	34	71,47	9,721	1,667
	extracurricular	51	74,67	13,633	1,909
N score of Categories subtest	no extracurricular	34	74,56	15,196	2,606
	extracurricular	51	78,80	17,361	2,431
N score of Analogies subtest	no extracurricular	34	79,06	14,416	2,472
	extracurricular	51	80,04	15,764	2,207
average mark in term 3 2015 (percentage points)	no extracurricular	34	67,35	12,232	2,098
	extracurricular	51	69,69	11,283	1,580
mark in home language in term 3 2015 (percentage points)	no extracurricular	34	69,65	12,853	2,204
	extracurricular	50	72,74	12,380	1,751

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
mean of N scores	Equal variances assumed	2,805	,098	-1,180	83	,241	-3,196	2,707	-8,581	2,189
	Equal variances not assumed			-1,261	82,576	,211	-3,196	2,535	-8,238	1,845
N score of Categories subtest	Equal variances assumed	1,173	,282	-1,160	83	,250	-4,245	3,661	-11,526	3,036
	Equal variances not assumed			-1,191	76,958	,237	-4,245	3,564	-11,342	2,852
	Equal variances assumed	,000	,998	-,291	83	,772	-,980	3,375	-7,693	5,732

N score of Analogies subtest	Equal variances not assumed			-,296	75,092	,768	-,980	3,314	-7,583	5,622
average mark in term 3 2015 (percentage points)	Equal variances assumed	,290	,591	-,903	83	,369	-2,333	2,584	-7,472	2,805
	Equal variances not assumed			-,888	66,855	,377	-2,333	2,626	-7,575	2,909
mark in home language in term 3 2015 (percentage points)	Equal variances assumed	,096	,757	-1,107	82	,272	-3,093	2,795	-8,652	2,467
	Equal variances not assumed			-1,099	69,216	,276	-3,093	2,815	-8,708	2,522

```
*Nonparametric Tests: Independent Samples.
NPTESTS
  /INDEPENDENT TEST (mean_N score_C_N score_S_N score_A_N T3_average_mark
T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO) GROUP (II_Chess_vs_NoChess)
MANN_WHITNEY
  /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE
  /CRITERIA ALPHA=0.05  CILEVEL=95.
```

Nonparametric Tests

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of mean of N scores is the same across categories of recoded into chess vs. no chess (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,131	Retain the null hypothesis.
2	The distribution of N score of Categories subtest is the same across categories of recoded into chess vs. no chess (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,226	Retain the null hypothesis.
3	The distribution of N score of Situations subtest is the same across categories of recoded into chess vs. no chess (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,113	Retain the null hypothesis.
4	The distribution of N score of Analogies subtest is the same across categories of recoded into chess vs. no chess (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,152	Retain the null hypothesis.
5	The distribution of average mark in term 3 2015 (percentage points) is the same across categories of recoded into chess vs. no chess (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,142	Retain the null hypothesis.
6	The distribution of mark in home language in term 3 2015 (percentage points) is the same across categories of recoded into chess vs. no chess (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,431	Retain the null hypothesis.
7	The distribution of mark in first additional language in term 3 2015 (percentage points) is the same across categories of recoded into chess vs. no chess (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,467	Retain the null hypothesis.
8	The distribution of mark in mathematics in term 3 2015 (percentage points) is the same across categories of recoded into chess vs. no chess (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,291	Retain the null hypothesis.
9	The distribution of mark in life skills/orientation in term 3 2015 (percentage points) is the same across categories of recoded into chess vs. no chess (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,047	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

```
*Nonparametric Tests: Independent Samples.
NPTESTS
  /INDEPENDENT TEST (mean_N score_C_N score_S_N score_A_N T3_average_mark
T3_HL_mark T3_FAL_mark T3_M_mark T3_LSorLO) GROUP (II_Extra_vs_NoExtra)
MANN_WHITNEY
  /MISSING SCOPE=ANALYSIS USERMISSING=EXCLUDE
  /CRITERIA ALPHA=0.05  CILEVEL=95.
```

Nonparametric Tests

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of mean of N scores is the same across categories of recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,384	Retain the null hypothesis.
2	The distribution of N score of Categories subtest is the same across categories of recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,288	Retain the null hypothesis.
3	The distribution of N score of Situations subtest is the same across categories of recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,169	Retain the null hypothesis.
4	The distribution of N score of Analogies subtest is the same across categories of recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,757	Retain the null hypothesis.
5	The distribution of average mark in term 3 2015 (percentage points) is the same across categories of recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,351	Retain the null hypothesis.
6	The distribution of mark in home language in term 3 2015 (percentage points) is the same across categories of recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,227	Retain the null hypothesis.
7	The distribution of mark in first additional language in term 3 2015 (percentage points) is the same across categories of recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,268	Retain the null hypothesis.
8	The distribution of mark in mathematics in term 3 2015 (percentage points) is the same across categories of recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,943	Retain the null hypothesis.
9	The distribution of mark in life skills/orientation in term 3 2015 (percentage points) is the same across categories of recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m).	Independent-Samples Mann-Whitney U Test	,175	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

```
USE ALL.
COMPUTE filter_$=(NEW_group_3 ~= 999).
VARIABLE LABELS filter_$ 'NEW_group_3 ~= 999 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
FREQUENCIES VARIABLES=improvement_T1T3_marks
  /FORMAT=NOTABLE
  /STATISTICS=STDDEV MINIMUM MAXIMUM MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Statistics

Improvement from term 1 to term 3 in marks

N	Valid	73
	Missing	7
Mean		3,51
Median		3,00
Mode		2
Std. Deviation		5,748
Minimum		-10
Maximum		19

```
EXAMINE VARIABLES=improvement_T1T3_marks
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Improvement from term 1 to term 3 in marks	73	91,3%	7	8,8%	80	100,0%

Descriptives

			Statistic	Std. Error
Improvement from term 1 to term 3 in marks	Mean		3,51	,673
	95% Confidence Interval for Mean	Lower Bound	2,17	

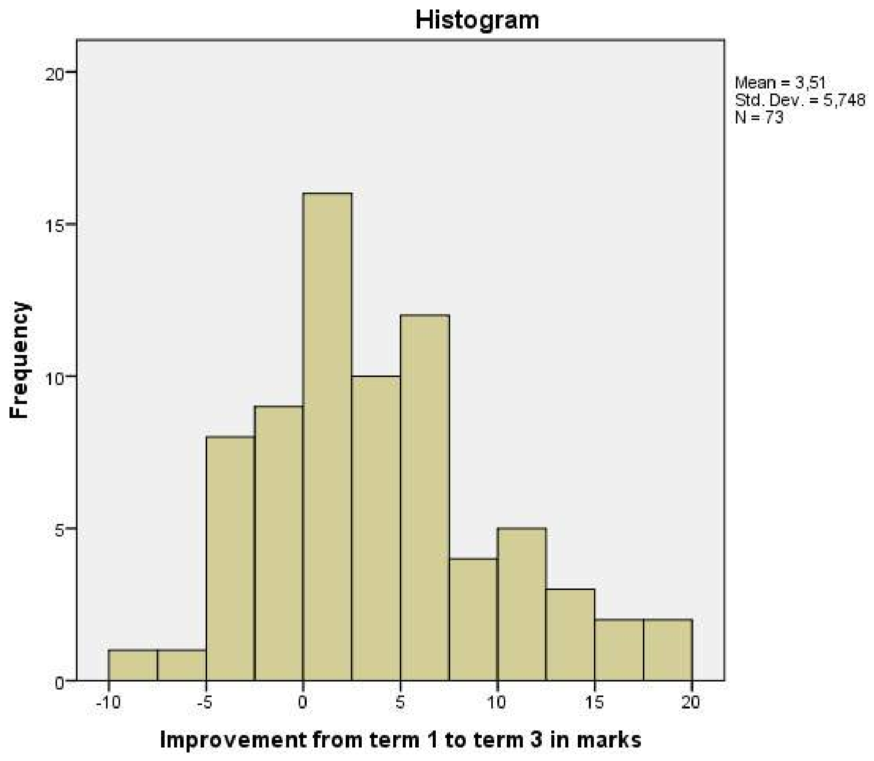
	Upper Bound	4,85	
	5% Trimmed Mean	3,31	
	Median	3,00	
	Variance	33,045	
	Std. Deviation	5,748	
	Minimum	-10	
	Maximum	19	
	Range	29	
	Interquartile Range	8	
	Skewness	,563	,281
	Kurtosis	,358	,555

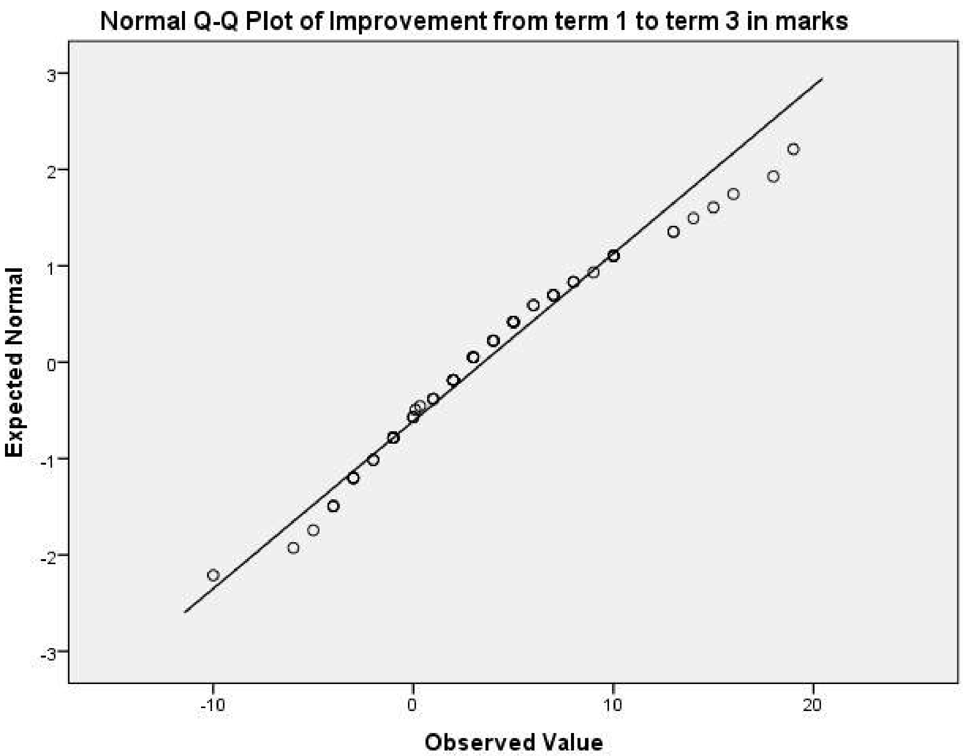
Tests of Normality

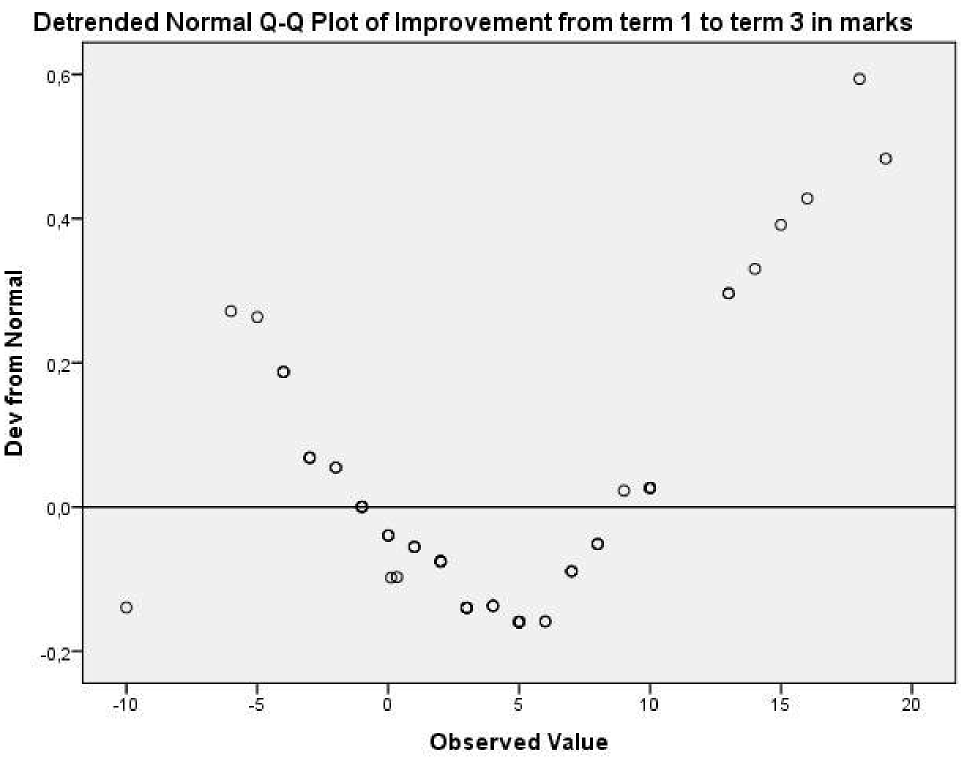
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Improvement from term 1 to term 3 in marks	,110	73	,028	,971	73	,093

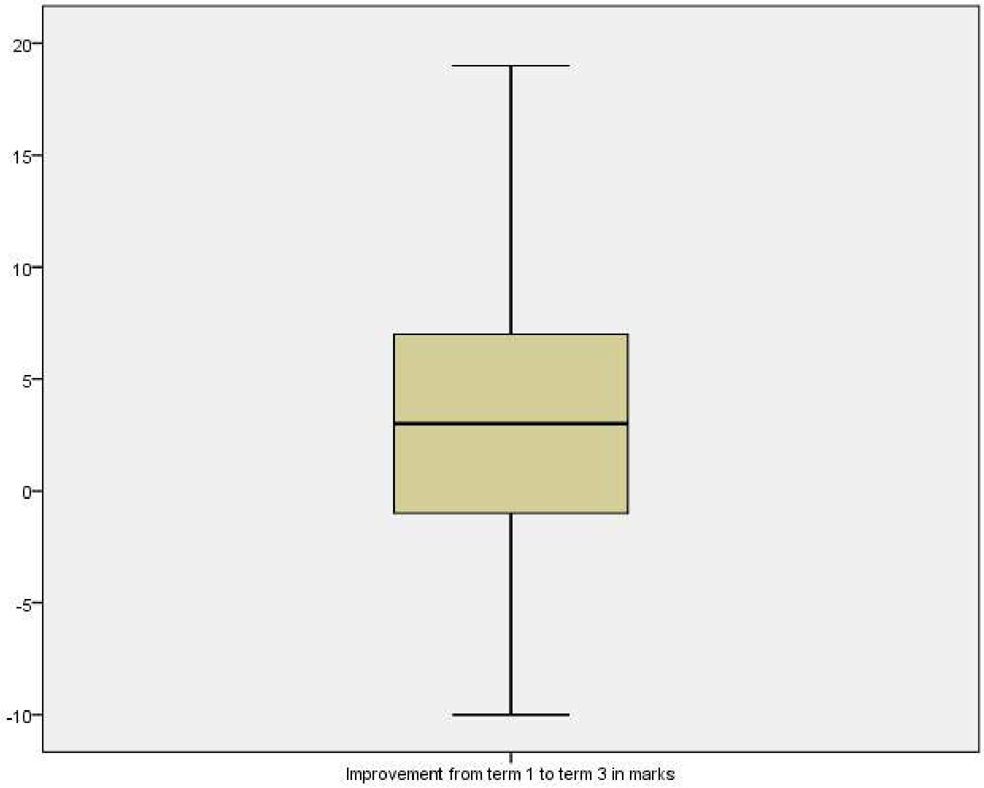
a. Lilliefors Significance Correction

Improvement from term 1 to term 3 in marks




Normal Q-Q Plot of Improvement from term 1 to term 3 in marks
Expected Normal
Observed Value
3
2
1
0
-1
-2
-3
-10
0
10
20


Detrended Normal Q-Q Plot of Improvement from term 1 to term 3 in marks
Dev from Normal
Observed Value
0,6
0,4
0,2
0,0
-0,2
-10
-5
0
5
10
15
20




```
EXAMINE VARIABLES=T1_average_mark
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
average mark in term 1 2015 (percentage points)	73	91,3%	7	8,8%	80	100,0%

Descriptives

			Statistic	Std. Error
average mark in term 1 2015 (percentage points)	Mean		66,32	1,312
	95% Confidence Interval for Mean	Lower Bound	63,71	
		Upper Bound	68,94	
	5% Trimmed Mean		66,39	
	Median		67,00	
	Variance		125,634	

	Std. Deviation	11,209	
	Minimum	44	
	Maximum	87	
	Range	43	
	Interquartile Range	17	
	Skewness	-,086	,281
	Kurtosis	-,935	,555

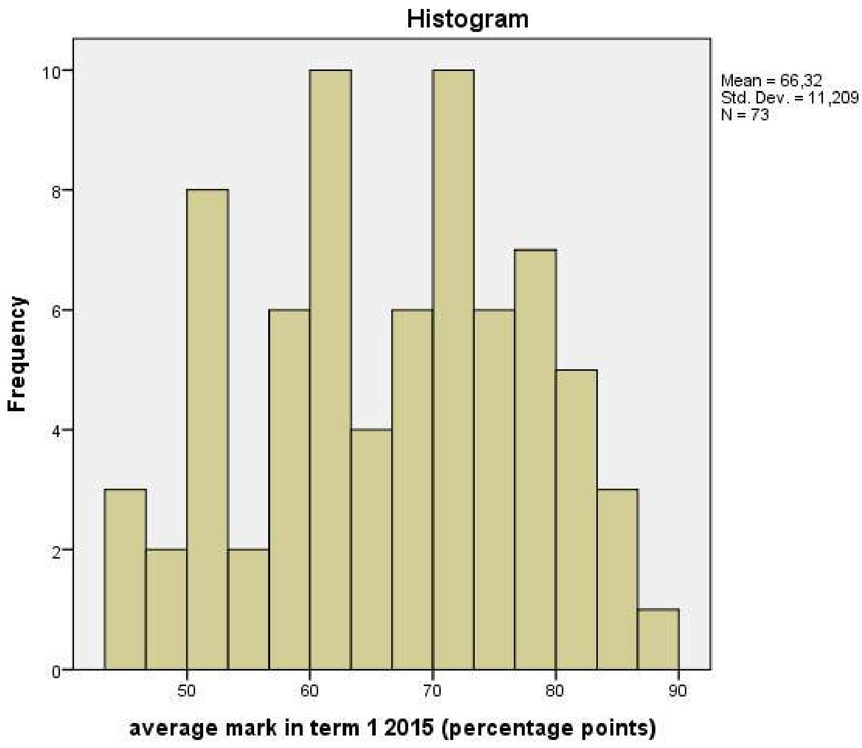
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
average mark in term 1 2015 (percentage points)	,077	73	,200*	,973	73	,122

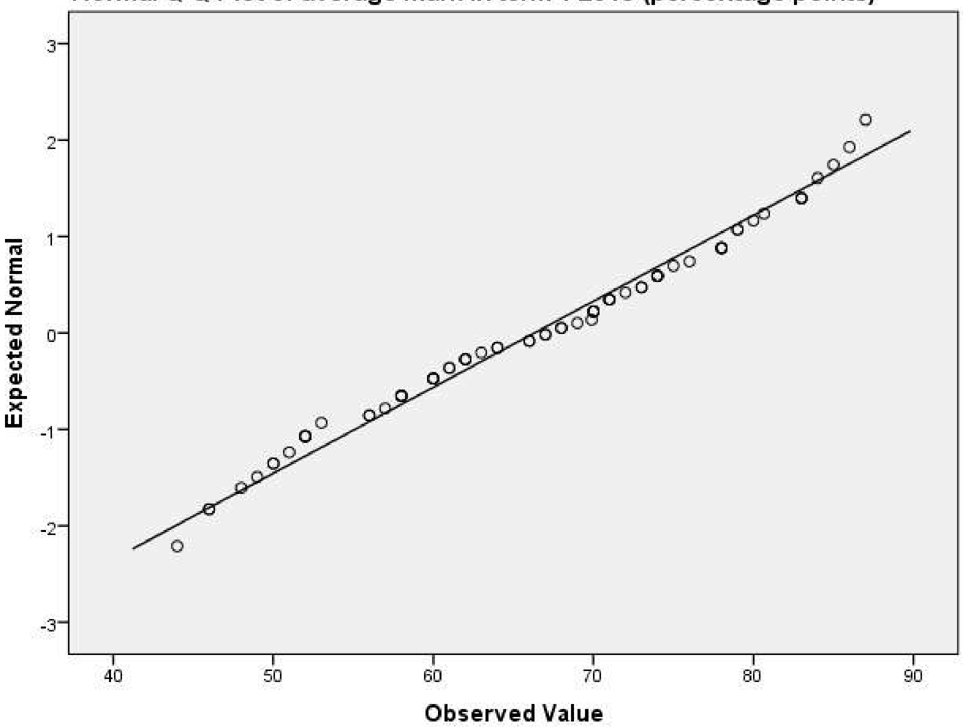
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

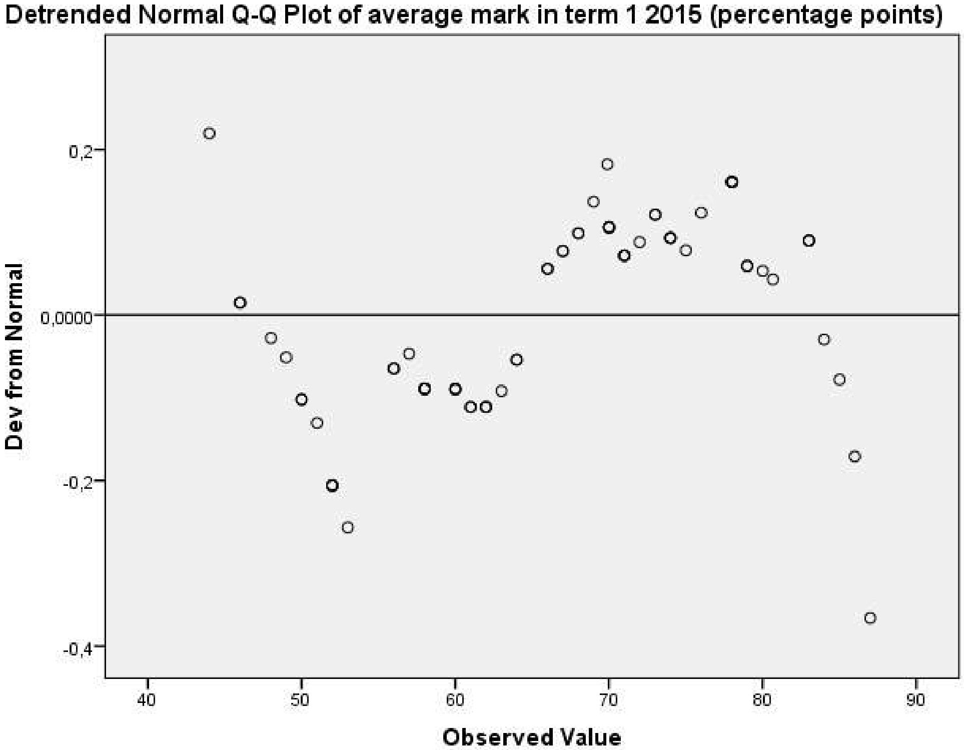
average mark in term 1 2015 (percentage points)

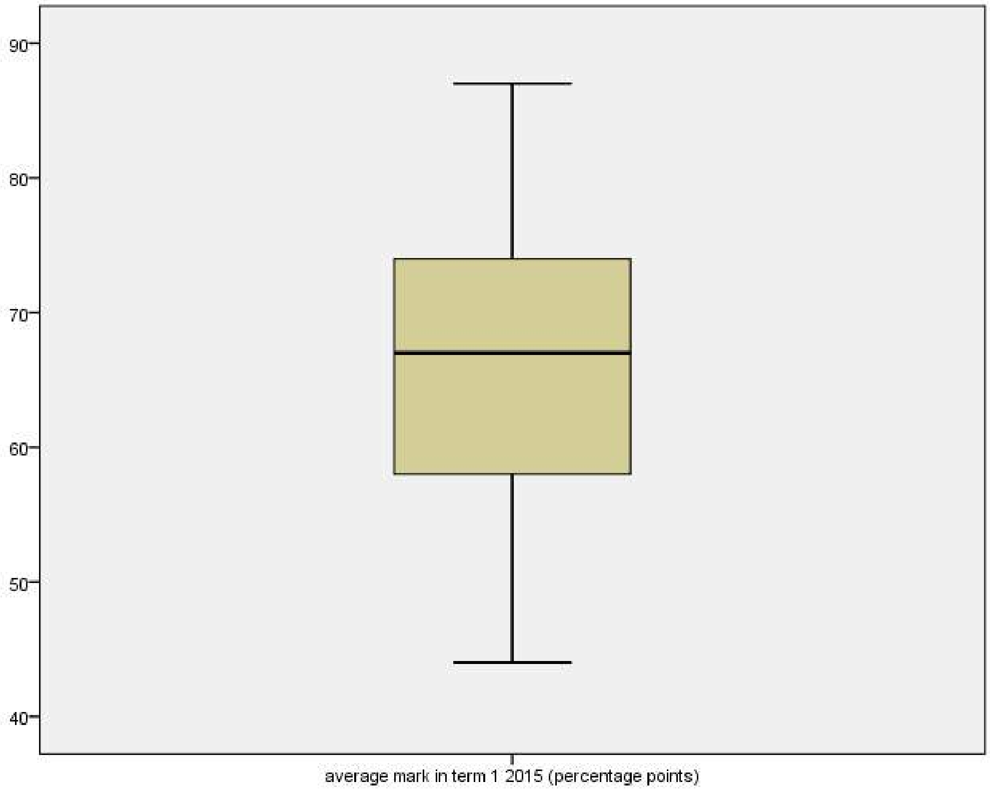


Normal Q-Q Plot of average mark in term 1 2015 (percentage points)



Detrended Normal Q-Q Plot of average mark in term 1 2015 (percentage points)




90
80
70
60
50
40
average mark in term 1 2015 (percentage points)

```
T-TEST PAIRS=T1_average_mark WITH T3_average_mark (PAIRED)
  /CRITERIA=CI(.9500)
  /MISSING=ANALYSIS.
```

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	average mark in term 1 2015 (percentage points)	66,32	73	11,209	1,312
	average mark in term 3 2015 (percentage points)	69,84	73	11,839	1,386

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	average mark in term 1 2015 (percentage points) & average mark in term 3 2015 (percentage points)	73	,877	,000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	average mark in term 1 2015 (percentage points) - average mark in term 3 2015 (percentage points)	-3,513	5,748	,673	-4,854	-2,172	-5,221	72	,000

```
NPAR TESTS
  /WILCOXON=T1_average_mark T1_average_level WITH T3_average_mark T3_average_level (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
average mark in term 3 2015 (percentage points) - average mark in term 1 2015 (percentage points)	Negative Ranks	19[a]	24,13	458,50
	Positive Ranks	51[b]	39,74	2026,50
	Ties	3[c]		
	Total	73		
average level in term 3 2015 - average level in term 1 2015	Negative Ranks	11[d]	18,23	200,50
	Positive Ranks	27[e]	20,02	540,50
	Ties	41[f]		
	Total	79		

a. average mark in term 3 2015 (percentage points) < average mark in term 1 2015 (percentage points)

b. average mark in term 3 2015 (percentage points) > average mark in term 1 2015 (percentage points)

c. average mark in term 3 2015 (percentage points) = average mark in term 1 2015 (percentage points)

d. average level in term 3 2015 < average level in term 1 2015

e. average level in term 3 2015 > average level in term 1 2015

f. average level in term 3 2015 = average level in term 1 2015

Test Statistics[a]

	average mark in term 3 2015 (percentage points) - average mark in term 1 2015 (percentage points)	average level in term 3 2015 - average level in term 1 2015
Z	-4,595[b]	-2,665[b]
Asymp. Sig. (2-tailed)	,000	,008

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
ONEWAY improvement_T1T3_marks BY NEW_group_3
  /STATISTICS HOMOGENEITY
  /MISSING ANALYSIS
  /POSTHOC=GABRIEL GT2 GH ALPHA(0.05).
```

Oneway

Test of Homogeneity of Variances

Improvement from term 1 to term 3 in marks

Levene Statistic	df1	df2	Sig.
2,486	2	70	,091

ANOVA

Improvement from term 1 to term 3 in marks

	Sum of Squares	df	Mean Square	F	Sig.

Between Groups	196,791	2	98,396	3,156	,049
Within Groups	2182,459	70	31,178		
Total	2379,250	72			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: Improvement from term 1 to term 3 in marks

	(I) restructured final three groups	(J) restructured final three groups	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Gabriel	chess	extracurriculars	-3,051	1,519	,134	-6,74	,64
		no activity, no chess	-3,562	1,685	,100	-7,61	,48
	extracurriculars	chess	3,051	1,519	,134	-,64	6,74
		no activity, no chess	-,511	1,835	,989	-4,98	3,96
	no activity, no chess	chess	3,562	1,685	,100	-,48	7,61
		extracurriculars	,511	1,835	,989	-3,96	4,98
Hochberg	chess	extracurriculars	-3,051	1,519	,137	-6,76	,66
		no activity, no chess	-3,562	1,685	,109	-7,68	,56
	extracurriculars	chess	3,051	1,519	,137	-,66	6,76
		no activity, no chess	-,511	1,835	,989	-5,00	3,97
	no activity, no chess	chess	3,562	1,685	,109	-,56	7,68
		extracurriculars	,511	1,835	,989	-3,97	5,00
Games-Howell	chess	extracurriculars	-3,051	1,395	,087	-6,46	,35

		no activity, no chess	-3,562	2,053	,217	-8,76	1,64
	extracurriculars	chess	3,051	1,395	,087	-,35	6,46
		no activity, no chess	-,511	2,247	,972	-6,10	5,07
	no activity, no chess	chess	3,562	2,053	,217	-1,64	8,76
		extracurriculars	,511	2,247	,972	-5,07	6,10

Homogeneous Subsets

Improvement from term 1 to term 3 in marks

	restructured final three groups	N	Subset for alpha = 0.05
			1
Gabriel[a,b]	chess	35	1,81
	extracurriculars	22	4,86
	no activity, no chess	16	5,38
	Sig.		,109
Hochberg[a,b]	chess	35	1,81
	extracurriculars	22	4,86
	no activity, no chess	16	5,38
	Sig.		,109

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 21,974.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

```
T-TEST GROUPS=I_Chess_vs_NoChess(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=improvement_T1T3_marks
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	recoded into chess vs. no chess (from restructured groups, all chess)	N	Mean	Std. Deviation	Std. Error Mean
Improvement from term 1 to term 3 in marks	no chess	38	5,08	6,415	1,041
	chess	35	1,81	4,413	,746

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Improvement from term 1 to term 3 in marks	Equal variances assumed	3,440	,068	2,513	71	,014	3,266	1,300	,675	5,858
	Equal variances not assumed			2,551	65,865	,013	3,266	1,280	,710	5,823

```
T-TEST GROUPS=chess_knowledge(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=improvement_T1T3_marks
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	knowledge of chess in general	N	Mean	Std. Deviation	Std. Error Mean
Improvement from term 1 to term 3 in marks	no	15	4,20	6,930	1,789
	yes	50	2,77	5,109	,722

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Improvement from term 1 to term 3 in marks	Equal variances assumed	3,318	,073	,874	63	,386	1,431	1,638	-1,843	4,705
	Equal variances not assumed			,742	18,794	,467	1,431	1,930	-2,611	5,473

```
T-TEST GROUPS=chess_home_total(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=improvement_T1T3_marks
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	students playing chess at home (all students)	N	Mean	Std. Deviation	Std. Error Mean
Improvement from term 1 to term 3 in marks	no	36	4,03	6,425	1,071
	yes	37	3,01	5,043	,829

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Improvement from term 1 to term 3 in marks	Equal variances assumed	1,574	,214	,753	71	,454	1,016	1,350	-1,676	3,707
	Equal variances not assumed			,750	66,352	,456	1,016	1,354	-1,688	3,719

```
T-TEST GROUPS=I_Extra_vs_NoExtra(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=improvement_T1T3_marks
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	recoded into extracurriculars vs. no extracurriculars (from restructured groups, all chess)	N	Mean	Std. Deviation	Std. Error Mean
Improvement from term 1 to term 3 in marks	no extracurriculars	19	4,16	7,618	1,748
	extracurriculars	54	3,29	4,998	,680

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Improvement from term 1 to term 3 in marks	Equal variances assumed	3,593	,062	,566	71	,573	,872	1,541	-2,200	3,944
	Equal variances not assumed			,465	23,682	,646	,872	1,875	-3,001	4,745

```
MEANS TABLES=T1_average_mark T3_average_mark T1_HL_mark T3_HL_mark T1_FAL_mark T3_FAL_mark T1_M_mark T3_M_mark T1_LSorLO_mark
T3_LSorLO BY NEW_group_3
  /CELLS=MEAN COUNT STDDEV.
```

Means

Case Processing Summary

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
average mark in term 1 2015 (percentage points) * restructured final three groups	73	91,3%	7	8,8%	80	100,0%
average mark in term 3 2015 (percentage points) * restructured final three groups	80	100,0%	0	0,0%	80	100,0%
mark in home language in term 1 2015 (percentage points) * restructured final three groups	73	91,3%	7	8,8%	80	100,0%
mark in home language in term 3 2015 (percentage points) * restructured final three groups	79	98,8%	1	1,3%	80	100,0%
mark in first additional language in term 1 2015 (percentage points) * restructured final three groups	73	91,3%	7	8,8%	80	100,0%
mark in first additional language in term 3 2015 (percentage points) * restructured final three groups	80	100,0%	0	0,0%	80	100,0%

mark in mathematics in term 1 2015 (percentage points) * restructured final three groups	73	91,3%	7	8,8%	80	100,0%
mark in mathematics in term 3 2015 (percentage points) * restructured final three groups	80	100,0%	0	0,0%	80	100,0%
mark in life skills/orientation in term 1 2015 (percentage points) * restructured final three groups	80	100,0%	0	0,0%	80	100,0%
mark in life skills/orientation in term 3 2015 (percentage points) * restructured final three groups	80	100,0%	0	0,0%	80	100,0%

Report

restructured final three groups		average mark in term 1 2015 (percentage points)	average mark in term 3 2015 (percentage points)	mark in home language in term 1 2015 (percentage points)	mark in home language in term 3 2015 (percentage points)	mark in first additional language in term 1 2015 (percentage points)	mark in first additional language in term 3 2015 (percentage points)	mark in mathematics in term 1 2015 (percentage points)	mark in mathematics in term 3 2015 (percentage points)	mark in life skills/orientation in term 1 2015 (percentage points)	mark in life skills/orientation in term 3 2015 (percentage points)
chess	Mean	70,30	71,78	70,11	72,64	70,17	70,06	72,17	69,56	68,58	73,97
	N	35	36	35	36	35	36	35	36	36	36
	Std. Deviation	11,226	12,071	11,103	11,485	16,050	14,493	15,149	16,892	17,303	15,423
extracurriculars	Mean	62,27	67,14	66,77	71,48	63,32	68,41	59,45	62,64	66,14	70,55
	N	22	22	22	21	22	22	22	22	22	22
	Std. Deviation	7,893	10,521	11,216	14,469	12,253	13,633	12,223	14,265	10,265	11,143

no activity, no chess	Mean	63,19	65,36	60,44	68,95	66,56	65,59	62,81	65,05	46,91	63,73
	N	16	22	16	22	16	22	16	22	22	22
	Std. Deviation	12,597	12,564	13,525	13,937	15,166	16,846	17,163	17,549	30,617	18,030
Total	Mean	66,32	68,74	66,99	71,30	67,32	68,38	66,29	66,41	61,95	70,21
	N	73	80	73	79	73	80	73	80	80	80
	Std. Deviation	11,209	12,002	12,138	12,944	14,911	14,878	15,719	16,473	22,311	15,588

```
FILTER OFF.
USE ALL.
EXECUTE.
EXAMINE VARIABLES=T1_average_mark
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
average mark in term 1 2015 (percentage points)	78	91,8%	7	8,2%	85	100,0%

Descriptives

			Statistic	Std. Error
average mark in term 1 2015 (percentage points)	Mean		66,65	1,245
	95% Confidence Interval for Mean	Lower Bound	64,17	
		Upper Bound	69,13	
	5% Trimmed Mean		66,75	
	Median		67,50	
	Variance		120,954	
	Std. Deviation		10,998	
	Minimum		44	
	Maximum		87	
	Range		43	
	Interquartile Range		17	
	Skewness		-,149	,272
	Kurtosis		-,879	,538

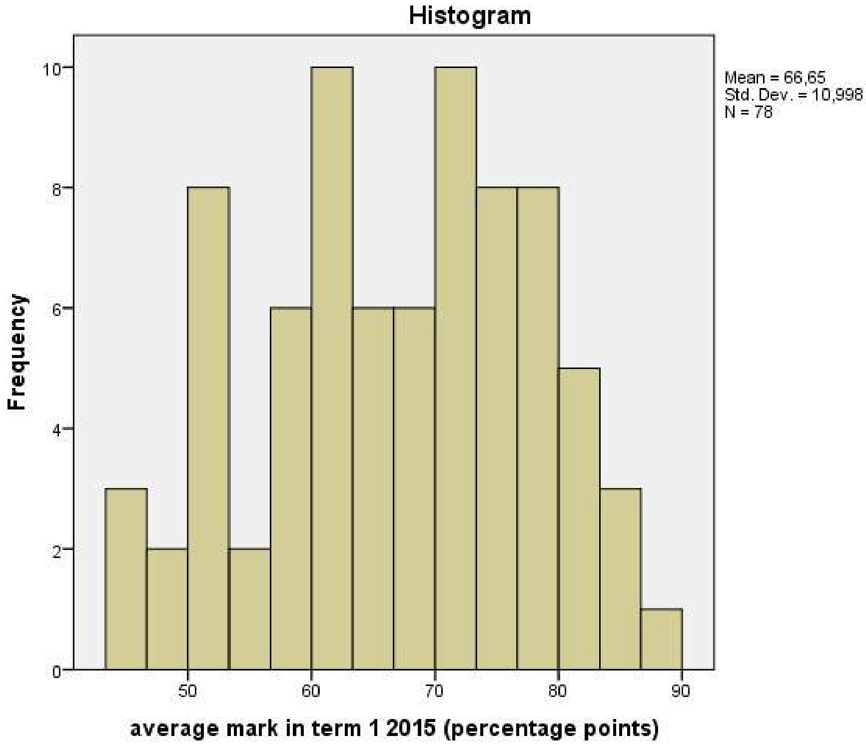
Tests of Normality

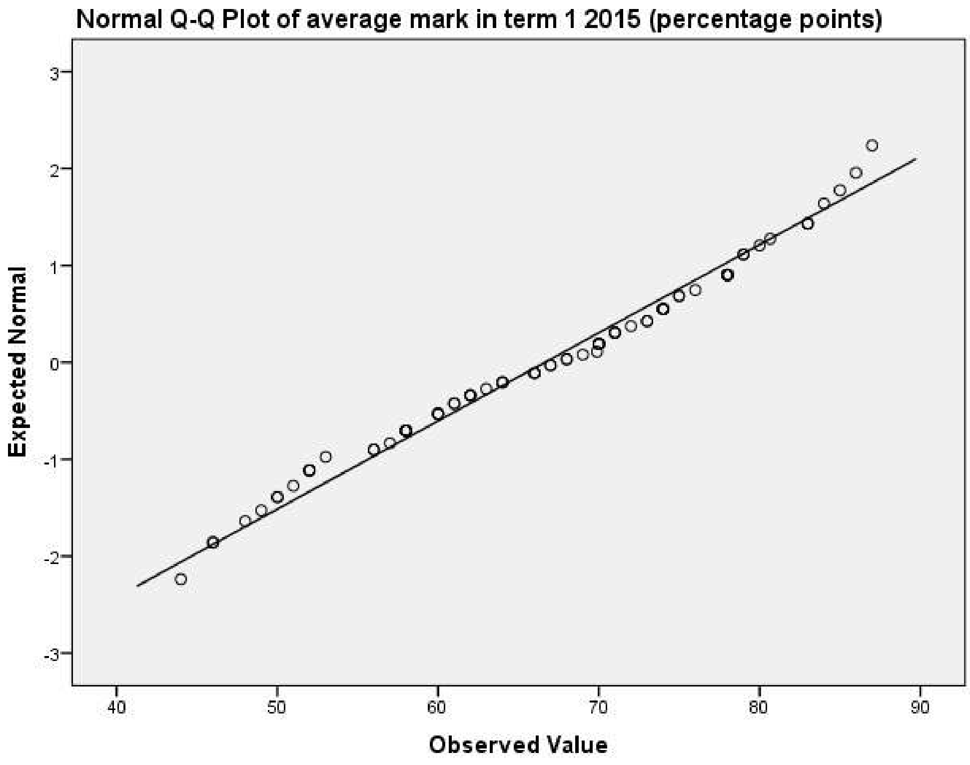
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
average mark in term 1 2015 (percentage points)	,077	78	,200*	,975	78	,121

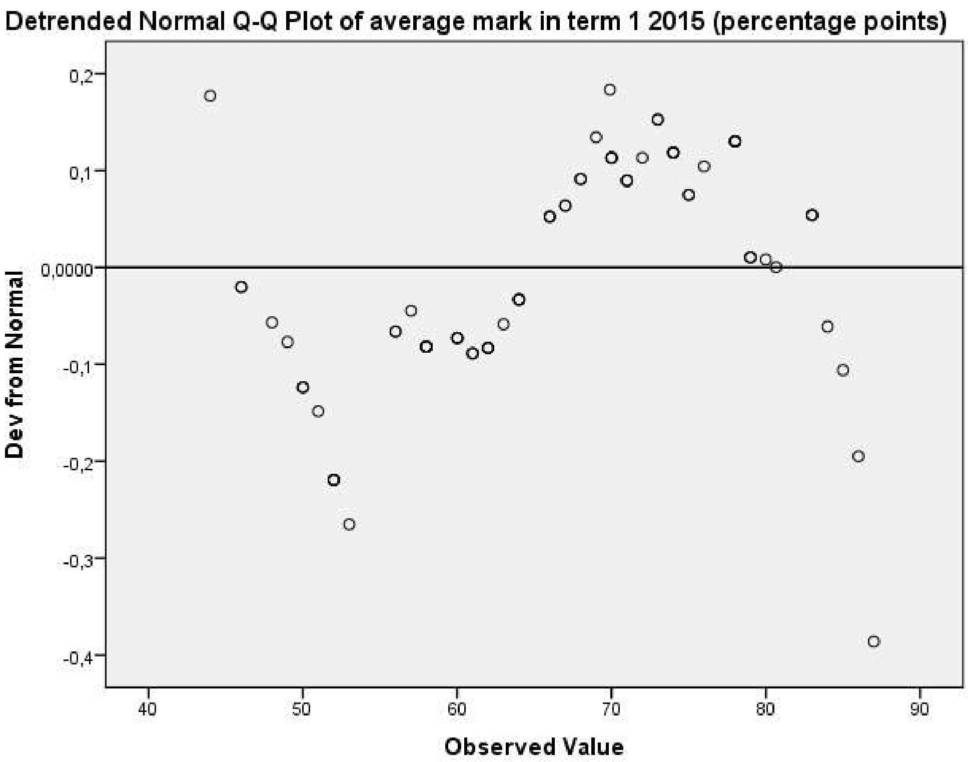
*. This is a lower bound of the true significance.

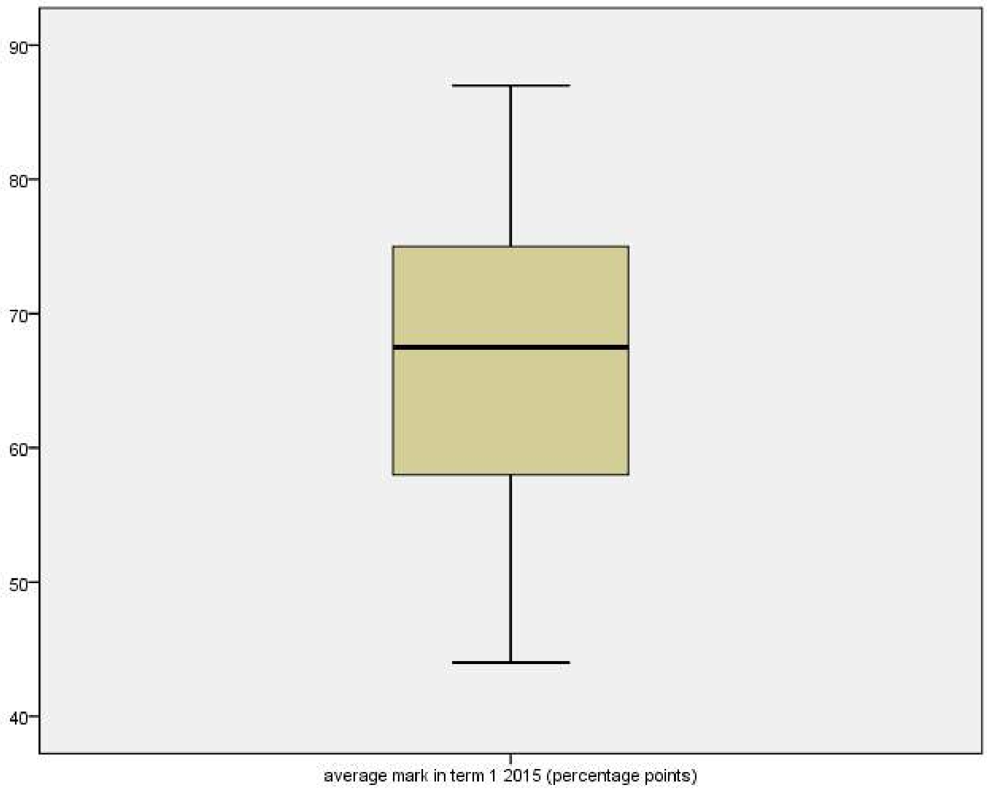
a. Lilliefors Significance Correction

average mark in term 1 2015 (percentage points)






Detrended Normal Q-Q Plot of average mark in term 1 2015 (percentage points)
Dev from Normal
0,2
0,1
0,0000
-0,1
-0,2
-0,3
-0,4
40
50
60
70
80
90
Observed Value


90
80
70
60
50
40
average mark in term 1 2015 (percentage points)

```
EXAMINE VARIABLES=improvement_T1T3_marks
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Improvement from term 1 to term 3 in marks	78	91,8%	7	8,2%	85	100,0%

Descriptives

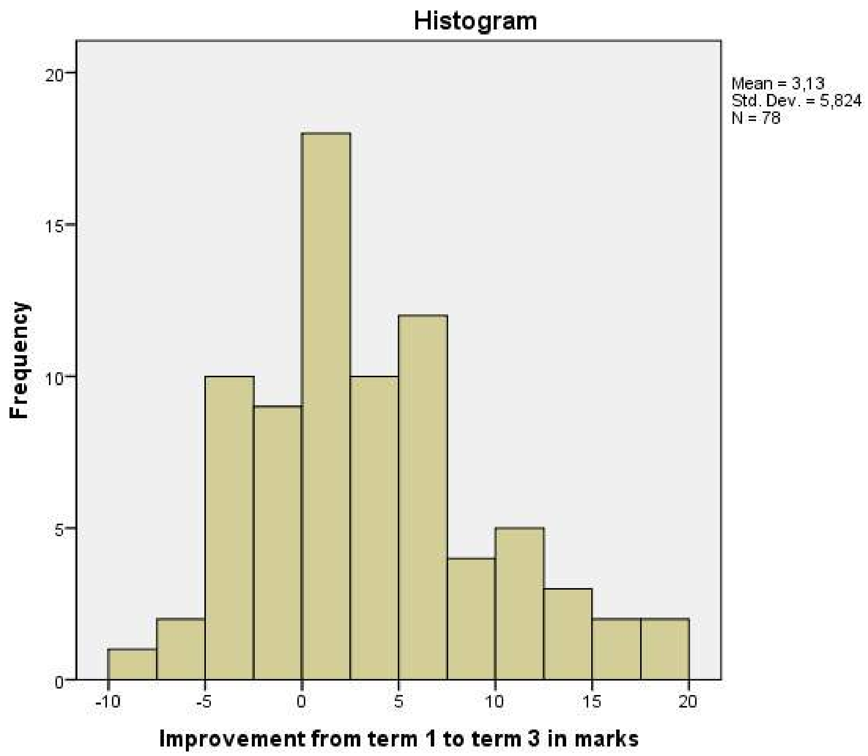
			Statistic	Std. Error
Improvement from term 1 to term 3 in marks	Mean		3,13	,659
	95% Confidence Interval for Mean	Lower Bound	1,82	
		Upper Bound	4,45	
	5% Trimmed Mean		2,93	
	Median		2,00	
	Variance		33,923	
	Std. Deviation		5,824	
	Minimum		-10	
	Maximum		19	
	Range		29	
	Interquartile Range		7	
	Skewness		,556	,272
	Kurtosis		,334	,538

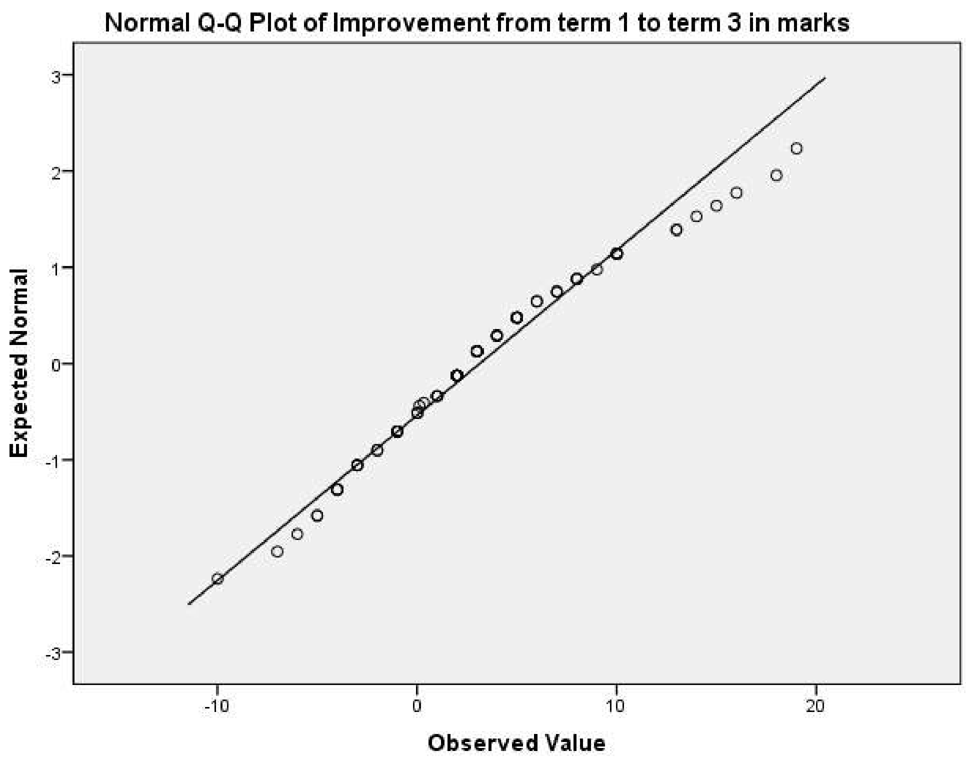
Tests of Normality

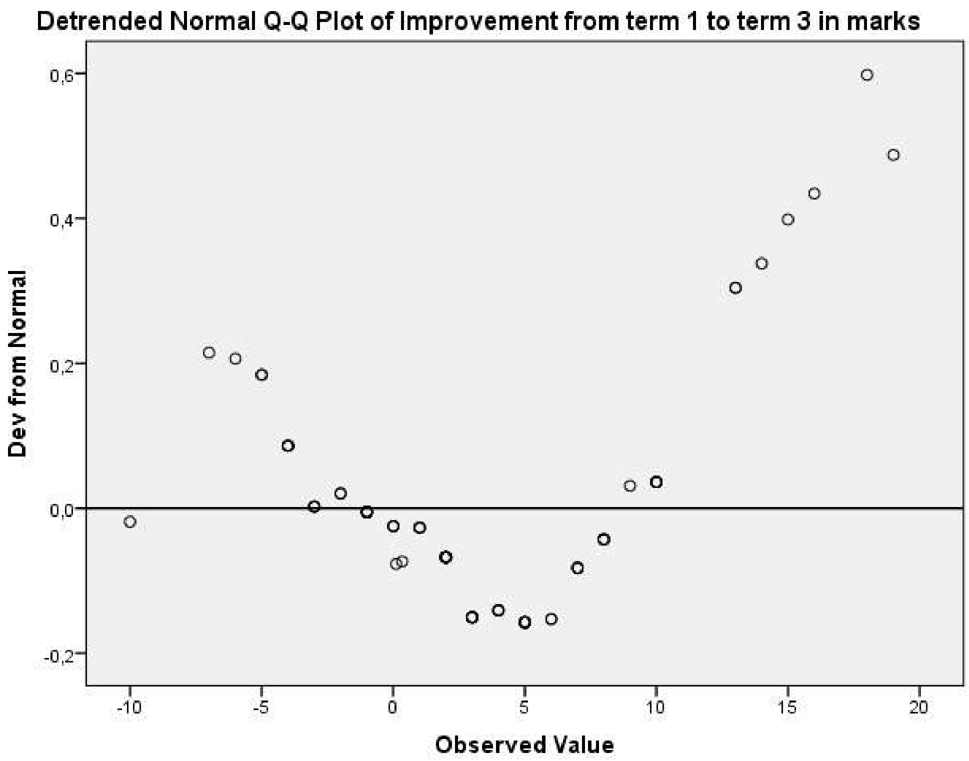
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Improvement from term 1 to term 3 in marks	,105	78	,033	,973	78	,097

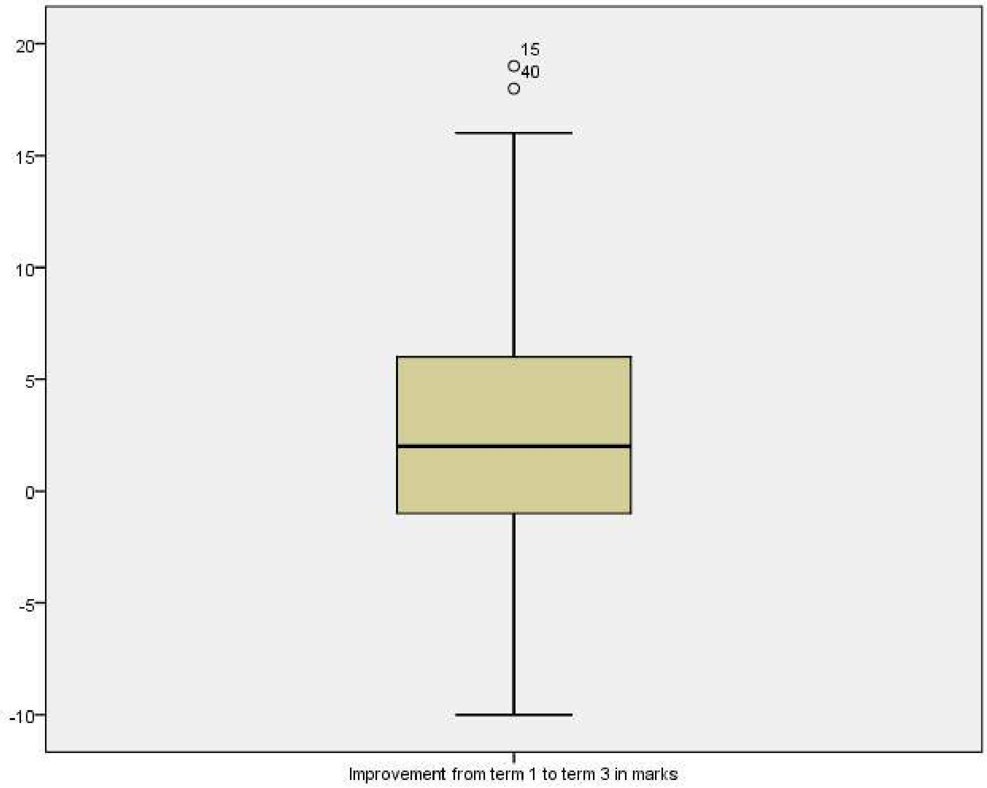
a. Lilliefors Significance Correction

Improvement from term 1 to term 3 in marks










```
T-TEST PAIRS=T1_average_mark WITH T3_average_mark (PAIRED)
  /CRITERIA=CI(.9500)
  /MISSING=ANALYSIS.
```

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	average mark in term 1 2015 (percentage points)	66,65	78	10,998	1,245
	average mark in term 3 2015 (percentage points)	69,78	78	11,469	1,299

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	average mark in term 1 2015 (percentage points) & average mark in term 3 2015 (percentage points)	78	,866	,000

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	average mark in term 1 2015 (percentage points) - average mark in term 3 2015 (percentage points)	-3,134	5,824	,659	-4,447	-1,821	-4,752	77	,000

```
NPAR TESTS
  /WILCOXON=T1_average_mark T1_average_level WITH T3_average_mark T3_average_level (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
average mark in term 3 2015 (percentage points) - average mark in term 1 2015 (percentage points)	Negative Ranks	22[a]	28,66	630,50
	Positive Ranks	53[b]	41,88	2219,50
	Ties	3[c]		
	Total	78		
average level in term 3 2015 - average level in term 1 2015	Negative Ranks	12[d]	18,63	223,50
	Positive Ranks	27[e]	20,61	556,50
	Ties	45[f]		
	Total	84		

a. average mark in term 3 2015 (percentage points) < average mark in term 1 2015 (percentage points)

b. average mark in term 3 2015 (percentage points) > average mark in term 1 2015 (percentage points)

c. average mark in term 3 2015 (percentage points) = average mark in term 1 2015 (percentage points)

d. average level in term 3 2015 < average level in term 1 2015

e. average level in term 3 2015 > average level in term 1 2015

f. average level in term 3 2015 = average level in term 1 2015

Test Statistics[a]

	average mark in term 3 2015 (percentage points) - average mark in term 1 2015 (percentage points)	average level in term 3 2015 - average level in term 1 2015
Z	-4,202[b]	-2,515[b]
Asymp. Sig. (2-tailed)	,000	,012

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

```
ONEWAY improvement_T1T3_marks BY groups_longterm
  /STATISTICS HOMOGENEITY
  /MISSING ANALYSIS
  /POSTHOC=GABRIEL GT2 GH ALPHA(0.05).
```

Oneway

Test of Homogeneity of Variances

Improvement from term 1 to term 3 in marks

Levene Statistic	df1	df2	Sig.
,663	2	75	,518

ANOVA

Improvement from term 1 to term 3 in marks

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	19,170	2	9,585	,277	,759
Within Groups	2592,888	75	34,572		
Total	2612,058	77			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: Improvement from term 1 to term 3 in marks

	(I) restructured groups only considering more than three months of chess instruction	(J) restructured groups only considering more than three months of chess instruction	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Gabriel	chess	other extracurricular activities	-1,125	1,650	,871	-5,15	2,90
		no extracurricular activities	-1,014	1,650	,901	-5,04	3,01
	other extracurricular activities	chess	1,125	1,650	,871	-2,90	5,15
		no extracurricular activities	,111	1,600	1,000	-3,79	4,02
	no extracurricular activities	chess	1,014	1,650	,901	-3,01	5,04
		other extracurricular activities	-,111	1,600	1,000	-4,02	3,79
Hochberg	chess	other extracurricular activities	-1,125	1,650	,871	-5,15	2,90
		no extracurricular activities	-1,014	1,650	,902	-5,04	3,01
	other extracurricular activities	chess	1,125	1,650	,871	-2,90	5,15
		no extracurricular activities	,111	1,600	1,000	-3,79	4,02
	no extracurricular activities	chess	1,014	1,650	,902	-3,01	5,04
		other extracurricular activities	-,111	1,600	1,000	-4,02	3,79
Games-Howell	chess	other extracurricular activities	-1,125	1,504	,736	-4,76	2,51
		no extracurricular activities	-1,014	1,605	,803	-4,90	2,87
	other extracurricular activities	chess	1,125	1,504	,736	-2,51	4,76
		no extracurricular activities	,111	1,719	,998	-4,04	4,26
	no extracurricular activities	chess	1,014	1,605	,803	-2,87	4,90
		other extracurricular activities	-,111	1,719	,998	-4,26	4,04

Homogeneous Subsets

Improvement from term 1 to term 3 in marks

	restructured groups only considering more than three months of chess instruction	N	Subset for alpha = 0.05
			1
Gabriel[a,b]	chess	24	2,39
	no extracurricular activities	27	3,41
	other extracurricular activities	27	3,52
	Sig.		,868
Hochberg[a,b]	chess	24	2,39
	no extracurricular activities	27	3,41
	other extracurricular activities	27	3,52
	Sig.		,868

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 25,920.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

```
T-TEST GROUPS=II_Chess_vs_NoChess(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=improvement_T1T3_marks
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	recoded into chess vs. no chess (from restructured groups, only chess > 3m)	N	Mean	Std. Deviation	Std. Error Mean
Improvement from term 1 to term 3 in marks	no chess	54	3,46	6,255	,851
	chess	24	2,39	4,753	,970

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Improvement from term 1 to term 3 in marks	Equal variances assumed	1,334	,252	,746	76	,458	1,069	1,433	-1,785	3,923
	Equal variances not assumed			,829	57,297	,411	1,069	1,291	-1,515	3,654

```
T-TEST GROUPS=II_Extra_vs_NoExtra(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=improvement_T1T3_marks
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	recoded into extracurricular vs. no extracurricular (from restructured groups, only chess > 3m)	N	Mean	Std. Deviation	Std. Error Mean
Improvement from term 1 to term 3 in marks	no extracurricular	27	3,41	6,641	1,278
	extracurricular	51	2,99	5,408	,757

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Improvement from term 1 to term 3 in marks	Equal variances assumed	,419	,520	,300	76	,765	,418	1,394	-2,359	3,196
	Equal variances not assumed			,282	44,606	,780	,418	1,486	-2,574	3,411

```
USE ALL.
COMPUTE filter_$=(NEW_group_3 ~= 999).
VARIABLE LABELS filter_$ 'NEW_group_3 ~= 999 (FILTER)'.
VALUE LABELS filter_$ 0 'Not Selected' 1 'Selected'.
FORMATS filter_$ (f1.0).
FILTER BY filter_$.
EXECUTE.
DATASET ACTIVATE DataSet1.

SAVE OUTFILE='C:\Users\Franziska\Documents\MADM\MA thesis\Testing\SPSS
data\Franziska Lammers MA '+
    'Thesis Dataset.sav'
  /COMPRESSED.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(95) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT mean_N
  /METHOD=ENTER I_Chess_vs_NoChess.
```

Regression

Descriptive Statistics

	Mean	Std. Deviation	N
mean of N scores	73,29	12,282	80
recoded into chess vs. no chess (from restructured groups, all chess)	,45	,501	80

Correlations

		mean of N scores	recoded into chess vs. no chess (from restructured groups, all chess)
Pearson Correlation	mean of N scores	1,000	,234
	recoded into chess vs. no chess (from restructured groups, all chess)	,234	1,000
Sig. (1-tailed)	mean of N scores	.	,018
	recoded into chess vs. no chess (from restructured groups, all chess)	,018	.
N	mean of N scores	80	80
	recoded into chess vs. no chess (from restructured groups, all chess)	80	80

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	recoded into chess vs. no chess (from restructured groups, all chess)[b]	.	Enter

a. Dependent Variable: mean of N scores

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,234[a]	,055	,043	12,017

a. Predictors: (Constant), recoded into chess vs. no chess (from restructured groups, all chess)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	652,340	1	652,340	4,517	,037[b]
	Residual	11264,048	78	144,411		
	Total	11916,387	79			

a. Dependent Variable: mean of N scores

b. Predictors: (Constant), recoded into chess vs. no chess (from restructured groups, all chess)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	70,705	1,812		39,028	,000	67,098	74,311
	recoded into chess vs. no chess (from restructured groups, all chess)	5,740	2,701	,234	2,125	,037	,363	11,116

a. Dependent Variable: mean of N scores

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(95) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT T3_average_mark
  /METHOD=ENTER I_Chess_vs_NoChess.
```

Regression

Descriptive Statistics

	Mean	Std. Deviation	N

average mark in term 3 2015 (percentage points)	68,74	12,002	80
recoded into chess vs. no chess (from restructured groups, all chess)	,45	,501	80

Correlations

		average mark in term 3 2015 (percentage points)	recoded into chess vs. no chess (from restructured groups, all chess)
Pearson Correlation	average mark in term 3 2015 (percentage points)	1,000	,231
	recoded into chess vs. no chess (from restructured groups, all chess)	,231	1,000
Sig. (1-tailed)	average mark in term 3 2015 (percentage points)	.	,020
	recoded into chess vs. no chess (from restructured groups, all chess)	,020	.
N	average mark in term 3 2015 (percentage points)	80	80
	recoded into chess vs. no chess (from restructured groups, all chess)	80	80

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	recoded into chess vs. no chess (from restructured groups, all chess)[b]	.	Enter

a. Dependent Variable: average mark in term 3 2015 (percentage points)

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,231[a]	,053	,041	11,753

a. Predictors: (Constant), recoded into chess vs. no chess (from restructured groups, all chess)

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.

1	Regression	605,015	1	605,015	4,380	,040[b]
	Residual	10774,472	78	138,134		
	Total	11379,488	79			

a. Dependent Variable: average mark in term 3 2015 (percentage points)

b. Predictors: (Constant), recoded into chess vs. no chess (from restructured groups, all chess)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	66,250	1,772		37,391	,000	62,723	69,777
	recoded into chess vs. no chess (from restructured groups, all chess)	5,528	2,641	,231	2,093	,040	,269	10,786

a. Dependent Variable: average mark in term 3 2015 (percentage points)

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(95) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT mean_N
  /METHOD=ENTER chess_home_total.
```

Regression

Descriptive Statistics

	Mean	Std. Deviation	N
mean of N scores	73,29	12,282	80
students playing chess at home (all students)	,49	,503	80

Correlations

		mean of N scores	students playing chess at home (all students)
Pearson Correlation	mean of N scores	1,000	,250
	students playing chess at home (all students)	,250	1,000
Sig. (1-tailed)	mean of N scores	.	,013
	students playing chess at home (all students)	,013	.
N	mean of N scores	80	80

	students playing chess at home (all students)	80	80

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	students playing chess at home (all students)[b]	.	Enter

a. Dependent Variable: mean of N scores

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,250[a]	,062	,050	11,969

a. Predictors: (Constant), students playing chess at home (all students)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	742,074	1	742,074	5,180	,026[b]
	Residual	11174,314	78	143,260		
	Total	11916,387	79			

a. Dependent Variable: mean of N scores

b. Predictors: (Constant), students playing chess at home (all students)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	70,317	1,869		37,617	,000	66,596	74,038
	students playing chess at home (all students)	6,093	2,677	,250	2,276	,026	,763	11,423

a. Dependent Variable: mean of N scores

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(95) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT T3_average_mark
  /METHOD=ENTER chess_home_total.
```

Regression

Descriptive Statistics

	Mean	Std. Deviation	N
average mark in term 3 2015 (percentage points)	68,74	12,002	80
students playing chess at home (all students)	,49	,503	80

Correlations

		average mark in term 3 2015 (percentage points)	students playing chess at home (all students)
Pearson Correlation	average mark in term 3 2015 (percentage points)	1,000	,030
	students playing chess at home (all students)	,030	1,000
Sig. (1-tailed)	average mark in term 3 2015 (percentage points)	.	,396
	students playing chess at home (all students)	,396	.
N	average mark in term 3 2015 (percentage points)	80	80
	students playing chess at home (all students)	80	80

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	students playing chess at home (all students)[b]	.	Enter

a. Dependent Variable: average mark in term 3 2015 (percentage points)

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,030[a]	,001	-,012	12,073

a. Predictors: (Constant), students playing chess at home (all students)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10,142	1	10,142	,070	,793[b]
	Residual	11369,346	78	145,761		
	Total	11379,488	79			

a. Dependent Variable: average mark in term 3 2015 (percentage points)

b. Predictors: (Constant), students playing chess at home (all students)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	68,390	1,886		36,272	,000	64,636	72,144
	students playing chess at home (all students)	,712	2,700	,030	,264	,793	-4,664	6,089

a. Dependent Variable: average mark in term 3 2015 (percentage points)

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(95) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT mean_N
  /METHOD=ENTER chess_knowledge.
```

Regression

Descriptive Statistics

	Mean	Std. Deviation	N
mean of N scores	73,67	12,547	69
knowledge of chess in general	,77	,425	69

Correlations

		mean of N scores	knowledge of chess in general
Pearson Correlation	mean of N scores	1,000	-,001
	knowledge of chess in general	-,001	1,000
Sig. (1-tailed)	mean of N scores	.	,497
	knowledge of chess in general	,497	.
N	mean of N scores	69	69
	knowledge of chess in general	69	69

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	knowledge of chess in general[b]	.	Enter

a. Dependent Variable: mean of N scores

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,001[a]	,000	-,015	12,640

a. Predictors: (Constant), knowledge of chess in general

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,009	1	,009	,000	,994[b]
	Residual	10705,324	67	159,781		
	Total	10705,333	68			

a. Dependent Variable: mean of N scores

b. Predictors: (Constant), knowledge of chess in general

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	73,688	3,160		23,318	,000	67,380	79,995
	knowledge of chess in general	-,027	3,606	-,001	-,008	,994	-7,224	7,170

a. Dependent Variable: mean of N scores

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(95) R ANOVA
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT T3_average_mark
  /METHOD=ENTER chess_knowledge.
```

Regression

Descriptive Statistics

	Mean	Std. Deviation	N
average mark in term 3 2015 (percentage points)	68,77	12,073	69
knowledge of chess in general	,77	,425	69

Correlations

		average mark in term 3 2015 (percentage points)	knowledge of chess in general
Pearson Correlation	average mark in term 3 2015 (percentage points)	1,000	-,105
	knowledge of chess in general	-,105	1,000
Sig. (1-tailed)	average mark in term 3 2015 (percentage points)	.	,195
	knowledge of chess in general	,195	.
N	average mark in term 3 2015 (percentage points)	69	69
	knowledge of chess in general	69	69

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	knowledge of chess in general[b]	.	Enter

a. Dependent Variable: average mark in term 3 2015 (percentage points)

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,105[a]	,011	-,004	12,096

a. Predictors: (Constant), knowledge of chess in general

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	109,654	1	109,654	,749	,390[b]
	Residual	9802,636	67	146,308		
	Total	9912,290	68			

a. Dependent Variable: average mark in term 3 2015 (percentage points)

b. Predictors: (Constant), knowledge of chess in general

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	95,0% Confidence Interval for B Upper Bound
1	(Constant)	71,063	3,024		23,500	,000	65,027	77,098
	knowledge of chess in general	-2,987	3,450	-,105	-,866	,390	-9,874	3,900

a. Dependent Variable: average mark in term 3 2015 (percentage points)

```
EXAMINE VARIABLES=age_recoded
  /PLOT BOXPLOT HISTOGRAM NPPLOT
  /COMPARE GROUPS
  /STATISTICS DESCRIPTIVES
  /CINTERVAL 95
  /MISSING LISTWISE
  /NOTOTAL.
```

Explore

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
age (complete in months)	80	100,0%	0	0,0%	80	100,0%

Descriptives

			Statistic	Std. Error
age (complete in months)	Mean		118,24	2,917
	95% Confidence Interval for Mean	Lower Bound	112,43	
		Upper Bound	124,04	
	5% Trimmed Mean		118,35	
	Median		115,50	
	Variance		680,791	
	Std. Deviation		26,092	
	Minimum		75	
	Maximum		161	
	Range		86	

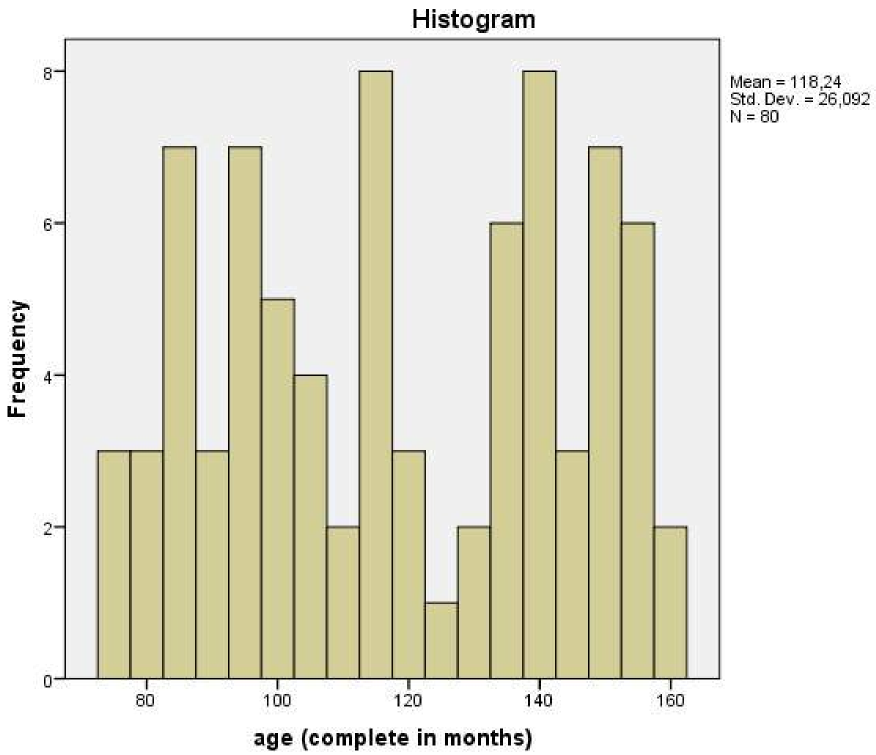
	Interquartile Range	46	
	Skewness	-,011	,269
	Kurtosis	-1,354	,532

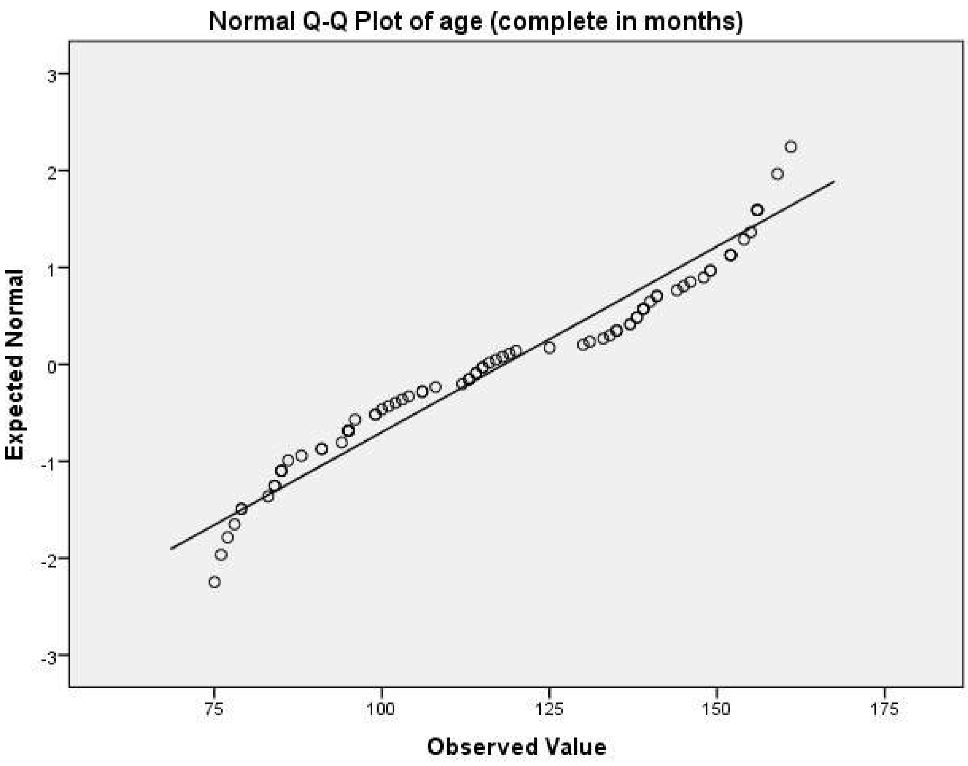
Tests of Normality

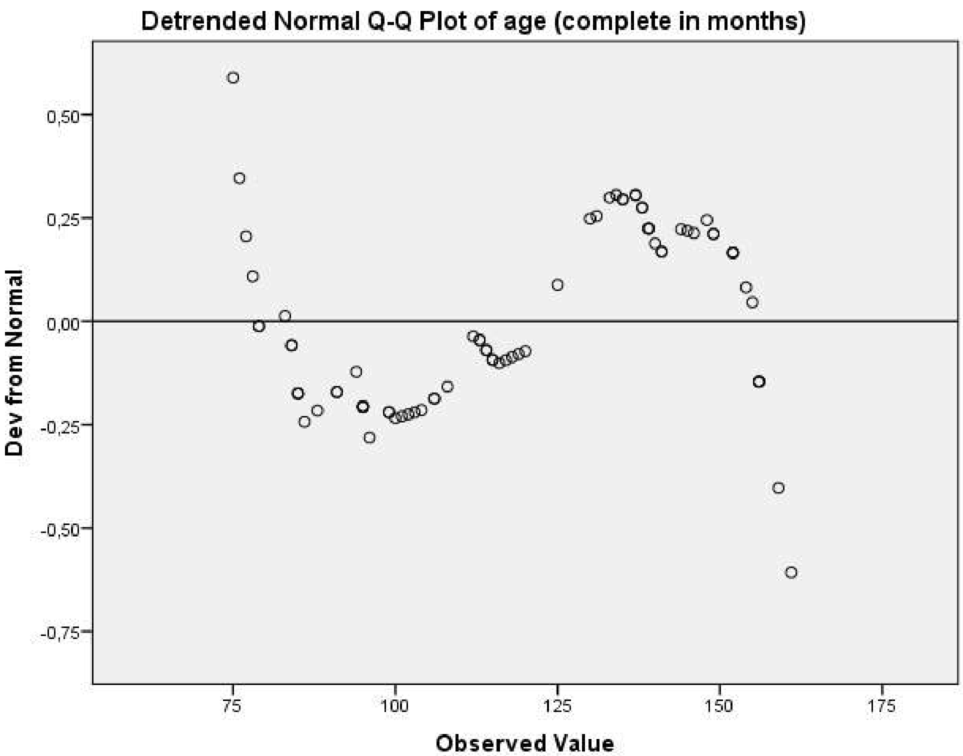
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
age (complete in months)	,115	80	,011	,935	80	,001

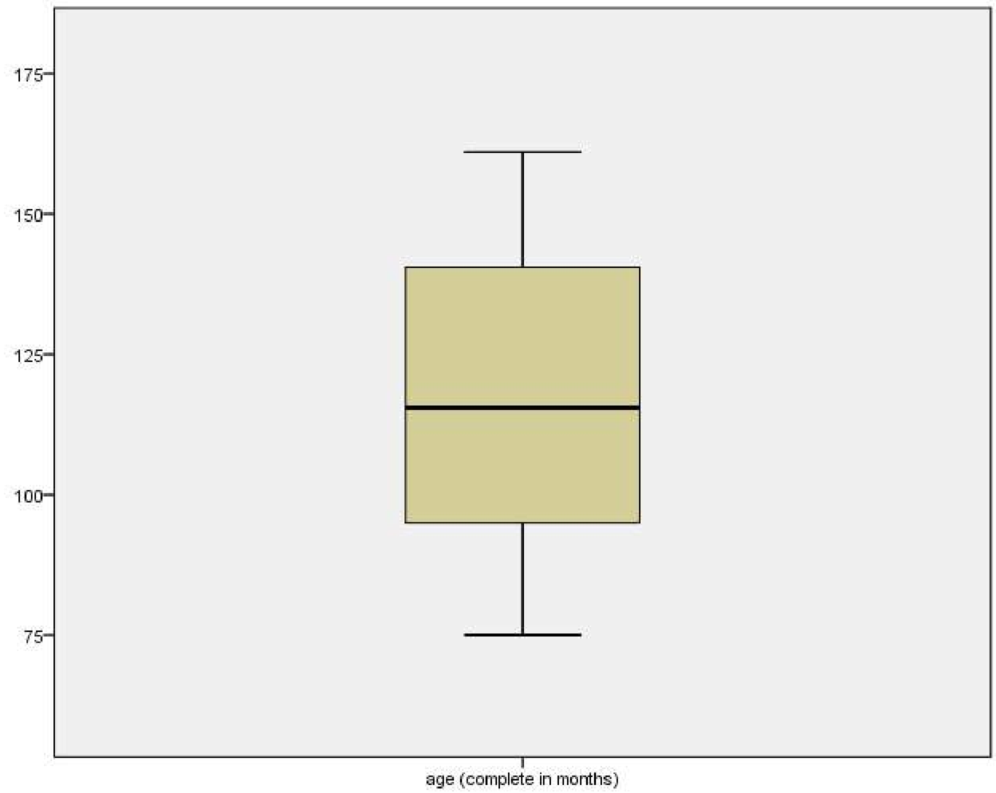
a. Lilliefors Significance Correction

age (complete in months)




Normal Q-Q Plot of age (complete in months)
Expected Normal
3
2
1
0
-1
-2
-3
75
100
125
150
175
Observed Value


Detrended Normal Q-Q Plot of age (complete in months)
Dev from Normal
0,50
0,25
0,00
-0,25
-0,50
-0,75
75
100
125
150
175
Observed Value




```
NONPAR CORR
  /VARIABLES=age_recoded mean_N T3_average_mark
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Correlations

			age (complete in months)	mean of N scores	average mark in term 3 2015 (percentage points)
Spearman's rho	age (complete in months)	Correlation Coefficient	1,000	,110	-,166
		Sig. (2-tailed)	.	,333	,142
		N	80	80	80
	mean of N scores	Correlation Coefficient	,110	1,000	,264*
		Sig. (2-tailed)	,333	.	,018
		N	80	80	80
	average mark in term 3 2015 (percentage points)	Correlation Coefficient	-,166	,264*	1,000
		Sig. (2-tailed)	,142	,018	.
		N	80	80	80

*. Correlation is significant at the 0.05 level (2-tailed).

```
T-TEST GROUPS=sex(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=mean_N
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	sex	N	Mean	Std. Deviation	Std. Error Mean
mean of N scores	female	40	75,15	13,915	2,200
	male	40	71,43	10,238	1,619

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
mean of N scores	Equal variances assumed	3,109	,082	1,364	78	,177	3,725	2,731	-1,713	9,163
	Equal variances not assumed			1,364	71,655	,177	3,725	2,731	-1,720	9,170

```
T-TEST GROUPS=sex(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=T3_average_mark
  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	sex	N	Mean	Std. Deviation	Std. Error Mean
average mark in term 3 2015 (percentage points)	female	40	70,53	11,830	1,870
	male	40	66,95	12,053	1,906

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
average mark in term 3 2015 (percentage points)	Equal variances assumed	,034	,854	1,339	78	,185	3,575	2,670	-1,741	8,891
	Equal variances not assumed			1,339	77,973	,185	3,575	2,670	-1,741	8,891

```
FREQUENCIES VARIABLES=chess_length chess_length_recode chess_length_recode_II
  /STATISTICS=STDDEV MINIMUM MAXIMUM MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Statistics

		Length of chess instruction (in months)	Length of chess instruction (recoded into categories of starting point)	Length of chess instruction (recoded into categories of starting year)
N	Valid	72	33	33
	Missing	8	47	47
Mean		655,39	2,27	1,52
Median		999,00	2,00	1,00
Mode		999	2	1
Std. Deviation		474,487	1,098	,755
Minimum		1	1	1
Maximum		999	5	3

Frequency Table

Length of chess instruction (in months)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	3	3,8	4,2	4,2
	3	6	7,5	8,3	12,5
	5	1	1,3	1,4	13,9
	6	2	2,5	2,8	16,7
	7	8	10,0	11,1	27,8
	19	1	1,3	1,4	29,2
	21	2	2,5	2,8	31,9
	29	1	1,3	1,4	33,3
	51	1	1,3	1,4	34,7
	999	47	58,8	65,3	100,0
	Total	72	90,0	100,0	
Missing	System	8	10,0		
Total		80	100,0		

Length of chess instruction (recoded into categories of starting point)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	second half of 2015	9	11,3	27,3	27,3
	first half of 2015	12	15,0	36,4	63,6

	2014	7	8,8	21,2	84,8
	2013	4	5,0	12,1	97,0
	before 2013	1	1,3	3,0	100,0
	Total	33	41,3	100,0	
Missing	999	47	58,8		
Total		80	100,0		

Length of chess instruction (recoded into categories of starting year)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2015	21	26,3	63,6	63,6
	2014	7	8,8	21,2	84,8
	before 2014	5	6,3	15,2	100,0
	Total	33	41,3	100,0	
Missing	999	47	58,8		
Total		80	100,0		

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL ZPP
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT mean_N
  /METHOD=ENTER I_Chess_vs_NoChess chess_home_total
  /RESIDUALS DURBIN.
```

Regression

Descriptive Statistics

	Mean	Std. Deviation	N
mean of N scores	73,29	12,282	80
recoded into chess vs. no chess (from restructured groups, all chess)	,45	,501	80
students playing chess at home (all students)	,49	,503	80

Correlations

		mean of N scores	recoded into chess vs. no chess (from restructured groups, all chess)	students playing chess at home (all students)
Pearson Correlation	mean of N scores	1,000	,234	,250
	recoded into chess vs. no chess (from restructured groups, all chess)	,234	1,000	,475

	students playing chess at home (all students)	,250	,475	1,000
Sig. (1-tailed)	mean of N scores	.	,018	,013
	recoded into chess vs. no chess (from restructured groups, all chess)	,018	.	,000
	students playing chess at home (all students)	,013	,000	.
N	mean of N scores	80	80	80
	recoded into chess vs. no chess (from restructured groups, all chess)	80	80	80
	students playing chess at home (all students)	80	80	80

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	students playing chess at home (all students), recoded into chess vs. no chess (from restructured groups, all chess)[b]	.	Enter

a. Dependent Variable: mean of N scores

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,282[a]	,079	,056	11,936	2,356

a. Predictors: (Constant), students playing chess at home (all students), recoded into chess vs. no chess (from restructured groups, all chess)

b. Dependent Variable: mean of N scores

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	947,119	2	473,560	3,324	,041[b]
	Residual	10969,268	77	142,458		
	Total	11916,387	79			

a. Dependent Variable: mean of N scores

b. Predictors: (Constant), students playing chess at home (all students), recoded into chess vs. no chess (from restructured groups, all chess)

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	69,514	1,980		35,100	,000	65,571	73,458					
	recoded into chess vs. no chess (from restructured groups, all chess)	3,657	3,048	,149	1,200	,234	-2,413	9,727	,234	,135	,131	,774	1,291
	students playing chess at home (all students)	4,364	3,034	,179	1,438	,154	-1,677	10,405	,250	,162	,157	,774	1,291

a. Dependent Variable: mean of N scores

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	recoded into chess vs. no chess (from restructured groups, all chess)	students playing chess at home (all students)
1	1	2,393	1,000	,06	,06	,06
	2	,332	2,684	,84	,45	,04
	3	,275	2,952	,10	,49	,90

a. Dependent Variable: mean of N scores

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	69,51	77,54	73,29	3,462	80
Residual	-20,535	34,465	,000	11,784	80
Std. Predicted Value	-1,090	1,227	,000	1,000	80
Std. Residual	-1,721	2,888	,000	,987	80

a. Dependent Variable: mean of N scores

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(95) R ANOVA COLLIN TOL ZPP
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT T3_average_mark
  /METHOD=ENTER I_Chess_vs_NoChess chess_home_total
  /RESIDUALS DURBIN.
```

Regression

Descriptive Statistics

	Mean	Std. Deviation	N
average mark in term 3 2015 (percentage points)	68,74	12,002	80
recoded into chess vs. no chess (from restructured groups, all chess)	,45	,501	80
students playing chess at home (all students)	,49	,503	80

Correlations

		average mark in term 3 2015 (percentage points)	recoded into chess vs. no chess (from restructured groups, all chess)	students playing chess at home (all students)
Pearson Correlation	average mark in term 3 2015 (percentage points)	1,000	,231	,030
	recoded into chess vs. no chess (from restructured groups, all chess)	,231	1,000	,475
	students playing chess at home (all students)	,030	,475	1,000
Sig. (1-tailed)	average mark in term 3 2015 (percentage points)	.	,020	,396

	recoded into chess vs. no chess (from restructured groups, all chess)	,020	.	,000
	students playing chess at home (all students)	,396	,000	.
N	average mark in term 3 2015 (percentage points)	80	80	80
	recoded into chess vs. no chess (from restructured groups, all chess)	80	80	80
	students playing chess at home (all students)	80	80	80

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	students playing chess at home (all students), recoded into chess vs. no chess (from restructured groups, all chess)[b]	.	Enter

a. Dependent Variable: average mark in term 3 2015 (percentage points)

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	,248[a]	,061	,037	11,778	1,791

a. Predictors: (Constant), students playing chess at home (all students), recoded into chess vs. no chess (from restructured groups, all chess)

b. Dependent Variable: average mark in term 3 2015 (percentage points)

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	698,313	2	349,157	2,517	,087[b]
	Residual	10681,174	77	138,717		
	Total	11379,488	79			

a. Dependent Variable: average mark in term 3 2015 (percentage points)

b. Predictors: (Constant), students playing chess at home (all students), recoded into chess vs. no chess (from restructured groups, all chess)

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	95,0% Confidence Interval for B Lower Bound	95,0% Confidence Interval for B Upper Bound	Correlations Zero-order	Correlations Partial	Correlations Part	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	66,920	1,954		34,242	,000	63,028	70,811					
	recoded into chess vs. no chess (from restructured groups, all chess)	6,700	3,008	,279	2,227	,029	,710	12,689	,231	,246	,246	,774	1,291
	students playing chess at home (all students)	-2,455	2,994	-,103	-,820	,415	-8,417	3,506	,030	-,093	-,091	,774	1,291

a. Dependent Variable: average mark in term 3 2015 (percentage points)

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions (Constant)	Variance Proportions recoded into chess vs. no chess (from restructured groups, all chess)	Variance Proportions students playing chess at home (all students)
1	1	2,393	1,000	,06	,06	,06
	2	,332	2,684	,84	,45	,04
	3	,275	2,952	,10	,49	,90

a. Dependent Variable: average mark in term 3 2015 (percentage points)

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	64,46	73,62	68,74	2,973	80
Residual	-25,164	23,080	,000	11,628	80
Std. Predicted Value	-1,437	1,642	,000	1,000	80
Std. Residual	-2,137	1,960	,000	,987	80

a. Dependent Variable: average mark in term 3 2015 (percentage points)

```
NONPAR CORR
  /VARIABLES=mean_N T3_average_mark chess_length_recode_II
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

Correlations

			mean of N scores	average mark in term 3 2015 (percentage points)	Length of chess instruction (recoded into categories of starting year)
Spearman's rho	mean of N scores	Correlation Coefficient	1,000	,264*	,111
		Sig. (2-tailed)	.	,018	,538
		N	80	80	33
	average mark in term 3 2015 (percentage points)	Correlation Coefficient	,264*	1,000	,170
		Sig. (2-tailed)	,018	.	,343
		N	80	80	33
	Length of chess instruction (recoded into categories of starting year)	Correlation Coefficient	,111	,170	1,000
		Sig. (2-tailed)	,538	,343	.
		N	33	33	33

*. Correlation is significant at the 0.05 level (2-tailed).

```
FREQUENCIES VARIABLES=chess_why
  /ORDER=ANALYSIS.
```

Frequencies

Statistics

"Why have you started to play chess?"

N	Valid	80
	Missing	0

"Why have you started to play chess?"

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		47	58,8	58,8	58,8
	always my parents told me chess is a nice sport	1	1,3	1,3	60,0
	because chess is a funny game	1	1,3	1,3	61,3
	because I already knew	1	1,3	1,3	62,5
	because I can	1	1,3	1,3	63,7
	because I like to play chess	1	1,3	1,3	65,0
	because I loved it	1	1,3	1,3	66,3
	because I was interested to play chess	1	1,3	1,3	67,5
	because it tells me to think, helps me to think at math too	1	1,3	1,3	68,8
	because it's a mind game and you can concentrate very well	1	1,3	1,3	70,0
	because it's my average	1	1,3	1,3	71,3
	because it's my favorite	1	1,3	1,3	72,5
	because it's too fun	1	1,3	1,3	73,8
	because my sister told me to play chess	1	1,3	1,3	75,0
	because of my father	1	1,3	1,3	76,3
	committed on school work	1	1,3	1,3	77,5
	concentration	1	1,3	1,3	78,8
	don't know	2	2,5	2,5	81,3
	friends took me	1	1,3	1,3	82,5
	fun	1	1,3	1,3	83,8
	funny	1	1,3	1,3	85,0
	I don't know	1	1,3	1,3	86,3
	I like chess, because it's easy for me	1	1,3	1,3	87,5
	I love chess	1	1,3	1,3	88,8
	I love it	1	1,3	1,3	90,0
	I think it's a great thing	1	1,3	1,3	91,3
	important to play chess	1	1,3	1,3	92,5

	it was my passion	1	1,3	1,3	93,8
	it's great	1	1,3	1,3	95,0
	not sure	1	1,3	1,3	96,3
	really, really fun playing with others	1	1,3	1,3	97,5
	recommended by class teacher	1	1,3	1,3	98,8
	to use your mind	1	1,3	1,3	100,0
	Total	80	100,0	100,0	

```
SPLIT FILE OFF.
SORT CASES BY code (A).
SORT CASES  BY ORG_group.
SPLIT FILE LAYERED BY ORG_group.
FREQUENCIES VARIABLES=fav_sub
  /PIECHART PERCENT
  /ORDER=ANALYSIS.
```

Frequencies

Statistics

favorite subject in school

chess	N	Valid	32
		Missing	1
extracurriculars	N	Valid	26
		Missing	1
no activity	N	Valid	24
		Missing	1

favorite subject in school

groups originally sampled			Frequency	Percent	Valid Percent	Cumulative Percent
chess	Valid	math	19	57,6	59,4	59,4
		English	6	18,2	18,8	78,1
		language other than English	2	6,1	6,3	84,4
		life skills	1	3,0	3,1	87,5
		chess	2	6,1	6,3	93,8
		other	2	6,1	6,3	100,0
		Total	32	97,0	100,0	
	Missing	999	1	3,0		
	Total		33	100,0		
extracurriculars	Valid	math	11	40,7	42,3	42,3
		English	4	14,8	15,4	57,7

			Frequency	Percent	Valid Percent	Cumulative Percent
		language other than English	10	37,0	38,5	96,2
		other	1	3,7	3,8	100,0
		Total	26	96,3	100,0	
	Missing	999	1	3,7		
	Total		27	100,0		
no activity	Valid	math	6	24,0	25,0	25,0
		English	8	32,0	33,3	58,3
		language other than English	4	16,0	16,7	75,0
		life skills	4	16,0	16,7	91,7
		other	2	8,0	8,3	100,0
		Total	24	96,0	100,0	
	Missing	999	1	4,0		
	Total		25	100,0		

```
SPLIT FILE OFF.
SORT CASES BY code (A).
DATASET ACTIVATE DataSet1.

SAVE OUTFILE='C:\Users\Franziska\Documents\MADM\MA thesis\Testing\SPSS
data\Franziska Lammers MA '+
    'Thesis Dataset.sav'
  /COMPRESSED.
CROSSTABS
  /TABLES=ORG_group BY fav_sub_MnoM
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ CC PHI CORR
  /CELLS=COUNT
  /COUNT ROUND CELL.
```

Crosstabs

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
groups originally sampled * favorite subject (recoded into math vs. no math)	82	96,5%	3	3,5%	85	100,0%

groups originally sampled * favorite subject (recoded into math vs. no math) Crosstabulation

Count

		favorite subject (recoded into math vs. no math)		
		math	other than math	Total
groups originally sampled	chess	19	13	32

	extracurriculars	11	15	26
	no activity	6	18	24
Total		36	46	82

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6,619[a]	2	,037
Likelihood Ratio	6,806	2	,033
Linear-by-Linear Association	6,538	1	,011
N of Valid Cases	82		

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 10,54.

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Phi	,284			,037
	Cramer's V	,284			,037
	Contingency Coefficient	,273			,037
Interval by Interval	Pearson's R	,284	,103	2,650	,010[c]
Ordinal by Ordinal	Spearman Correlation	,284	,103	2,647	,010[c]
N of Valid Cases		82			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

c. Based on normal approximation.

```
FREQUENCIES VARIABLES=mean_N
  /FORMAT=NOTABLE
  /STATISTICS=STDDEV MINIMUM MAXIMUM MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Statistics

mean of N scores

N	Valid	85
	Missing	0
Mean		73,39
Median		73,00
Mode		69[a]
Std. Deviation		12,257
Minimum		50
Maximum		112

a. Multiple modes exist. The smallest value is shown

```
FREQUENCIES VARIABLES=cum_norm
  /STATISTICS=STDDEV MINIMUM MAXIMUM MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Statistics

cumulative percent of the norm population

N	Valid	85
	Missing	0
Mean		8,12
Median		2,00
Mode		1
Std. Deviation		13,801
Minimum		1
Maximum		80

cumulative percent of the norm population

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	34	40,0	40,0	40,0
	2	9	10,6	10,6	50,6
	3	6	7,1	7,1	57,6
	4	5	5,9	5,9	63,5
	5	2	2,4	2,4	65,9
	6	2	2,4	2,4	68,2
	7	2	2,4	2,4	70,6
	8	2	2,4	2,4	72,9
	9	4	4,7	4,7	77,6
	10	2	2,4	2,4	80,0
	11	2	2,4	2,4	82,4
	13	1	1,2	1,2	83,5
	14	2	2,4	2,4	85,9
	19	2	2,4	2,4	88,2
	20	1	1,2	1,2	89,4
	22	1	1,2	1,2	90,6
	26	1	1,2	1,2	91,8
	27	1	1,2	1,2	92,9
	31	2	2,4	2,4	95,3

34	1	1,2	1,2	96,5
56	1	1,2	1,2	97,6
64	1	1,2	1,2	98,8
80	1	1,2	1,2	100,0
Total	85	100,0	100,0	

```
* Custom Tables.
CTABLES
  /VLABELS VARIABLES=CA1 CA2 CA3 CA4 CA5 CA6 CA7 CA8 CA9 CB1 CB2 CB3 CB4 CB5 CB6
CB7 CB8 CB9 CC1 CC2 CC3 CC4 CC5 CC6 CC7 CC8 CC9
    DISPLAY=LABEL
  /TABLE CA1 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CA2 [COUNT F40.0,
SUBTABLEPCT.COUNT PCT40.1] + CA3 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CA4
[COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CA5 [COUNT F40.0, SUBTABLEPCT.COUNT
PCT40.1] + CA6 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CA7 [COUNT F40.0,
SUBTABLEPCT.COUNT PCT40.1] + CA8 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CA9
[COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CB1 [COUNT F40.0, SUBTABLEPCT.COUNT
PCT40.1] + CB2 [COUNT F40.0,
SUBTABLEPCT.COUNT PCT40.1] + CB3 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CB4
[COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CB5 [COUNT F40.0, SUBTABLEPCT.COUNT
PCT40.1] + CB6 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CB7 [COUNT F40.0,
SUBTABLEPCT.COUNT PCT40.1] + CB8 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CB9
[COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CC1 [COUNT F40.0, SUBTABLEPCT.COUNT
PCT40.1] + CC2 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CC3 [COUNT F40.0,
SUBTABLEPCT.COUNT PCT40.1] + CC4 [COUNT
F40.0, SUBTABLEPCT.COUNT PCT40.1] + CC5 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] +
CC6 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CC7 [COUNT F40.0, SUBTABLEPCT.COUNT
PCT40.1] + CC8 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + CC9 [COUNT F40.0,
SUBTABLEPCT.COUNT PCT40.1]
  /CATEGORIES VARIABLES=CA1 CA2 CA3 CA4 CA5 CA6 CA7 CA8 CA9 CB1 CB2 CB3 CB4 CB5 CB6
CB7 CB8 CB9 CC1 CC2 CC3 CC4 CC5 CC6 CC7 CC8 CC9 ORDER=A KEY=VALUE EMPTY=INCLUDE
TOTAL=YES POSITION=AFTER MISSING=EXCLUDE.
```

Custom Tables

		Count	Subtable N %
Categories subtest, a-series, item 1	item not solved	20	23,5%
	item solved	65	76,5%
	Total	85	100,0%
Categories subtest, a-series, item 2	item not solved	42	49,4%
	item solved	43	50,6%
	Total	85	100,0%
Categories subtest, a-series, item 3	item not solved	29	42,0%
	item solved	40	58,0%
	Total	69	100,0%
Categories subtest, a-series, item 4	item not solved	45	83,3%
	item solved	9	16,7%
	Total	54	100,0%
Categories subtest, a-series, item 5	item not solved	21	72,4%
	item solved	8	27,6%
	Total	29	100,0%

Categories subtest, a-series, item 6	item not solved	5	50,0%
	item solved	5	50,0%
	Total	10	100,0%
Categories subtest, a-series, item 7	item not solved	5	100,0%
	item solved	0	0,0%
	Total	5	100,0%
Categories subtest, a-series, item 8	item not solved	2	66,7%
	item solved	1	33,3%
	Total	3	100,0%
Categories subtest, a-series, item 9	item not solved	1	100,0%
	item solved	0	0,0%
	Total	1	100,0%
Categories subtest, b-series, item 1	item not solved	16	29,1%
	item solved	39	70,9%
	Total	55	100,0%
Categories subtest, b-series, item 2	item not solved	32	47,8%
	item solved	35	52,2%
	Total	67	100,0%
Categories subtest, b-series, item 3	item not solved	35	53,0%
	item solved	31	47,0%
	Total	66	100,0%
Categories subtest, b-series, item 4	item not solved	15	30,6%
	item solved	34	69,4%
	Total	49	100,0%
Categories subtest, b-series, item 5	item not solved	22	55,0%
	item solved	18	45,0%
	Total	40	100,0%
Categories subtest, b-series, item 6	item not solved	22	73,3%
	item solved	8	26,7%
	Total	30	100,0%
Categories subtest, b-series, item 7	item not solved	12	75,0%
	item solved	4	25,0%
	Total	16	100,0%
Categories subtest, b-series, item 8	item not solved	5	71,4%
	item solved	2	28,6%
	Total	7	100,0%
Categories subtest, b-series, item 9	item not solved	2	66,7%
	item solved	1	33,3%
	Total	3	100,0%
Categories subtest, c-series, item 1	item not solved	20	55,6%
	item solved	16	44,4%
	Total	36	100,0%

Categories subtest, c-series, item 2	item not solved	18	38,3%
	item solved	29	61,7%
	Total	47	100,0%
Categories subtest, c-series, item 3	item not solved	33	66,0%
	item solved	17	34,0%
	Total	50	100,0%
Categories subtest, c-series, item 4	item not solved	32	68,1%
	item solved	15	31,9%
	Total	47	100,0%
Categories subtest, c-series, item 5	item not solved	19	59,4%
	item solved	13	40,6%
	Total	32	100,0%
Categories subtest, c-series, item 6	item not solved	10	41,7%
	item solved	14	58,3%
	Total	24	100,0%
Categories subtest, c-series, item 7	item not solved	15	83,3%
	item solved	3	16,7%
	Total	18	100,0%
Categories subtest, c-series, item 8	item not solved	5	71,4%
	item solved	2	28,6%
	Total	7	100,0%
Categories subtest, c-series, item 9	item not solved	1	50,0%
	item solved	1	50,0%
	Total	2	100,0%

```
* Custom Tables.
CTABLES
  /VLABELS VARIABLES=SA1 SA2 SA3 SA4 SA5 SA6 SA7 SA8 SA9 SA10 SA11 SB1 SB2 SB3 SB4
SB5 SB6 SB7 SB8 SB9 SB10 SB11 SC1 SC2 SC3 SC4 SC5 SC6 SC7 SC8 SC9 SC10 SC11
    DISPLAY=LABEL
  /TABLE SA1 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SA2 [COUNT F40.0,
SUBTABLEPCT.COUNT PCT40.1] + SA3 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SA4
[COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SA5 [COUNT F40.0, SUBTABLEPCT.COUNT
PCT40.1] + SA6 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SA7 [COUNT F40.0,
SUBTABLEPCT.COUNT PCT40.1] + SA8 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SA9
[COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SA10 [COUNT F40.0, SUBTABLEPCT.COUNT
PCT40.1] + SA11 [COUNT F40.0,
SUBTABLEPCT.COUNT PCT40.1] + SB1 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SB2
[COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SB3 [COUNT F40.0, SUBTABLEPCT.COUNT
PCT40.1] + SB4 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SB5 [COUNT F40.0,
SUBTABLEPCT.COUNT PCT40.1] + SB6 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SB7
[COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SB8 [COUNT F40.0, SUBTABLEPCT.COUNT
PCT40.1] + SB9 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SB10 [COUNT F40.0,
SUBTABLEPCT.COUNT PCT40.1] + SB11 [COUNT
F40.0, SUBTABLEPCT.COUNT PCT40.1] + SC1 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] +
SC2 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SC3 [COUNT F40.0, SUBTABLEPCT.COUNT
PCT40.1] + SC4 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SC5 [COUNT F40.0,
SUBTABLEPCT.COUNT PCT40.1] + SC6 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SC7
[COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SC8 [COUNT F40.0, SUBTABLEPCT.COUNT
PCT40.1] + SC9 [COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1] + SC10 [COUNT F40.0,
SUBTABLEPCT.COUNT PCT40.1] + SC11
[COUNT F40.0, SUBTABLEPCT.COUNT PCT40.1]
```

```
/CATEGORIES VARIABLES=SA1 SA2 SA3 SA4 SA5 SA6 SA7 SA8 SA9 SA10 SA11 SB1 SB2 SB3
SB4 SB5 SB6 SB7 SB8 SB9 SB10 SB11 SC1 SC2 SC3 SC4 SC5 SC6 SC7 SC8 SC9 SC10 SC11
ORDER=A KEY=VALUE EMPTY=INCLUDE TOTAL=YES POSITION=AFTER MISSING=EXCLUDE.
```

Custom Tables

Warnings

Some subtables in table 1 are empty. They may not display properly if EMPTY = EXCLUDE.

		Count	Subtable N %
Situations subtest, a-series, item 1	item not solved	20	23,5%
	item solved	65	76,5%
	Total	85	100,0%
Situations subtest, a-series, item 2	item not solved	25	29,4%
	item solved	60	70,6%
	Total	85	100,0%
Situations subtest, a-series, item 3	item not solved	28	38,4%
	item solved	45	61,6%
	Total	73	100,0%
Situations subtest, a-series, item 4	item not solved	36	55,4%
	item solved	29	44,6%
	Total	65	100,0%
Situations subtest, a-series, item 5	item not solved	34	75,6%
	item solved	11	24,4%
	Total	45	100,0%
Situations subtest, a-series, item 6	item not solved	8	34,8%
	item solved	15	65,2%
	Total	23	100,0%
Situations subtest, a-series, item 7	item not solved	13	72,2%
	item solved	5	27,8%
	Total	18	100,0%
Situations subtest, a-series, item 8	item not solved	3	60,0%
	item solved	2	40,0%
	Total	5	100,0%
Situations subtest, a-series, item 9	item not solved	1	33,3%
	item solved	2	66,7%
	Total	3	100,0%
Situations subtest, a-series, item 10	item not solved	0	0,0%
	item solved	2	100,0%
	Total	2	100,0%
Situations subtest, a-series, item 11	item not solved	2	100,0%
	item solved	0	0,0%

	Total	2	100,0%
Situations subtest, b-series, item 1	item not solved	22	56,4%
	item solved	17	43,6%
	Total	39	100,0%
Situations subtest, b-series, item 2	item not solved	29	53,7%
	item solved	25	46,3%
	Total	54	100,0%
Situations subtest, b-series, item 3	item not solved	20	41,7%
	item solved	28	58,3%
	Total	48	100,0%
Situations subtest, b-series, item 4	item not solved	28	57,1%
	item solved	21	42,9%
	Total	49	100,0%
Situations subtest, b-series, item 5	item not solved	24	63,2%
	item solved	14	36,8%
	Total	38	100,0%
Situations subtest, b-series, item 6	item not solved	19	76,0%
	item solved	6	24,0%
	Total	25	100,0%
Situations subtest, b-series, item 7	item not solved	5	38,5%
	item solved	8	61,5%
	Total	13	100,0%
Situations subtest, b-series, item 8	item not solved	9	81,8%
	item solved	2	18,2%
	Total	11	100,0%
Situations subtest, b-series, item 9	item not solved	3	75,0%
	item solved	1	25,0%
	Total	4	100,0%
Situations subtest, b-series, item 10	item not solved	3	100,0%
	item solved	0	0,0%
	Total	3	100,0%
Situations subtest, b-series, item 11	item not solved	0	0,0%
	item solved	0	0,0%
	Total	0	0,0%
Situations subtest, c-series, item 1	item not solved	24	63,2%
	item solved	14	36,8%
	Total	38	100,0%
Situations subtest, c-series, item 2	item not solved	21	40,4%
	item solved	31	59,6%
	Total	52	100,0%
Situations subtest, c-series, item 3	item not solved	17	34,0%
	item solved	33	66,0%

	Total	50	100,0%
Situations subtest, c-series, item 4	item not solved	20	43,5%
	item solved	26	56,5%
	Total	46	100,0%
Situations subtest, c-series, item 5	item not solved	22	47,8%
	item solved	24	52,2%
	Total	46	100,0%
Situations subtest, c-series, item 6	item not solved	27	81,8%
	item solved	6	18,2%
	Total	33	100,0%
Situations subtest, c-series, item 7	item not solved	12	60,0%
	item solved	8	40,0%
	Total	20	100,0%
Situations subtest, c-series, item 8	item not solved	9	81,8%
	item solved	2	18,2%
	Total	11	100,0%
Situations subtest, c-series, item 9	item not solved	3	60,0%
	item solved	2	40,0%
	Total	5	100,0%
Situations subtest, c-series, item 10	item not solved	2	100,0%
	item solved	0	0,0%
	Total	2	100,0%
Situations subtest, c-series, item 11	item not solved	1	100,0%
	item solved	0	0,0%
	Total	1	100,0%

```
FREQUENCIES VARIABLES=chess_frequency
  /STATISTICS=MINIMUM MAXIMUM MEAN MEDIAN MODE
  /ORDER=ANALYSIS.
```

Frequencies

Statistics

"How often do you attend the chess class?"

N	Valid	32
	Missing	53
Mean		3,97
Median		4,00
Mode		5
Minimum		2
Maximum		5

"How often do you attend the chess class?"

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	rarely	1	1,2	3,1	3,1
	sometimes	14	16,5	43,8	46,9
	often	2	2,4	6,3	53,1
	always	15	17,6	46,9	100,0
	Total	32	37,6	100,0	
Missing	999	53	62,4		
Total		85	100,0		

```
NONPAR CORR
  /VARIABLES=chess_frequency mean_N T3_average_mark
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Correlations

			"How often do you attend the chess class?"	mean of N scores	average mark in term 3 2015 (percentage points)
Spearman's rho	"How often do you attend the chess class?"	Correlation Coefficient	1,000	-,064	-,035
		Sig. (2-tailed)	.	,728	,849
		N	32	32	32
	mean of N scores	Correlation Coefficient	-,064	1,000	,264*
		Sig. (2-tailed)	,728	.	,015
		N	32	85	85
	average mark in term 3 2015 (percentage points)	Correlation Coefficient	-,035	,264*	1,000
		Sig. (2-tailed)	,849	,015	.
		N	32	85	85

*. Correlation is significant at the 0.05 level (2-tailed).