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THE FACTOR STRUCTURE OF LIST QUESTIONNAIRE FOR LEARNING STRATEGIES OF ESTONIAN STUDENTS IN MATHEMATICS

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ABSTRACT

This study reports learning strategies of first-year Estonian university students in mathematics. The data was collected from 232 university students of different disciplines. The participants filled out a Likert-type questionnaire that was developed using previously published instruments. The aim of this pilot study is to examine the 69-item LIST questionnaire first time for Estonian university students. By means of an exploratory factor analysis, 9 factors were confirmed. The pilot study confirmed most of the components identified in earlier studies. It validates the use of the instrument in further studies of learning strategies at the university level in Estonia.

KEYWORDS: learning strategies; LIST questionnaire; mathematics education; university mathematics

INTRODUCTION

Several researches (Collie, Martin, Bobis, Way & Anderson, 2019; Martin, Anderson, Bobis, Way, & Vellar, 2012) identified that middle and high school students do not seem to be interested in focusing on mathematics in their future academic life and beyond (referred to as 'switching on') and it may continue at university level. By Wang & Eccles, (2011, 2012) it is important to initiate and foster positive aspirations in mathematics and arrest growing disengagement in the subject. This brings into focus the need to understand students' trajectories in mathematics aspirations and disengagement (Collie et al, 2019).

Research into mathematics education at the tertiary level may be itself an interesting field of research and may give rise to useful results for teachers in all educational levels to apply to their teaching. This study is so far, the only investigation of students' learning strategies in mathematics in Estonia at the university level and until now the area has been unexplored in Estonia. One of the strategic objectives of the Estonian higher education strategy is to motivate students to study natural and exact sciences and technology at the tertiary level (Estonian Ministry of Education and Research, 2006). Our students showed excellent achievement in the PISA studies, and Estonian students know that mathematics is important (Estonian Ministry of Education and Research, 2013; 2017). PISA 2012 and 2015 shows that Estonia's basic school students rank among the best in the world while being at the absolute top in Europe (Estonian Ministry of Education and Research, 2017), but at the same time they conclude that mathematics is boring (Kislenko, 2009). However, at the university level natural sciences, exact sciences and technology are not popular fields of study and the dropout rate is high.

The research at the tertiary level in Estonia is limited to a few research papers about view of mathematics (Kaldo & Hannula 2012; Kaldo, 2014), which indicated that females are more motivated to study mathematics. In order to emphasize the present focus on studying the structure of students' mathematical beliefs and motivation, the term view of mathematics is used in this paper (Kaldo & Hannula 2012; Kaldo, 2014). This term about mathematics-related beliefs systems was originally introduced by Schoenfeld (1985) and later adapted by others (Pehkonen, 1995; Pehkonen & Törner, 1996; Rösken et al., 2011). We have been influenced by the work of Rösken et al. (2007; 2011) and therefore prefer to use the term "view" in our paper because it fits with the different aspects and concepts of beliefs, affect and attitudes to this more general construct.

Recent studies (Kaldo & Hannula, 2014; Kaldo, 2014) show that more than two-thirds of the students think that what they are learning in mathematics is interesting. The problem is that more than half of the students do not understand everything that they have done in mathematics over the last year (xxx). This calls for a change in learning techniques in mathematics at the university level. Based on Alsina (2001) and Bergsten (2007), we suggest that the students would benefit from learning strategies and additional materials (tutorials, books, lecture notes, web pages, etc.) for studying mathematics at home and practicing using mathematics after lectures. Moreover, because 92% of students agreed that mathematics is an important subject, although at the same time 65% of students think that studying mathematics is a waste of time (Kaldo, 2014).

Rosenthal (1995) described that university mathematics is often taught purely using the lecture format, which promotes passivity and isolation in students and suggest that university lecturers can implement many changes in their own classroom by their own initiative. In the learning strategies in mathematics education plays the important role affect, motivation and beliefs (Hannula, Evans, et al., 2004; McLeod, 1992; Zan et al., 2006).

Griese (2016) described learning mathematics at tertiary level as a complex matter. In their project they are looking for theories that can be applied to higher mathematics, that describe learning processes adequately in their complexity, and that comprise cognitive as well as affective and motivational aspects. By Griese (2016) „the last point is imperative as, apart from researching the conditions that support or hinder academic success in mathematics for engineering students, the focus lies on the interventions themselves, on approaching preconditions that are changeable Griese" (2016, p. 12).

Therefore, raises the question about how students use different learning strategies in mathematics. There is no previous researches in Estonia in this field at the university level and this pilot research is the first one in Estonia. The aim of this research was to use the some of the published instruments on mathematical learning strategies first time in Estonia at university level and check how it works in our culture. This instrument was then used to confirm its applicability in Estonia at the university level. In our comparative study, we particularly pursued the following research question: what kinds of factor structure in learning strategies in mathematics do students from Estonia hold at the university level?

METHOD

Theoretical framework

In the following the selection of approaches to capture learning strategies introduced, which reflect the importance of affective and motivational issues. The learning strategies by Wild (2005, p. 194) and Griese (2016), are divided into 1) cognitive learning strategies, 2) metacognitive learning strategies, and 3) learning strategies for the use of internal and external resources or in other words resource-oriented strategies. According to Wild (2005) and Griese (2016): cognitive learning strategies as primary strategies encompass repeating, organizing, elaborating, rote-learning and critical thinking strategies. Resource-oriented learning strategies as secondary strategies are divided into internal resources as time management, attentions and effort; and external resources as learning environment, peer learning and using works of reference. Metacognitive learning strategies cover planning, monitoring, and regulating the next steps in the learning process (Griese, 2016).

Pintrich and DeGroot (1990) developed a questionnaire “The Motivated Strategies for Learning Questionnaire” (MSLQ) which was developed to measure the types of learning strategies and academic motivation used by college students and uses a Likert scale. There are essentially two sections to the MSLQ, a motivation section, and a learning strategies section. In the MSLQ the learning strategy section includes 31 items regarding students' use of different cognitive and metacognitive strategies (Pintrich, Smith, García & McKeachie, 1991). The Approaches to Studying Inventory (ASI) by Entwistle and Ramsden (1983) and its refinements (ASSIST by Tait, Entwistle & McCune, 1998; ALSI by Entwistle & McCune 2004) feature the main distinction of categorizing learning behaviour as being of either strategic or of apathetic approach (Griese, Lehmann & Roesken-Winter, 2015). Another self-report instrument to assess students learning strategies is the Learning and Study Strategies Inventory (LASSI) by Weinstein and Palmer (2002). LASSI covers thoughts, behaviours, attitudes and beliefs in relation to successful learning that can also be fostered by interventions (Griese et al., 2015).

Another well-known questionnaire is the German LIST questionnaire (Wild & Schiefele, 1994), which is based on the same classification as MSLQ and takes up aspects from LASSI as well (Griese et al., 2015). LIST questionnaire has been modified and tested several times since 1994 and has been applied in the context of many subjects, mathematics among them (Liebendörfer, Hochmuth, Schreiber, Göller, Kolter, Biehler, Kortemeyer & Ostsieker, 2014; Griese et al, 2015). Griese et al. (2015) examined the 69-item LIST questionnaire for 2374 STEM students from different engineering courses at Ruhr-Universität Bochum in Germany, typically predominantly males, some with insufficient background in mathematics or non-native speakers of German. Gómez-Chacón, Griese, Rösken-Winter and Gonzàlez-Guillén (2015), explored by means of the LIST questionnaire learning strategies for two samples of 113 Spanish and 159 German engineering students. Griese et al. (2015), research focuses on engineering students in their first semester at the university. Out of the students questioned, 77.70 % are males, 22.30 % females in their study. In the paper Griese et al. (2015), learning strategies are understood as all kinds of planned and conscious learning behaviour and the attitudes behind it, involving observable actions (e.g. solving tasks, asking questions, taking notes) as well as thought processes (e.g. planning, reflecting) on the basis of both cognitive and affective-motivational dispositions.

All these questionnaires use Likert scales, and an overview on how LIST is based on MSLQ and LASSI is described in the work of Griese (2016).

The LIST questionnaire of Griese et. al (2015,) covers cognitive, metacognitive and resource-oriented learning strategies. Second reason why for this pilot research in Estonia, the decision fell for the Griese et al. (2015) 69-LIST questionnaire is that this one is modified and up-to-date questionnaire. Also, the sample groups used in the research are similar – first-year students who took at least one compulsory mathematics course and it fits with previous works Rösken et al. (2007; 2011) and (Kaldo & Hannula 2012; Kaldo, 2014). As there are no analogous Estonian questionnaires on learning strategies, our study opted for the LIST questionnaire, thus hoping for the further asset of a parallel instrument for different countries.

Sample of the research

This study was carried out in Estonia at the university level. A nationally representative study provides a strong basis for research at the tertiary level as well as for the conclusions and educational implications. In order to gain a complete picture and to get a representative sample, we wanted to cover almost all the universities in Estonia (a total of 5 universities in 2 cities: Tallinn and Tartu). In Estonia, we have only a few universities and they focus on different subjects. The participants were 232 volunteer bachelor students taking at least one first-year compulsory math course at the university level at The University of Tartu, at the Tallinn University of Technology, at the Estonian University of Life Sciences, at the Estonian Business School and at the Estonian Aviation Academy (state-owned professional higher education institution). The survey was completed during the mathematics lectures that were compulsory for the students and participation was voluntary. There were 128 males and 104 females; 178 students studying in Estonian and 54 students studying in English (Figure 1).

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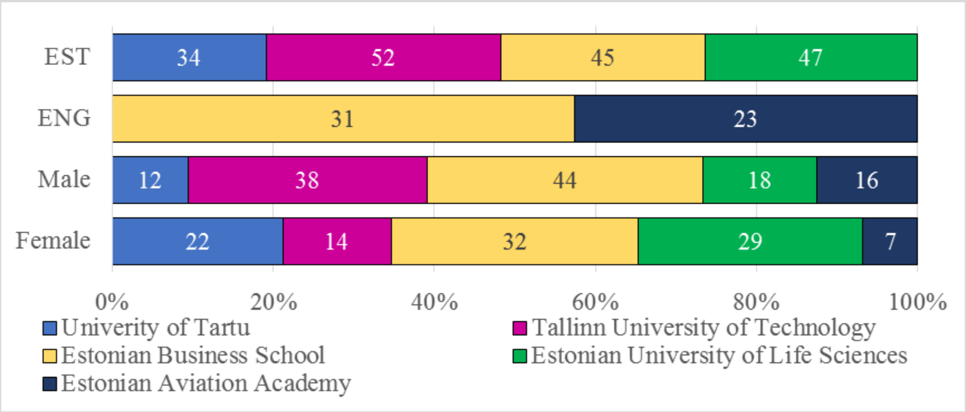

Figure 1. Counts (on coloured areas) and percentages of respondents' socio-demographic data

According to Estonian Educational Information System (www.ehis.ee) there was 1461 bachelor students in year 2015/2016 who have mathematics course in their study program, so the database is presenting population quite well.

Instrument and Procedures

The LIST questionnaire used in this research was developed in 1994 as part of a research project in Germany. The statements in the questionnaire are grouped into 13 topics (Wild & Schiefele, 1994). Griese et al. (2015) modified the original LIST questionnaire to 69-items LIST, they removed the scale Criticial Checks because it did not seem appropriate for mathematics at the beginning of the university. By the same reason we used the 69-items LIST because our sample was first-year university students. In the study, a quantitative (questionnaire) research strategy was used. The questionnaire was used to investigate students' learning strategies in mathematics.

The questionnaire used in Estonia was translated before the pilot study into Estonian and back to English. As one of the aims of the pilot study was to make a comparative analysis Griese et al (2015), then the translation had to have been carried out with a high degree of caution. Gorard's (2001) suggestion will be followed during the study where he recommends that:

"… if you are working in one language and translating your instrument into another language before completion (a common process for overseas students), then use the techniques of back translation as well. In this, the translated version is translated back into the original language by a third person as a check on the preservation of the original meaning." (p. 91)

The study in Spain (cf. Gómez-Chacón et al., 2015), show that LIST keeps its qualities when being used in another country: after being translated into English and then into Spanish, the cognitive and metacognitive scales from LIST kept their reliability, an indication for the questionnaire's universal applicability.

Since purpose of the study was to confirm the earlier scales on learning strategies (Griese et al., 2015), the original scales from the earlier research were used and their reliabilities were computed. Moreover, the structure of the learning strategies on mathematics was explored through calculating correlations between the reliable components.

Participants filled in a questionnaire on paper. The students were asked to respond on a Likert scale (4 options: strongly disagree, partly disagree, partly agree, and strongly agree). The students were given 30 minutes to fill in the questionnaire and told the questionnaire was anonymous and we collected 232 questionnaires.

Since purpose of the study was to confirm the 69-item LIST of students' learning strategies in mathematics (Griese et al., 2015), the same component names were used: Organizing, Elaborating, Repeating etc.

Statistical methods and data analysis

The statistical program SPSS Statistics was used for the data analysis. Since the aim of the study was to explore if the earlier scales on learning strategies (Griese et al., 2015) could be confirmed, items from the earlier research were used and the reliabilities of the modified scales were computed (Table 1). Exploratory factor analysis has three main uses: 1) to understand the structure of a set of variables; 2) to construct an instrument to measure an underlying variable; and 3) to reduce a data set to a more manageable size while retaining as much of the original information as possible (Field, 2009). In this study, we followed Field's (2009) directions. The decision to use the exploratory factor analysis for the questionnaire came from the following reasons: 1) the previous questionnaires were not tested in a similar population; i.e., these were used in Estonia for the first time; 2) the sample in this study is large and varied enough to make an exploratory analysis compelling. In this study, an exploratory factor analysis was done, which revealed factors similar to the earlier studies. For the exploratory factor analysis, the maximum likelihood method with direct oblique rotation was used to determine useful and statistically robust dimensions regarding this construct. This method of factor analysis allows for the making of inferences from sample to population; the sample of 232 students is, therefore, large and adequate enough. Oblique rotation is used when factors are allowed to correlate (Field, 2009). The factors of the learning strategies in mathematics cannot be regarded independently of each other; therefore, correlations among factors should be allowed. In that case, an oblique rotation will lead to a better estimation of factors since it derives factor loadings based on the assumption that they are correlated (Fabrigar, Wegener, MacCallum, & Strahan, 1999). The Kaiser criterion is based on the idea that the eigenvalues represent the amount of variation explained by a factor and that an eigenvalue of 1 represents a substantial amount of variation and therefore the recommendation is to retain all factors with eigenvalues greater than 1 (Field, 2009). The program SPSS with the Kaiser criteria "eigenvalue > 1" gave a suggestion to use 17 factors. Field (2009) argued that with a sample of more than 200 participants, the Catell's scree-test provides a fairly reliable criterion for factor selection. According to the Cattell's scree–test, after an inspection of the scree plot, the proper number of factors appeared to be between 7 and 8. A 12-factor solution for the whole survey was used, because a 12-factor solution corresponded with the number of factors predicted from the original studies. Another reason was that some factors contained only two items factor solutions, or their Cronbach alphas were low. Items which had communalities of less than 0.3 were removed, because these lowest communalities are not significant (Hair, Anderson, Tatham, & Black,1998). Moreover, the structure of the view of mathematics was explored through calculating correlations (Hinkle, Wiersma, & Jurs, 2009) between the reliable components in SPSS. At least moderate correlations coefficients that are greater than 0.5 are presented in this study. In addition, we also calculated the mean scores and standard deviations for the whole sample (n=232) on each of the components.

Reliability

Reliability characterises the stability, consistency and suitability of the methodology used. Reliability shows how well the results of repeated measurements (by either the same researcher or different researchers) carried out in the same circumstances coincide (Kask, 2009; Laius, 2011; Kaldo 2015). Reliability also indicates whether a certain indicator measures consistently and continuously (Kask, 2009; Laius 2011). In other words, how reliable is the result of the measurement (Kask, 2009; Laius, 2011)? In this study, the Cronbach's alpha was used as a measure of the internal consistency of the instrument and its subscales, which is the most widely used measure (Hair et al., 1998). If the reliability coefficient is 0.70 or higher, it is considered "acceptable" in most social science research situations (Hair et al., 1998).

RESULTS OF RESEARCH

The summarize results are presented in Table 1. The Cronbach's alpha shows reliability. We also calculated the mean scores and variances for the whole sample (n = 232) on each of the components. The original Cronbach's alpha is the alpha which is used in earlier studies of previously published instruments (Wild & Schiefele, 1994).

Table 1. The twelve factors of the students' learning strategies in mathematics

Factors (number of items)	Sample item	Original Cronbach's alpha	Cronbach's alpha in our study	Mean	Std. deviation
F1 Organizing (8)	I go over mu notes and structure the most important points.	0.82	0.805	2.61	0.56
F2 Elaborating (8)	I think of practical applications of new concepts.	0.77	0.815	2.69	0.54
F3	I read my notes	0.73	0.759	2.38	0.55

Repeating (7)	several times in a row.				
F4 Metacognition: Planning (4)	I plan in advance in which order I want to work through the subject matter.	0.64	0.634	2.50	0.63
F5 Metacognition: Monitoring (4)	I ask myself questions on the subject matter in order to make sure that I have understood everything correctly.	0.64	0.641	2.34	0.60
F6 Metacognition: Regulating (3)	Confronted with a difficult subject matter I adapt my learning strategy accordingly.	0.64	0.626	2.78	0.57
F7 Effort (8)	I make an effort even though the subject matter may not suit me well.	0.74	0.784	2.89	0.49
F8 Attention (6)	When I am learning I notice that my thoughts tend to stray.	0.90	0.908	2.50	0.68
F9 Time management (3)	I work according to a schedule.	0.83	0.701	2.01	0.56
F10 Learning Environment (5)	I work in a place that makes it easy to concentrate.	0.71	0.711	2.81	0.52
F11 Peer Learning (7)	I work on tasks together with my peer students.	0.82	0.846	2.57	0.63
F12 Using Reference (4)	I search for explanatory material if certain facts are not completely clear.	0.72	0.804	3.11	0.59

The Cronbach's alpha shows reliability. It is commonly used as a measure of the internal consistency or reliability of factors for a sample of examinees. We also calculated the mean scores and variances for the whole sample (n = 232) on each of the components. In our study, the factor analysis confirmed 9 factors of 12. In this study, the factor analysis confirmed factors: F1 Organizing, F2 Elaborating, F3 Repeating, F7 Effort, F8 Attention, F9 Time management, F10 Learning Environment, F11 Peer Learning and F12 Using Reference. Three factors did not confirm because of the low reliability: F4 Metacognition: Planning; F5 Metacognition: Monitoring and F6 Metacognition: Regulating.

Analyzing factors F4-F6 one similarity appeared – 69-83% of respondents choose two answers (partly disagree and partly agree) for items included these factors so the low standard deviation is the reason why reliability is not high enough.

The highest learning strategies are: F11 Using Reference, F7 Effort and F10 Learning Environment which are resource-oriented learning strategies. The lowest strategy is F9 Time management, which is internal resource learning strategy.

Initially structure the students' learning strategies was obtained. Relations between the factors were calculated for the confirmed nine factors.

Table 2. Correlations between the factors

	F1	F2	F3	F7	F8	F9	F10	F11	F12
F1 Organizing	1								
F2 Elaborating	0.341**	1							
F3 Repeating	0.511*	0.147*	1						
F7 Effort	0.370**	0.339**	0.380**	1					
F8 Attention	-0.125	-0,068	-0.005	-0.297**	1				
F9 Time management	0.241**	0.268**	0.241**	0.281**	-0.033	1			
F10 Learning Environmen	0.294**	0.271**	0.201**	0.309**	-0.140*	0.269**	1		

t									
F11 Peer Learning	0.210**	0.114	0.243**	0.139*	0.020	0.005	0.097	1	
F12 Using Reference	0.256**	0.327**	0.292**	0.525**	-0.060	0.178**	0.187**	0.084	1

Table 2 shows that nearly all dimensions correlate statistically significantly with each other. All correlations with the sign ** are significant at the level 0.01 (2-tailed). Correlations with the sign * are significant at the 0.05 level (2-tailed). The results of the correlation analysis showed that nearly all factors correlated statistically significantly with each other. However, the strength of the correlation in the pilot survey (Hinkle, Wiersma & Jurs, 2009) varied from little, if any (0.00 to 0.29) to low (0.30 to 0.49) and moderate (0.50 to 0.70). Moderate correlations are the following factors: Organizing (F1) and Repeating (F3) were found to correlate with a coefficient of 0.511. The correlations of the rest of the factors are weak.

The idea for the correlation matrix is that due to high correlation between two of the scales and high similarity in their content, we can combine two of the scales and construct a new scale that had high reliability. But in our study, we did not find these scales which we can combine and therefore number of factors did not change.

DISCUSSION AND CONCLUSIONS

Research into mathematics education at the tertiary level may be itself an interesting field of research and may give rise to useful results for teachers in all educational levels to apply to their teaching (Alsina, 2001; Abdulwahed, Jaworski & Crawford, 2012). Based on studies carried out by researchers in other countries, it is clear that students' learning strategies in mathematics are important areas in mathematics education and need attention in an Estonian context. This study is so far the only investigation of students' learning strategies in mathematics in Estonia at the university level and until now the area has been unexplored in Estonia.

Research question: What kinds of factor structure in learning strategies in mathematics do students from Estonia hold at the university level?

The Cronbach's alpha is commonly used as a measure of the internal consistency reliability of a questionnaire. If the reliability coefficient is 0.70 or higher, it is considered to be "acceptable" in most social science research situations. In the Table 1 nine factors had a high Cronbach's alpha and their reliability for Estonian university students was confirmed. The reliability of three factors used in the study was not confirmed and the reason was high frequency of partly disagree and partly agree answers for factor items. However, those that were not found to be reliable were not far from the threshold level. The standard deviation of the item responses was very low, which may have contributed to the low reliability of the scale in this sample.

In our study, we got similar results with (Wild & Schiefele, 1994). The difference between the study of STEM students' learning strategies (Griese et al., 2015) was that in their study Metacognition factors were confirmed.

The scales had been previously tested on high school students and university students outside of Estonia, which suggest that the differences in reliability can be related to differences between samples (age, level of study, field of study, culture) or the translation of the items. This claim is coherent with Diego-Mantecón et al.'s (2007) conclusion that questionnaires can be sensitive to variables such as student age, gender and nationality.

The instrument was built on previous works in this area and the instrument combines scales and items from previous studies of students of few countries and we do not have knowledge that it will work in our cultural context regarding age, gender and students background. Therefore, one task of the survey was to check the reliability of the questionnaire. That means that we can use the questionnaire later for the survey. Nine reliable factors for students' learning strategies in mathematics were obtained. For identical items in both populations, we found the same factor structure and reliability analysis confirmed the internal consistency of nine factors. Describing the factors, it can be concluded that among these nine factors the highest value of mean is in F12 (Effort) and the lowest value is in F9 (Time Management). That is perfectly understandable that students make bigger effort to find extra materials (from internet or library) for their better understanding of learning subject. The low value of F9 (Time management) is caused of low values of items were students planning their study time – there is no specific time limit for them in the beginning of doing their tasks, they just start to study till it is done or the time is up and they continue it next free time period. The results show that Estonian students are not very eager to plan their exact study time, but they consider it important to learn in the group or at least in pairs and have a proper environment for learning.

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APPENDIX

Table 3. Reliable scale´s questions.

F1 Organizing (Cronbach's alpha =0.805)	Communalities
1. I make charts, diagrams and graphics in order to have the subject matter in front of me in a structured form.	0.577
2. I compile short summaries of the most important contents as a mnemonic aid.	0.670
3. I go over my notes and structure the most important points.	0.709
4. I try to order the subject matter in a way that makes it easy for me to remember.	0.663
5. I compile a summary of the main ideas out of my notes, the script or other sources.	0.704
6. I underline the most important parts in my notes or in the texts.	0.605
7. For bigger amounts of subject matter I find an arrangement that	0.721

mirrors the structure best.	
8. I assemble important terms and definitions in my own lists.	0.639
F2 Elaborating (Cronbach's alpha =0.815)	
9. I try to find connections to other subjects or courses.	0.632
10. I think of practical applications of new concepts.	0.643
11. I try to relate new terms or theories to terms or theories I already know.	0.668
12. I visualize new issues.	0.567
13. In my mind I try to connect newly learnt facts to what I already know.	0.588
14. I think of practical examples for certain curricular facts.	0.588
15. I relate what I am learning to my own experiences.	0.655
16. I wonder if the subject matter is relevant for my everyday life.	0.522
F3 Repeating (Cronbach's alpha =0.759)	
17. I imprint the subject matter from the lecture on my memory by repeating it.	0.587
18. I read my notes several times in a row.	0.524
19. I learn key terms by heart in order to remember important facts better in the exam.	0.639
20. I commit a self-compiled compendium to memory.	0.668
21. I read a text and try to recite it at the end of each paragraph.	0.565
22. I commit rules, technical terms or formulas to memory.	0.780
23. I learn the subject matter by heart using scripts or other notes.	0.718
F7 Effort (Cronbach's alpha =0,784)	
24. Whenever I have planned a certain workload, I make an effort to master it.	0.630
25. I make an effort even though the subject matter may not suit me well.	0.606
26. I do not give up even though the subject matter is very difficult and complex.	0.614
27. I work late at night or at the weekends if necessary.	0.521

28. It usually does not need much time until I decide to start working.	0.612
29. Before exams I take the time to go over all the subject matter again.	0.602
30. I take more time for learning than most of my fellow students.	0.630
31. I work until I am sure to pass the exam well.	0.660
F8 Attention (Cronbach's alpha =0.908)	
32. When I am learning I notice that my thoughts tend to stray.	0.730
33. It is difficult for me to concentrate.	0.781
34. I find myself thinking of completely different things.	0.787
35. When learning I am lacking in concentration.	0.725
36. I am easy to distract when learning	0.741
37. My concentration does not last very long	0.695
F9 Time Management (Cronbach's alpha =0.701)	
38. I work according to a schedule.	0.691
39. I fix the hours I spend daily on learning in a schedule.	0.644
40. Before each study period I appoint the duration of my work.	0.604
F10 Learning Environment (Cronbach's alpha =0,711)	
41. I work in a place that makes it easy to concentrate.	0.637
42. I design my work environment in a way that I am distracted as little as possible.	0.680
43. When learning I always sit at the same place.	0.617
44. When studying I make sure that I can work uninterrupted.	0.700
45. At my desk I have the most important papers within reach	0.770
F11 Peer Learning (Cronbach's alpha =0.846)	
46. I work on tasks together with my peer students.	0.668
47. I take my time to discuss the subject matter with other students.	0.716
48. I compare my notes with my peer students.	0.679
49. I make other students ask me questions on the subject matter and ask them questions too.	0.570
50. I turn to help from others when I have serious problems in	0.640

understanding something.	
51. When I am not sure about something, I ask a fellow student for advice.	0.786
52. If I find considerable gaps in my notes, I turn to fellow students.	0.731
F12 Using Reference (Cronbach's alpha =0.804)	
53. I search for explanatory material if certain facts are not completely clear.	0.672
54. Whenever I do not understand a technical term, I look it up in a textbook or on the Internet.	0.723
55. I look for missing information in different sources, e.g. the Internet, textbooks, or journals.	0.751
56. When my notes are incomplete, I use additional sources.	0.665