Unraveling the complex relationship in critical thinking, approaches to learning and self-efficacy beliefs among first-year educational science students

Heidi Hyytinen[1], Auli Toom[1], and Liisa Postareff[2]

[1]Centre for University Teaching and Learning, Faculty of Educational Sciences, the University of Helsinki, Finland

[2]Department of Teacher Education, Unit for University Pedagogy, the University of Turku

Corresponding author: PhD Heidi Hyytinen, Centre for University Teaching and Learning, University of Helsinki, 00014 University of Helsinki, Finland.

Tel +358504156617

Email address: heidi.m.hyytinen@helsinki.fi

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Abstract

Critical thinking is a key capability for academic experts and for developing one's expertise from the very beginning of studying at university. Self-efficacy beliefs and approaches to learning are important in this process, although their relationships with critical thinking are not clear. This study explores the relationship between critical thinking, approaches to learning and self-efficacy beliefs among Finnish first-year students in educational sciences (n=92). The self-reported data were used to measure approaches to learning and self-efficacy beliefs, and performance-based assessment data of critical thinking skills were analysed by using both quantitative and qualitative procedures. The results showed that most of the new students applied the deep approach to learning and had high self-efficacy beliefs related to learning. However, there were great differences in the quality of their

critical thinking. Three groups with remarkable differences in critical thinking skills were detected. There were no connections between critical thinking, approaches to learning and self-efficacy beliefs. The results imply that the development of critical thinking needs to be facilitated systematically during study at university.

Keywords: university students; critical thinking; self-efficacy beliefs; approaches to learning; transition to university

1. Introduction

Critical thinking, approaches to learning and self-efficacy beliefs have been shown to be essential factors for university students to progress in their studies (Baik, Naylor, Arkoudis & Dabrowski, 2017; Brooman & Darwent, 2014; Arum & Roksa, 2011; Evens, Verburgh & Elen, 2013). As they are also related to the quality of student learning in general, these skills should be acquired during their studies (Chapman, 2001; Kreber, 2003; Lizzio, Wilson & Simons, 2002). Empirical evidence has shown that there are differences between university students concerning the levels of these skills, and that some students do not acquire them at all (Arum & Roksa, 2011; Evens et al., 2013; Pascarella, Blaich, Martin, & Hanson, 2011). This might lead to unexpected challenges and disengagement as well as insufficient acquisition of the required academic capabilities during their studies (e.g., Baik et al., 2017; Korhonen, Inkinen, Mattsson, & Toom, 2017). For these reasons, universities should support the development of these skills systematically from the very beginning of studies.

Traditionally, higher education institutions set their own entry requirements for students wishing to enter the university. The aim of university admission is to identify individuals who have the aptitude or necessary skills for acquiring the required subject-specific knowledge as well as generic academic competencies, such as critical thinking skills (Stemler, 2012). In Finland, university students in educational sciences degrees are selected through the "VAKAVA" multiple-choice entrance exam (2015) and an individual interview. Educational sciences programmes, especially in teacher education, are very popular, and there is fierce competition for the available places. Even though the majority of the applicants have performed extremely well in upper secondary school, only a small number of the applicants (6-8%) are accepted into the available study programme (VAKAVA, 2015). Because of this, relative homogeneity among first-year students could be assumed, especially in terms of the academic qualities required to undertake university studies. First-year students who have a good foundation for learning and are academically engaged are more likely to complete their studies than their peers without these attributes (Baik et al., 2017).

Previous studies on approaches to learning by first-year students have shown that a deep approach to learning is related to an ability to regulate learning (Heikkilä, Lonka, Nieminen, & Niemivirta, 2012) and desirable academic outcomes (Öhrstedt & Lindfors, 2016). Self-efficacy beliefs have been shown to be related to students' motivation, as well as their self-regulation, engagement and performance (e.g., Lane, Lane, & Kyprianou, 2004). Although a positive connection between the

deep approach to learning and critical thinking is often presumed, there has been surprisingly little research into this aspect (Nelson Laird, Seifert, Pascarella, & Blaich, 2014). The relationships between critical thinking, approaches to learning and self-efficacy beliefs have not been empirically investigated among new students. The present study aims at gaining a better understanding of first-year university students' critical thinking, their approaches to learning and self-efficacy beliefs and how they are related to each other. The findings will help in understanding differences between students' academic achievements, and in developing pedagogical practices to enhance these skills.

1.1 Critical thinking - a key for student learning

Critical thinking is promoted as the foundation of democratic citizenship, freedom and autonomy (Arum & Roksa, 2011). It is also considered to be an essential factor for university students progressing successfully in their studies (Utriainen, Marttunen, Kallio, & Tynjälä, 2016). Students cannot meet the intended learning objectives without thinking skills. In addition, the adequate acquisition of critical thinking skills during their university studies will later enable them to work effectively in their professions when they enter working life. Critical thinking refers to self-disciplined thinking, during which a thinker assesses, evaluates, synthesises and interprets relevant information that is associated with a situation. The thinker must also apply that information in order to solve a problem, to decide on a course of action, to find an answer to a given question or to reach a well-reasoned conclusion (Abrami et al., 2015; Author, 2015; Halpern, 2014; Ennis, 1991). Critical thinking involves open-minded thinking about alternative solutions and effective communication (Halpern, 2014; Authors, 2015), and it is an essential part of the problem-solving process (Willingham, 2007; Ennis, 1991).

There has been debate in the educational literature (e.g. Abrami et al., 2015; Kuhn, 2005), about whether critical thinking is general or discipline-specific in nature. Based on this debate, it seems that critical thinking involves both these elements; neither alone can capture this complex phenomenon. While the conventions of critical thinking are always embedded in social practices and they are also bound to disciplinary contexts, there are always myriad subjective elements (such as students' prior knowledge, expectations, engagement, motivations) related to and influencing critical thinking (e.g. Arum & Roksa, 2011; Evens et al., 2013; Kuhn, 2005; Shavelson, 2010). Moreover, many components of critical thinking (i.e. evaluating the reliability and relevance of evidence, analysing information, addressing opposing viewpoints, reasoning, making decisions,

drawing inferences, and producing arguments) are relevant and commonly shared in all the disciplines.

It has been suggested previously that there might be limited opportunities for students to develop their capacity for critical thinking during their university studies (e.g., Authors 2015; 2016; Arum & Roksa, 2011; Evens et al., 2013; Pascarella et al., 2011). Using performance-based assessment, Arum and Roksa (2011) found in their longitudinal study that almost half of the students demonstrated no significant improvement in critical thinking and complex reasoning during their first two years at college (cf. Evens et al., 2013). Students who start their university studies without solid critical thinking skills are less likely to improve their critical thinking skills during their studies (cf. Pascarella et al., 2011). The progress of these students tends to show only modest improvements. Research has also shown that the various components of students' critical thinking skills can be unevenly developed. In other words, a student might be able to identify and evaluate information, yet at the same time struggle to acquire other abilities, such as arriving at a conclusion, adjudicating conflicting claims or producing arguments (Authors, 2015; 2016). In a similar vein, a recent qualitative study has demonstrated that a notable proportion of graduates are unable to evaluate and describe their academic competencies (Tuononen, Parpala, & Lindblom-Ylänne, 2017). These diverse concerns about the importance of critical thinking highlight the need to pay more attention to students' capacities for critical thinking and reasoning from the beginning of their university studies.

1.2 The relationship between critical thinking and approaches to learning

Interest in exploring students' approaches to learning arose in the late 1970s when researchers investigated how students read academic texts (Marton & Säljö, 1976). It was noted that some students concentrated on the text itself ('surface processing') while others aimed at interpreting the meaning of the text ('deep processing'). The term 'approach' was introduced in order to include the intentional component of learning with the processing component (Svensson, 1977; Entwistle & Ramsden, 1983). The *surface approach* is characterised by an intention to memorise and reproduce information, leading to routine fact memorization (e.g. Entwistle & Ramsden, 1983) and fragmented knowledge (Lindblom-Ylänne, Parpala, & Postareff, 2017). *The deep approach*, on the other hand, involves an intention to analyse and understand information, which guides the learner to study actively, relate ideas, use evidence and critically evaluate the study material (Entwistle & Ramsden, 1983). A third 'strategic' approach was introduced in the 1980s when researchers identified the fact that some students attempted to achieve the highest possible grades through

studying effectively and applying organised study methods (Biggs, 1987; Entwistle & Ramsden, 1983; Entwistle, McCune, & Walker, 2001). More recently, this approach has been referred to as *organised studying*, which does not include such a clear focus on attaining the highest grades, but it concerns students' everyday study practices; how they organise their study and how they manage their efforts and time (Entwistle, 2009; Parpala et al., 2010).

The deep approach to learning is considered to include elements that enhance deep understanding (Entwistle & Ramsden, 1983; Lindblom-Ylänne, Lonka, & Leskinen, 1999; Trigwell & Prosser, 1991) and thus it is likely to lead to high-quality learning outcomes (see e.g., Trigwell et al., 2012; Watters & Watters, 2007). However, some studies have found a relationship between the surface approach and academic achievement (Lizzio, Wilson, & Simons, 2002). The reason for this might be that course assignments and good grades do not necessarily reflect the quality of learning outcomes in a reliable manner (e.g., Asikainen, Parpala, Virtanen, & Lindblom-Ylänne, 2013). Rytkönen et al. (2012) found that study success was most strongly associated with organised studying, and not with deep or surface approaches.

Researchers have commonly assumed that students' approaches to learning are related to their perceptions of the learning context (Parpala et al., 2010). However, previous research has suggested that the adoption of the deep approach to learning is not only characterised by context-specific factors but also by student-dependent factors such as age, personality, self-direction in learning, motivation and previous learning experiences (Baeten, Kyndt, Struyven, & Dochy, 2010). Hence, it follows that approaches to learning are not solely context-dependent.

The majority of previous studies focusing on approaches to learning among first-year students have been conducted at the end of the students' first study year at university, and thus, empirical evidence about their learning approaches at the beginning of their university student career is scarce. Surprisingly, relatively few studies have explored the relationship between approaches to learning and critical thinking, although critical thinking is often assumed to be a key capability related to deep approaches to learning (Nelson Laird et al., 2014). From the theoretical point of view, the concepts of critical thinking and deep approach to learning share same features, such as an intention to actively assess, evaluate, synthesise, understand and interpret relevant information and the different points of views. However, the conclusions reached in these previous studies have been contradictory. Evidence shows that some students' abilities to think critically are connected to their deep approach to learning, but this is not the case for all students (Chapman, 2001; Kreber, 2003; Lizzio et al., 2002). For example, Nelson Laird et al. (2014) did not find clear evidence that there is

a positive relationship between these two aspects. These contradictory results thus call for a more thorough examination of the relationships.

1.3 Self-efficacy plays a significant role in learning

Self-efficacy refers to "beliefs in one's capabilities to organise and execute the courses of action required in producing given attainments" (Bandura, 1997, p. 3). More recently, van Dinther, Dochy & Segers (2011) defined self-efficacy as "self-belief a person holds or his personal judgement about his competencies". According to Pintrich (1991; see also Pintrich, Smith, Garcia, & McKeachie, 1993), in addition to judgements about one's abilities to accomplish a task, self-efficacy also includes confidence in one's skills to perform that task, i.e. expectancy for success. Self-efficacy has been shown to affect students' motivation, the goals they set, their use of cognitive, meta-cognitive and self-regulatory strategies, as well as their engagement and performance (see Lane et al., 2004; Linnenbrink & Pintrich, 2003). Thus, self-efficacy plays a significant role in student learning. Chemers, Hu and Garcia (2001) showed that self-efficacy was directly related to first-year university students' performance. Self-efficacy plays an important role especially when students face difficult tasks, because strong self-efficacy is likely to increase students' efforts and persistence (Linnenbrink & Pintrich, 2003; van Dinther, Dochy, & Segers, 2011). Van Dinther et al. (2011) emphasise that higher education institutions should pay attention to enhancing students' self-efficacy, because self-efficacy predicts and mediates students' achievements, motivation and learning. Thus, in addition to putting effort into helping students develop the required knowledge, skills and competencies, more attention should be paid to how students' self-efficacy could be supported. One suggested solution that could enhance students' self-efficacy is to provide them with authentic tasks, which would require them to apply knowledge and skills in different situations (van Dinther, Dochy, & Segers, 2011).

Although critical thinking and self-efficacy beliefs have been popular concepts in higher education for the last century, empirical analyses focusing on the relationship between these two aspects in the context of higher education have been scarce. Dwyer et al. (2017) found that self-efficacy is a critical factor for critical thinking, i.e., a critical thinker needs to have confidence in her/his ability to solve a problem, to decide on a course of action, to find an answer to a given question or to reach a well-reasoned conclusion. Previous research has found that acquiring and recognising academic competence are related to high levels of self-efficacy beliefs (Tuononen et al., 2017). In addition, metacognitive skills and reflective thinking are seen as important factors for the development of critical thinking (Halpern, 2014). Reflection and self-evaluated skills have been found to be

connected with flexibility and the intention to use critical thinking skills in problem-solving situations (Authors, 2015; Mason, Ariasi, & Boldrin, 2011).

In summary, the previous literature suggests that critical thinking, approaches to learning, and self-efficacy beliefs are important factors in the progress students make in their studies. Challenges to these aspects may not only affect the quality of learning but may also cause significant delays in study progress and even lead to students dropping out (Baik et al., 2017; Korhonen et al., 2017). Considering the pivotal role of critical thinking, approaches to learning and self-efficacy beliefs in the learning processes as a whole, it is rather surprising that the relationships between these three aspects have remained unclear in empirical studies. In order to make an impact on pedagogical practices, more research on university students' critical thinking, approaches to learning, and self-efficacy beliefs is necessary, as well as the relationships between them. In this study, due to their similar ultimate goals and characteristics, we expect that solid critical thinking skills, a deep approach to learning and high self-efficacy beliefs are related to each other. In Finland, students in educational sciences are selected through demanding entrance exams. Hence, we also hypothesise that students are a homogeneous group in terms of their academic competence, i.e. these students' abilities to think critically do not vary dramatically.

1.4 Aims of the study

This study aims to gain a better understanding of critical thinking, approaches to learning and self-efficacy beliefs related to learning among new students in educational sciences. The associations of approaches to learning and self-efficacy beliefs with students' critical thinking skills have been examined by using a mixed-method approach. In addition, the study aims to identify distinct students' critical thinking groups and their features. The specific research questions are:

1) How are critical thinking, self-efficacy beliefs and approaches to learning related to each other among new educational science students?
2) What kind of groups of critical thinkers can be detected among the students? What kind of approaches to learning and self-efficacy beliefs do they display?

2. Materials and methods

2.1 Context of the study: Educational science studies in Finnish research-intensive university

In Finland, all educational science students have to take a master's degree (300 ECTS[1]). All prospective university students have to pass an entrance exam consisting of a 100-item multiple choice test (VAKAVA, 2015) and have an individual interview. Finnish primary teacher education is exceptionally popular and thus very competitive, with a yearly intake of only about 6-8% of all applicants (VAKAVA, 2015). The master's level studies (300 ECTS) includes orientating studies (25 ECTS), main subject studies (140 ECTS), and minor subject studies (135 ECTS). Students complete bachelor's and master's theses as well as undertake teaching practice or other work practice periods during their studies. Primary teacher students also receive their formal teacher qualification during their studies. University studies are funded by the state, and according to the Bologna regulations, the estimated time for completing the studies is five years.

2.2 Participants

In total, 92 new students in educational sciences at a large Finnish research-intensive university participated in the study. The students had just started their university studies, and the data were collected during their first study week as a part of their orientating studies. They had succeeded in the entrance exam and were accepted into the five-year master's programme in educational sciences (180 + 120 ECTS). The mean age of the participants was 23.7 years (SD=5.16; Min/Max 18/45 years). All students had completed the upper secondary school matriculation examination, and most of them had not completed any other higher education or university degree (76%). Most of the respondents were female (n=69), with fewer male students (n=23) participating in the study. All new students in educational sciences were invited to participate in the study, and 25% of the cohort volunteered. However, the sample represented the whole first year educational science student population in terms of gender and age (cf. Statistics Finland, 2017). Voluntary participation, informed consent, and anonymity of the participants were ensured in the research process. The study did not involve intervention in the physical integrity of the participants, deviation from informed consent, studying children under the age of 15 without parental consent, exposure to exceptionally strong stimuli, causing long-term mental harm beyond the risks of daily life, or

[1] The European Credit Transfer and Accumulation System (ECTS) for higher education is used across the European Union and other collaborating European countries. One academic year corresponds to 60 ECTS credits which are equivalent to 1500 hours of total workload.

risking participants' security (cf. Finnish Advisory Board on Research Integrity, 2009). Consequently, this study did not require Finnish ethics review.

2.3 Measures and data collection

The present study utilised a mixed-method approach (Onwuegbuzie, Johnson, & Collins, 2009) integrating both self-report and performance-based assessments in order to identify differences in students' critical thinking and to explore the relationships between students' critical thinking skills, approaches to learning and self-efficacy beliefs. Through the use of the mixed-method approach, it was possible to select and integrate the appropriate methods to gain a more thorough picture of the phenomenon (Teddlie & Tashakkori, 2009).

2.3.1 The Collegiate Learning Assessment

Students' capacity for critical thinking and reasoning were assessed using a performance-based assessment from the Collegiate Learning Assessment (henceforth CLA). The CLA is designed to measure broad critical thinking abilities, which are relevant across all academic majors (Klein, Benjamin, Shavelson, & Bolus, 2007; Shavelson, 2010). The CLA is based on the idea that critical thinking cannot be captured when it is divided and measured as single skills, because real world situations demanding applications of critical thinking skills are not divided into individual skills (Shavelson, 2010). Completing the CLA task, with its open-ended questions, requires integration of analytical reasoning, problem solving and argumentation skills.

The CLA is not specialised to any disciplinary context, thus ensuring that students from different disciplinary backgrounds can complete it. The CLA used in this study was translated into Finnish and adapted to the Finnish context. The adaptation and translation process of the CLA followed the same detailed protocols as in the Organisation for Economic Co-operation and Development's Assessment of Higher Education Learning Outcomes (AHELO) Feasibility Study (Tremblay, Lalancette, & Roseveare, 2012). Three certified translators participated in this process. The content validity of the CLA and the validity of the translations were confirmed by using the students' interviews and the think-aloud method (i.e. a pilot study before the large-scale research was undertaken). The translation, adaptation and validation process has been explained in more detail in the AHELO report (Tremblay et al., 2012). Previous research has pointed out that students' CLA scores correlate positively with other related measures, such as the Scholastic Assessment Test (SAT), the Collegiate Assessment of Academic Proficiency Critical Thinking Test (CAAP-CT) and

the Defining Issues Test (DIT) (see Arum & Roksa, 2011; Pascarella et al., 2011; Klein et al., 2007).

The CLA included instructions, four open-ended questions and reading material about a fictitious, but realistic societal problem (see Figure 1). Students were instructed to use the reading materials provided in preparing their answers to the questions. The task was designed to evoke the critical thinking processes of (a) organising, synthesising, assessing and analysing information (which might be reliable/unreliable or relevant/irrelevant to the task); (b) identifying judgemental errors, such as 'correlation proves causation' from several sources (email correspondence, memoranda, research abstracts, research reports, newspaper articles, statistics, etc.); (c) making a reasoned explanation for a problem and proposing a solution; and (d) justifying an explanation by writing arguments and counter-arguments for and against a particular solution using information from the reading material (Shavelson, 2010; Authors, 2014, 2015).

Add Figure 1 here

One limitation of the CLA concerns a risk of assessing bias. Students' written answers are assessed by human evaluators (Authors, 2015; Almond, 2014). Difficulties arise if scorers do not use assessment criteria in a systematic way. Another limitation is that the questions and other materials in the CLA task are not specialized to the specific context. Thus, the CLA does not measure the specific knowledge and skills taught in particular courses or majors (Arum & Roksa, 2011; Shavelson, 2010; cf. Zlatkin-Troitschanskaia, Shavelson, & Kuhn, 2015). However, this is not necessarily a problem. The CLA makes it possible to focus on the general critical thinking skills that are applicable across domains.

2.3.2 HowULearn questionnaire

The self-report data were collected with the HowULearn questionnaire (Parpala & Lindblom-Ylänne, 2012). Scales measuring students' approaches to learning and self-efficacy beliefs were utilised in the present study. The questionnaire included descriptive background questions and 17 items, which were measured using the five-point Likert scale. The 12 items measuring students' approaches to learning originated from the Approaches to Learning and Studying Inventory (ALSI; Entwistle & McCune 2004). The deep approach, surface approach and organised studying were each measured by using four items. Students' self-efficacy beliefs in the HowULearn questionnaire were measured by using five items which originated from the Motivated Strategies for Learning

Questionnaire (MSLQ; Pintrich et al., 1991), more specifically from its Self-Efficacy for Learning and Performance subscale. The original scale includes eight items to measure students' expectancy for success or self-efficacy. Three of the five items in the HowULearn questionnaire measured self-efficacy and two items expectancy of success.

A limitation of the HowULearn questionnaire is that it measures students' approaches to learning and self-efficacy beliefs at a general level, i.e. how students typically study in their major subject. Thus, it does not capture contextual variation in the approaches to learning or self-efficacy beliefs. A second limitation of the questionnaire concerns the deep approach scale, which sometimes appears to form two separate factors: one focusing on the intention to understand and the other one focusing on the deep processing of information (Herrmann, Bager-Elsborg & Parpala, 2016; Parpala, Lindblom-Ylänne, Komulainen & Entwistle, 2013). In spite of these limitations, the HowULearn questionnaire has been shown to be a robust instrument for measuring students' approaches to learning (Herrmann et al., 2016; Parpala & Lindblom-Ylänne, 2012). Therefore, it was considered to be an appropriate instrument for measuring students' approaches to learning and self-efficacy beliefs in the present study.

In the data collection situation, the students first had 90 minutes to complete the CLA and after that, they completed the HowULearn questionnaire. The first and second named authors collected the CLA and questionnaire data, which were completed in the Moodle learning environment using a computer and additional paper materials. All personal information was removed before the analysis phase and the participants' anonymity was ensured by using ID numbers as identifiers.

2.4 Data analyses

First, the students' CLA responses were evaluated and scored for Analytical Reasoning and Evaluation (i.e. how well does the student assess the quality and relevance of evidence, how well does the student analyse and synthesise the data and information), Problem Solving (i.e. how well do the students form a conclusion from their analyses and how well do the students acknowledge and consider other options) and Argumentation (i.e. how clearly do the students express their arguments within an acceptable context) based on detailed criteria by the first and second-named authors using a 1 to 6 scale. The CLA scoring criteria and the steps of analysis procedure can be found available in the OECD's AHELO report (Tremblay et al., 2012, see also Shavelson, 2010). It was required that at least a good range of inter-rater agreement had to be achieved before researchers could score the data. The researchers first scored the students' responses to each

dimension independently. After that, the scores were compared. If the scores differed by more than one point, the researchers re-scored the student's response. The final inter-rater agreement was measured by using a two-way mixed, average-measures ICC (Hallgren, 2012) to assess the degree of consistency in the researchers' scores. The resulting ICC was in the excellent range (Analytical Reasoning and Evaluation ICC = .94, Problem Solving ICC= .95, Argumentation ICC =.93), indicating that the researchers had a high degree of agreement, and they scored the dimensions of critical thinking in a similar manner. The scores were coded into an SPSS matrix.

Secondly, exploratory factor analysis was conducted to explore the factor structure of the inventory. Exploratory factor analysis was conducted because the students had no experience of studying at university and the students were also asked to reflect back on their previous study before entering the university when they were answering the items that measured approaches to learning. The HowULearn questionnaire has been created to be used in the context of studying at university, and the questionnaire has been validated with more experienced university students. Therefore, exploratory factor analysis was chosen to test how the questionnaire functions among students just beginning their study at university, who reflected on their pre-university studies. The two sets of items (12 items measuring approaches to learning, five items measuring self-efficacy beliefs) were separately subjected to an exploratory factor analysis (principal axis factoring with promax rotation). An examination of the Kaiser-Meyer Olkin measure of sampling adequacy suggested that the samples for approaches to learning were factorable (KMO=.68) as were those for self-efficacy beliefs (KMO=.81). For the approaches to learning, the analysis yielded a three-factor solution, which is in line with several previous studies (e.g., Herrmann et al., 2016; Parpala et al., 2010). The first factor includes four items measuring the deep approach to learning. The four items in the second factor measure the surface approach to learning, and the third factor includes four items measuring organised studying. The five self-efficacy items loaded on one factor. The factor loadings for each item are presented in Appendix 1. Cronbach's alpha for the deep approach scale was .80, for the surface approach scale .74 and for the organised studying scale .77. For the self-efficacy scale, Cronbach's alpha was .88, meaning that the internal reliabilities of the scales were relatively good. The third phase of the analysis focused on exploring how critical thinking skills are related to approaches to learning and self-efficacy beliefs. Pearson's correlations were used to explore the correlations between the variables.

The last phase of the analysis focused on analysing the qualitative variation in critical thinking in the three student groups scoring below, average, or above the mean of the CLA scores (for a more

detailed description of creating the groups, see section 3.2). This was done to examine students' CLA responses in a more detailed way than was done when scoring the responses. The qualities of the three groups were elaborated thoroughly. The qualitative analysis of CLA responses was divided into several phases. In the first phase, the first and second named authors read through students' answers several times. The second phase of the analysis was data coding. In this phase, we utilised our previous findings on thematic analysis (Authors, 2015; 2014). The coding focused on the following characteristics of critical thinking: (1) identifying, analysing, and synthesising knowledge from multiple sources to make judgements and decisions, and (2) evaluating the quality and premises of knowledge, (3) communicating ideas, analyses, courses of action and conclusions in writing. These qualities were coded systematically for each student's response, and a short annotation describing the qualities of each response as a wholeness was written. Then, similarities and differences within and between the student groups were examined. In the last phase, the final results and interpretations were obtained through discussion with all three authors in order to guarantee agreement between the researchers and to assure the reliability of results.

3. Findings

3.1 Students' critical thinking skills, approaches to learning and self-efficacy beliefs and their relationships

The students' scores on the CLA varied from 3 to 17 points (i.e. an average score by two scorers on a scale of 0 to 18), the mean score being 9.72 (see Table 1). Their scores on the three sub-scales of the CLA, Analytical Reasoning (ARE), Problem Solving (PS) and Writing Effectiveness (WE), varied from 1 to 6.0 on a scale of 1 to 6. As can be seen in Table 1, the means varied between 3.09 and 3.35. Students' scores on the three approaches to learning varied from very low to very high scores (see Table 2). Students' scored relatively highly on the deep approach (M=3.45 on a scale of 1 to 5) and organised studying (M=3.48) and low on the surface approach (M=2.41). They scored very highly for self-efficacy (M=4.31), although some students had lower scores, the lowest being 2.40.

Table 1. Descriptive statistics of critical thinking skills, approaches to learning and self-efficacy beliefs related to learning.

	N	Minimum	Maximum	M	SD

CLA total[a]	92	3.0	17.0	9.72	2.95
CLA-WE[b]	92	1.00	6.00	3.35	1.07
CLA-PS[b]	92	1.00	6.00	3.09	1.11
CLA-ARE[b]	92	1.00	6.00	3.28	1.00
Deep approach[c]	92	1.50	5.00	3.45	0.79
Surface approach[c]	92	1.25	4.25	2.41	0.68
Organised studying[c]	92	1.00	5.00	3.48	0.72
Self-efficacy beliefs[c]	92	2.40	5.00	4.31	0.57

[a] Scale 0-18; an average score of two scorers; [b] Scale 1-6; an average score of two scorers; [c] Scale 1-5

The inter-correlations between CLA sub-scores revealed that there is a strong positive correlation between Analytical Reasoning (ARE), Problem Solving (PS) and Writing Effectiveness (WE) (see Table 2). The correlational analysis between the observed variables further showed that CLA variables did not correlate with approaches to learning (i.e. deep approach to learning, surface approach to learning and organised studying). However, the CLA total variable and CLA-PS (Problem Solving) variable correlated positively with self-efficacy beliefs. The inter-correlations between the variables measuring approaches to learning demonstrated the typical relationships between the variables.

Table 2. Correlations between critical thinking skills, approaches to learning and self-efficacy beliefs related to learning (*N*=92).

	1.	2.	3.	4.	5.	6.	7.	8.
1. CLA total	1.00							
2. CLA-WE	.92**	1.00						
3. CLA-PS	.93**	.77**	1.00					
4. CLA-ARE	.93**	.81**	.80*	1.00				
5. Deep approach	.10	.06	.18	.05	1.00			
6. Surface approach	-.17	-.16	-.18	-.13	-.20	1.00		

7.	Organised studying	-.09	-.19	.04	-.09	.52**	-.16	1.00	
8.	Self-efficacy	.21*	.16	.24*	.18	.29*	-.43**	.13	1.00

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

3.2 Student groups with low, average and high CLA scores

As Table 1 shows, there was a large variation in the students' critical thinking skills. The CLA total scores varied from 3 to 17 points. The students were divided into three groups based on their CLA total scores. We used the mean (9.72) and standard deviation (2.95) of the CLA total scores to create the groups (cf. Lindblom, Parpala & Postareff, 2013). The group with average scores consists of students (n= 39) scoring half of the standard deviation (1.48) above or below the average (9.72 +/- 1.48). With this procedure, the lowest CLA score for this group was 8.24 and the highest 11.2. These were rounded to 8.0 and 11.0. The group with the lowest CLA scores consisted of students (n=24) scoring below 8.0 and the group with highest scores includes students (n=29) scoring above 11.0. To address our second research question**,** we analysed the relationships between the quality of students' critical thinking, approaches to learning and self-efficacy beliefs among these three groups.

Table 3 illustrates the range of the CLA scores and the means of CLA scores, approaches to learning and self-efficacy beliefs in each group. As could be expected, on the basis of the correlations, there were no statistically significant differences in the students' approaches to learning or self-efficacy beliefs in the three groups as analysed through ANOVAs.

Table 3. Range and mean of the CLA scores and means of approaches to learning and self-efficacy of the three CLA groups.

Variable	Group 1 (n=24) CLA range 3.0-7.5 CLA total 6.1	Group 2 (n=39) CLA range 8.0-11.0 CLA total 9.3	Group 3 (n=29) CLA range 11.5-17 CLA total 13.3
	M (SD)	M (SD)	M (SD)
Deep approach	3.4 (0.84)	3.4 (0.76)	3.6 (0.79)
Surface approach	2.6 (0.60)	2.3 (0.61)	2.4 (0.82)
Organised studying	3.5 (0.60)	3.6 (0.69)	3.3 (0.83)

Self-efficacy	4.3 (0.62)	4.3 (0.53)	4.4 (0.59)

To better understand the differences in the CLA scores, we analysed in more detail what kind of features of critical thinking were emphasised among the CLA groups. The qualitative analysis of the CLA responses showed that the students in the first group tried to solve the problem using isolated details and referring to their personal opinion. The students in the second group came up with a conclusion, but their reasoning was weak, while in the third group students' CLA responses indicated that the students evaluated the quality of the information and considered its premises. They also weighed up the implications of different conclusions and mainly gave well-reasoned explanations. The groups were labelled on the basis of their features found in the detailed qualitative analysis as 1) Superficial thinkers, 2) Data-oriented thinkers, and 3) Elaborative thinkers. Below we provide more details pertaining to these groups.

Group 1: Superficial thinkers (n= 24) focused on details and only briefly reproduced the given information. They offered fragmented pieces of knowledge as a solution to the problem, but did not analyse, combine different perspectives or sufficiently synthesise the information presented in documents. They provided the most obvious solution that could be relatively easily reproduced from the materials without thinking further and realizing the problematic aspects of the solution. Qualitative analysis of CLA responses revealed that these students provided hasty and superficial generalizations without thorough elaboration. Common to all the answers in this group was that the students did not analyse deeply enough to notice errors and biases in the materials or in their own reasoning. They evaluated neither the quality nor the premises of knowledge and they accepted what was stated without critical evaluation. They did not provide clear decisions or valid rationales for their decisions. Some of them tried to justify their decisions entirely on their personal opinions or intuition, and the decisions were laden with emotional premises. The solutions were provided for the apparent problems and questions, but the aspects that required deep understanding of the problem and the materials as well as creativity to be solved were left out from the students' answers. Table 4 includes a short extract from one student's answer.

Table 4. An extract of a typical answer of Superficial thinkers.

Data extract	**Coded for**
"Eager uses many charts as a justification for his claims. The results of the Strive program are promising but in my opinion it is wrong to justify your opinion only using those charts.	Brings out some fragmented knowledge Deals only with what is obvious or apparent No elaboration of the information presented in the documents

We should remember that the drugs are not the only factor that lead to the crimes. The Adults' problems of the people often date from their childhoods. Therefore, it is extremely important to guarantee a safe childhood for everyone. Also, stress and pressure are common problems for the people in our society."	Provides personal opinions rather than information from the documents. Provides no clear conclusion No valid rationale for the conclusion

Group 2: Data-oriented thinkers (n=39) focused especially on the separate documents and facts presented in them without relating them with each other. The students demonstrated an understanding of the content of documents and described what they understood in their own words. However, they did not approach the situation purely from the problem perspective nor did they synthesise what was given in the documents so as to provide an interrelated whole. The written CLA responses revealed that students made a few claims about the quality and premises found in the documents; they probably did not dare to explain the errors or mistakes in the documents. Common to the answers in this group was that students proposed a careful conclusion but provided very little rationale to justify the conclusion, or any rationale given was based partly on irrelevant knowledge. None of the students within this group were able to distinguish relevant claims from irrelevant ones. In addition, the reasoning of some students was partly fallacious (i.e. students provided inconsistent and ambiguous claims or came to irrelevant conclusions). Students in this group proposed a single decision for the problem but did not consider any alternative decisions. It seemed to be challenging for students to formulate their conception and justify it with the documents. Depending on the case, the students based their arguments on the documents, irrelevant aspects or their own opinions. Table 5 presents an example of a typical answer in this group.

Table 5. An extract of the typical answer of Data-oriented thinkers.

Data extract	**Coded for**
"Pat Stone has argued for increasing the number of police officers. Eager proposes that money should be spent on the Strive programme. Stone's proposal is based on the idea that increasing the number of police officers will increase safety among the inhabitants of Jefferson (Scenario). The number of the police officers also might reduce the number of the crimes due to the fear of getting caught. However, Eager looks for a deeper solution: he would spend the money on the drug treatment programme. Eager thinks	Describes the content of each document separately Does not synthesise or combine the information in the documents Superficial reasoning - deals only with what is obvious or apparent - Presents some irrelevant information as being relevant. Does not make claims about the quality and premises of the knowledge Provides no clear conclusion nor valid rationale for the conclusion

that the drugs users must be helped to get off drug dependence because "half of our arrests involve drugs" (Document B). The results of Strive are good. However, when comparing the Strive programme with other programmes, we can see that, in a long run, differences between the different treatments have not been systematically found (Document D)."	

Group 3: Elaborative thinkers (n=29) synthesised and elaborated the information presented in the documents. They evaluated the quality of information and considered its premises. They provided analysis that went beyond the obvious, meaning that they determined what information is or is not pertinent to the task. They were able to make sharp-sighted interpretations, and thus, look beneath the surface. Their answers indicated a thorough understanding of all the documents. The written CLA responses revealed that Elaborative thinkers recognised the instances of limited, biased or compromised evidence. They clearly stated where the information presented in documents was contradictory or in some other way irrelevant to the problem. The answers in this group further showed that the students were able to distinguish between rational claims and emotional ones, "fact" from opinion. They proposed well-reasoned explanations and conclusions that logically followed their decision. They weighed the implications of different conclusions. Due to their deep understanding of the problem and overall understanding of the documents, the students were able to suggest alternative approaches and creative solutions as the next steps in clarifying the situation. They were also able to consider the overall consequences of the solutions they suggested. They presented mainly relevant and coherent arguments, i.e. the rationales they gave supported their conclusions. In sum, they justified their response using reliable and valid evidence avoiding biases and problematic decisions. Table 6 illustrates a typical response in this group.

Table 6. An extract of the typical answer of Elaborative thinkers.

Data extract	**Coded for**
"In my opinion Eager's idea that it is more important to treat a problem rather than a symptom is good. According to document D, the effectiveness of the Strive programme is clear: the use of drugs has decreased 34% in Clarendon. Also, the lower incidence of drug use is related to lower crime rates (25%), which is an important finding. However, the	Demonstrates a deep understanding of the documents Synthetises and combines the knowledge of the documents Makes claims about the quality and premises of the knowledge Provides clear decision/conclusion with a brief rationale

information of Document D partly contradicts that of Document C. According to Document C, there is no correlation between drug use and crime when the number of crimes is adjusted for the population in Jefferson. Furthermore, the superiority of Strive is not completely clear when comparing the results of Strive to other addiction treatments (Document G). In addition, the information of documents D and G are not necessarily generalizable to Jefferson. Because of these reasons and other contradictory findings, I propose that more research on the effectiveness of different drug addiction treatments is needed."	

4. Discussion and conclusions

4.1 Findings in the light of the previous literature

In the light of recent studies, students' approaches to learning, self-efficacy beliefs and their abilities to think critically are crucial factors for progress in their study (Baik et al., 2017; Brooman & Darwent, 2014; Arum & Roksa, 2011; Chapman, 2001). Our results indicate that first-year students in educational sciences start their studies with high self-efficacy beliefs related to their abilities to learn and report that they have applied a deep approach to learning in their previous studies. These results are naturally based on the students' earlier learning experiences and orientations before entering university. Still, in terms of students' beliefs, they indicate a strong and promising basis for university studies in a relatively demanding environment (cf. Baeten et al., 2010). However, the results of our study conducted with the CLA instrument (cf. Arum & Roksa, 2011; Evens et al., 2013; Utriainen, et al., 2016) show that students enter the university with a wide range of critical thinking skills. In contradiction to our hypothesis, the results further demonstrate that students' deep approach to learning and high self-efficacy beliefs are not related to their critical thinking skills (cf. Nelson Laird et al., 2014). Although the students stated that they had a strong intention to analyse and understand information deeply in their previous studies, this is not seen in how most of them now performed in the CLA task (cf. Authors, 2015).

We detected three groups of critical thinkers among the new students in educational science based on students' CLA scores. The qualitative analyses of students' CLA responses indicated that there

were considerable variations in their capabilities. The groups differed from each other in terms of their ability to analyse the quality and characteristics of information, combine information from different sources, synthesise the core meanings, and provide justified decisions and further suggestions. The majority of the students had modest capabilities for critical thinking, but the heterogeneity among students is notable, due to the fact that students who have good critical thinking skills are better positioned to progress in their studies (Arum & Roksa, 2011; Pascarella et al., 2011). This is an especially important aspect from the viewpoint of students' learning at the start of their study at university.

The results of this study identify the need for several avenues of further research. From the viewpoint of student learning, it would be important to explore the development of students' self-efficacy beliefs, potential changes in approaches to learning, and the development of critical thinking skills longitudinally throughout university studies. In addition, the learning patterns of single skills included in critical thinking should be investigated further, e.g. analytical reasoning and evaluation, problem solving and argumentation. This might provide detailed information about the possible changes occurring during studies as well as contextual aspects influencing the process. This would extend the understanding of the importance of critical thinking further and allow deeper exploration of the multiple aspects/components of critical thinking and their crucial role.

4.2 Practical implications

Our results show that the new educational science students were not a homogeneous group in terms of the academic qualities required in their university studies. Students varied significantly from each other in terms of their critical thinking capabilities (Evens et al., 2013). Thus, the findings suggest that this should be taken into account from the beginning of the first courses in the study programmes. We know from previous studies that students' first year experiences significantly influence their study paths during their time at university (Baik et al., 2017; Korhonen et al., 2017). Therefore, the systematic development of critical thinking skills requires a lot of attention in university education to avoid challenges and disengagement from their university studies. The teaching practices should enable students to actively use their critical thinking skills. High-quality teaching practices that appropriately meet the varied needs of heterogeneous student population and provide relevant support should be applied. The learning environment in study at university can significantly contribute to the development of students' critical thinking skills (Abrami et al., 2015; Halpern, 2014) and further enhance students' academic expertise during their studies.

Finally, the results suggest that it is important to reconsider the characteristics and focus of the university entrance exams. The highly competitive entrance exam does not necessarily guarantee advanced critical thinking skills (cf. Utriainen et al., 2016). However, on one hand, the exams should support selecting the best possible students into the various study programmes. On the other, the exam should challenge the candidates in a way that guarantees that they will be able to meet the university study requirements. It has been suggested that students entering universities should have at least moderate critical thinking skills (Utriainen et al., 2016; Stemler, 2012). Ensuring a sufficient level of critical thinking skills through the entrance exams could reduce the challenges students face during their university studies.

4.3 Limitations and methodological reflection

The aim of this study was to explore the relationships between quality of critical thinking, approaches to learning and self-efficacy beliefs among new educational science students at a Finnish university by applying a mixed-method approach. Measuring critical thinking is considered to be a complex and multidimensional task, which poses several methodological challenges (Authors, 2015; Zlatkin-Troitschanskaia et al., 2015). The validity and reliability of indirect measurements, such as respondents' self-reports of self-perceptions and self-evaluations, has been questioned (Zlatkin-Troitschanskaia et al., 2015). Reporting academic competencies requires considerable self-reflection from respondents, which is a cognitively challenging task (Tuononen et al., 2017; Karabenick at al., 2007). In addition, it can also be noted that students' beliefs of themselves as critical thinkers are not necessary equivalent to how they perform in real life situations (Authors, 2015). Respondents can thus overestimate or underestimate their own abilities to think critically (Zlatkin-Troitschanskaia et al., 2015). Because of these restrictions in the present study, a direct measurement, namely the CLA performance task, was used to analyse students' critical thinking skills. CLA is designed to measure complex real-world thinking. Previous research has shown that it determines the extent to which students are able to analyse, evaluate and synthesise complex information, as well as provide reasoned explanations in written form (e.g., Shavelson, 2010; Klein et al., 2007).

Conversely, the students' approaches to learning and self-efficacy beliefs were measured indirectly through the HowULearn survey. As noted above, the most important drawback of indirect measures is that they are based on respondents' subjective perceptions and views (Bowman & Seifert, 2011; Zlatkin-Troitschanskaia et al., 2015). Nevertheless, previous research has shown that the

HowULearn survey provides internationally and disciplinary comparable information about student learning and self-efficacy beliefs (e.g., Herrmann et al., 2016). It is important to note that in the present study, the students reflected on their previous studies when answering the questions related to approaches to learning, and the instrument has not been validated in such contexts. Regarding the measurement of self-efficacy beliefs, it is difficult to capture self-efficacy beliefs without using self-report measures and thus using a valid questionnaire scale seemed to be a proper way to measure students' self-efficacy beliefs. It should also be noted, that the quantitative results might have been different if there had been more than 92 participants. Now many of the correlations remained modest, but with larger data some of the correlations might have been stronger. However, the correlational analyses provided valuable information about the directions of the relationships between approaches to learning and critical thinking.

This study has several other limitations. Firstly, it is important to note that it involved a relatively small sample of students in one discipline. Also, only a quarter of the cohort consented to participate in the research, which may indicate the risk of potential bias in the data. That said, the results of the present study are not generalizable beyond the local context, and they should not be interpreted as an accurate prediction of the whole target population. The level of critical thinking skills of those students who either declined to participate in the research remains unknown. It is possible that the students who participated in this study were more confident about their test performance than those who declined. Therefore, the variation in students' capacity for critical thinking among first-year students may be even greater than our study indicates. Nevertheless, the sample provides insights into the variation of academic competencies of a specific group of students.

Secondly, the small sample size and low correlations among the observed variables restricted further quantitative analyses. The descriptive analysis, however, revealed remarkable variation in students' CLA scores. Furthermore, the qualitative analyses of students' CLA responses provided rich insights into differences in critical thinking not only with regard to this small group of students, but also in identifying more general challenges in critical thinking, such as problems in justifying decisions using reliable and valid evidence while avoiding biases and problematic judgments (cf. Authors, 2015; Arum & Roksa, 2011; Evens et al., 2013; Utriainen et al, 2016).

References

Abrami, P. C., Bernard, M. R., Borokhovski, E., Waddington, D. I. Wade, C. A., & Persson, T. (2015). Strategies for Teaching Students to Think Critically: A Meta-Analysis. *Review of Educational Research*, 85 (2), 275–314. DOI: 10.3102/0034654314551063

Almond, R. G. (2014). Using Automated Essay Scores as an Anchor When Equating Constructed Response Writing Tests. *International Journal of Testing* 14: 73−91.

Arum, R., & Roksa, J. (2011). *Academically Adrift. Limited Learning on College Campuses*. Chicago: The University of Chicago Press.

Asikainen, H., Virtanen, V., Parpala, A., & Lindblom-Ylänne, S. (2013). Understanding the variation in bioscience students' conceptions of learning in the 21st century. International Journal of Educational Research, 62, 36–42. DOI: http://dx.doi.org/10.1016/j.ijer.2013.06.010.

Authors. (2014)

Authors. (2015)

Authors. (2016)

Baik, C., Naylor, R., Arkoudis, S., & Dabrowski, A. (2017): Examining the experiences of first-year students with low tertiary admission scores in Australian universities. *Studies in Higher Education*. DOI: 10.1080/03075079.2017.1383376

Bandura, A. (1997). Self-efficacy: The exercise of control. New York: W.H. Freeman Company.

Baeten, M., Kyndt, E., Struyven, K., & Dochy, P. 2010. Using student-centred learning environments to stimulate deep approaches to learning: Factors encouraging or discouraging their effectiveness. *Educational Research Review,* 5, 243–260.

Biggs, J. (1987). *Student approaches to learning and studying*. Camberwell, Vic:Australian Council for Educational Research.

Bowman, N. A., & Seifert, T. A. (2011). Can College Students Accurately Assess What Affects Their Learning and Development? *Journal of College Student Development*, 52, 270–290.

Brooman, S., & Darwent, S. (2014). Measuring the beginning: a quantitative study of the transition to higher education. *Studies in Higher Education, 39*(9), 1523-1541. DOI: 10.1080/03075079.2013.801428

Chapman, B. S. (2001). Emphasising concepts and reasoning skills in introductory college molecular cell biology. *International Journal of Science Education, 23,* 1157–1176.

Chemers, M. M., Hu, L., & Garcia, B .F. (2001). Academic self-efficacy and first-year college student performance and adjustment. *Journal of Educational Psychology, 93,* 55–64.

van Dinther, M., Dochy, F., & Segers, M. (2011). Factors affecting students' self-efficacy in higher education. *Educational research review*, 6(2), 95–108.

Dwyer, C. P., Hogan, M. J., Harney, O. M., & Kavanagh, C. (2017). Facilitating a student-educator conceptual model of dispositions towards critical thinking through interactive management. *Educational Technology Research and Development*, 65, 47–73.

Entwistle, N. (2009). *Teaching for understanding at university: Deep approaches to learning and distinctive ways of thinking*. Basingstoke, Hampshire: Palgrave Macmillan.

Entwistle, N., McCune, V., & Walker, P. (2001). Conceptions, styles and approaches within higher education: analytic abstractions and everyday experience. *Perspectives on thinking, learning, and cognitive styles*, 103–136.

Entwistle, N. J., & Ramsden, P. (1983). *Understanding student learning*. London: Croom Helm.

Evens, M., Verburgh, A., & Elen, J. (2013). Critical Thinking in College Freshmen: The Impact of Secondary and Higher Education. *International Journal of Higher Education*, 2(3), 139–151.

Hallgren, K. A. (2012). Computing Inter-Rater Reliability for Observational Data: An Overview and Tutorial. *Tutor Quant Methods Psycho,* 8(1), 23–34.

Halpern, D. F. (2014) *Thought and Knowledge*. Fifth edition. NY: Psychology Press.

Herrmann, K. J., Bager-Elsborg, A., & Parpala, A. (2016). Measuring perceptions of the learning environment and approaches to learning: validation of the learn questionnaire. *Scandinavian Journal of Educational Research*, 1–14. http://dx.doi.org/10.1080/00313831.2016.1172497.

Heikkilä, A., Lonka, K., Nieminen, J., & Niemivirta. M. (2012). Relations between Teacher Students' Approaches to Learning, Cognitive and Attributional Strategies, Well-Being, and Study Success. *Higher Education,* 64 (4), 455–471. doi:10.1007/s10734-012-9504-9.

Marton, F., & Säljö, R. (1976). On qualitative differences in learning: I—Outcome and process. *British journal of educational psychology*, 46(1), 4–11.

Mason, L., Ariasi, N., & Boldrin, A. (2011). Epistemic beliefs in action: Spontaneous reflections about knowledge and knowing during online information searching and their influence on learning. *Learning and Instruction*, 21, 137–151

Nelson Laird T. F., Seifert, T. A., Pascarella, M. J., & Blaich, C. F. (2014). Deeply affecting first-year students' thinking: deep Approaches to learning and three dimensions of cognitive development. *The Journal of Higher Education,* 85, 402–432.

Onwuegbuzie, A., Johnson, R. B., & Collins, K. (2009). Call for mixed analysis: A philosophical framework for combining qualitative and quantitative approaches. *International Journal of Multiple Research Approaches*, 3, 114–139.

Karabenick, S. A., Woolley, M. E., Friedel, J. M., Ammon, B. V., Blazevski, J., Bonney, C. R., De Groot, E., Gilbert, M. C., Musu, L., Kempler, T. M., & Kelly, K. L. (2007). Cognitive processing of self-report items in educational research: Do they think what we mean? *Educational Psychologist*, 42 (3), 139–151.

Klein, S., Benjamin R., Shavelson, R., & Bolus, R. (2007). The Collegiate Learning Assessment. Facts and Fantasies. *Evaluation Review*, 31 (5), 415–439.

Korhonen, V., Inkinen, M., Mattsson, M., & Toom, A. (2017,). Student engagement and the transition from the first to second year in higher education. In E. Kyndt, V. Donche, K. Trigwell & S. Lindblom-Ylänne (Eds.), *Higher Education Transitions: Theory and research. EARLI book series 17 "New Perspectives on Learning and Instruction"* (pp. 113−135). London: Routledge - Taylor & Francis group.

Kreber, C. (2003). The Relationship between Students' Course Perception and their Approaches to Studying in Undergraduate Science Courses: A Canadian experience. *Higher Education Research & Development*, 22, 57–75.

Lane, J., Lane, A., & Kyprianou, A. (2004). Self-efficacy, self-esteem and their impact on academic performance. *Social Behaviour and Personality, 32*, 247–256.

Lindblom-Ylänne, S., Parpala, A., & Postareff, L. (2017). Re-conceptualising the surface approach to learning. *Manuscript in preparation.*

Lindblom-Ylänne, S., Parpala, A., & Postareff, L. (2013). Challenges in analysing change in students' approaches to learning. In D. Gijbels, V. Donche, J. Richardson, & J. Vermunt (Eds.), *Learning patterns in higher education: Dimensions and research perspectives.* (pp. 232-248). (New Perspectives on Learning and Instruction). New York, US: Routledge.

Lindblom-Ylänne, S., Lonka, K., & Leskinen, E. (1999). On the predictive value of entry-level skills for successful studying in medical school. *Higher Education*, *37*(3), 239–258.

Linnenbrink, E.A., & Pintrich, P. (2003). The role of self-efficacy beliefs in student engagement and learning in the classroom. *Reading & Writing Quarterly*, 19, 119–137.

Lizzio, A., Wilson, K., & Simons, R. (2002). University students' perceptions of the learning environment and academic outcomes: implications for theory and practice. *Studies in Higher Education*, 27 (1), 27–52.

Parpala, A., Lindblom-Ylänne, S., Komulainen, E., & Entwistle, N. (2013). Assessing students' experiences of teaching–learning environments and approaches to learning: Validation of a

questionnaire in different countries and varying contexts. *Learning Environments Research*, *16*(2), 201-215.

Parpala, A. & Lindblom-Ylänne, S. (2012). Using a research instrument for developing quality at the university. Quality in Higher Education, 18 (3), 313–32

Parpala, A., Lindblom-Ylänne, S., Komulainen, E., Litmanen, T., & Hirsto, L. (2010). Students' approaches to learning and their experiences of the teaching–learning environment in different disciplines. *British Journal of Educational Psychology*, 80 (2), 269–282.

Pascarella, E. T., Blaich, C., Martin, G. L., & Hanson, J. M. (2011). How robust are the findings of academically adrift? Change: *The Magazine of Higher Learning,* 43, 20–24.

Pintrich, P. R. (1991). A manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ). Retrieved 28.4.2017 from https://www.researchgate.net/publication/271429287_A_Manual_for_the_Use_of_the_Motivated_Strategies_for_Learning_Questionnaire_MSLQ

Pintrich, P. R., Smith, D. A., García, T., & McKeachie, W. J. (1993). Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and psychological measurement,* 53 (3), 801–813.

Rytkönen, H., Parpala, A., Lindblom-Ylänne, S., Virtanen, V., & Postareff, L. (2012). Factors affecting bioscience students' academic achievement. *Instructional Science*, 40, 241–256.
Schmitt, N. (2012). Development of rationale and measures of noncognitive college student potential. Educational Psychologist, 47, 18–29.

Shavelson, R. J. (2010). *Measuring college learning responsibly: Accountability in a new era*. Stanford, CA: Stanford University Press.

Stemler, S. E. (2012). What should university admissions tests predict? *Educational Psychologist*, *47*(1), 5–17. DOI: 10.1080/00461520.2011.611444

Statistics Finland. (2017). Official Statistics of Finland (OSF): University education [e-publication].ISSN=2324-0148. Helsinki: Statistics Finland. Retrieved 19.4.2017 from http://www.stat.fi/til/yop/index_en.html

Svensson, L. (1977). On qualitative differences in learning: III. Study skill and learning. *British Journal of Educational Psychology*.

Teddlie, C., & Tashakkori, A. (2009). *Foundations of mixed methods research. Integrating quantitative and qualitative approaches in the social and behavioural Sciences*. Sage Publications: California.

Tremblay, K., Lalancette, D., & Roseveare, D. (2012) AHELO Feasibility Study Report. Volume 1 −Design and Implementation. Organisation for Economic Co-operation and development (OECD). Retrieved 20.4.2017 from http://www.oecd.org/edu/skills-beyond-school/AHELOFSReportVolume1.pdf.

Trigwell, K., Ellis, R. A., & Han, F. (2012). Relations between students' approaches to learning, experienced emotions and outcomes of learning. *Studies in Higher Education*, *37*(7), 811–824.
Trigwell, K., & Prosser, M. (1991). Improving the quality of student learning: the influence of learning context and student approaches to learning on learning outcomes. *Higher education*, *22*(3), 251–266.

Tuononen, T., Parpala, A., & Lindblom-Ylänne, S. (2017). Transition from university to working life - An exploration of graduates perceptions of their academic competences. In E. Kyndt, V. Donche, K. Trigwell & S. Lindblom-Ylänne (Eds.), *Higher Education Transitions: Theory and research. EARLI book series 17 "New Perspectives on Learning and Instruction"* (pp. 238−253). London: Routledge - Taylor & Francis group.

Utriainen, J., Marttunen, M., Kallio, E., & Tynjälä, P. (2016). University applicants' critical thinking skills: The case of the Finnish educational sciences. *Scandinavian Journal of Educational Research*. DOI: 10.1080/00313831.2016.1173092

VAKAVA. (2015). The National Selection Cooperation Network in the field of education. The number of applications for the degree programmes participating in VAKAVA 2015. Retrieved

28.04.2017 from https://www.helsinki.fi/en/networks/vakava/about-vakava-0#section-26697

Watters, D. J., & Watters, J. J. (2007). Approaches to learning by students in the biological sciences: Implications for teaching. *International Journal of Science Education*, *29*(1), 19–43.

Willingham, D.T. (2007). Critical thinking: Why is it so hard to teach? American Educator, summer, 8–19.

Zlatkin-Troitschanskaia, O., Shavelson, R. J., & Kuhn, C. (2015). The international state of research on measurement of competency in higher education. *Studies in Higher Education*, 40 (3), 393–411, DOI: 10.1080/03075079.2015.1004241.

Öhrstedt, M., & Lindfors, P. (2016). Linkages between approaches to learning, perceived stress and expected and actual academic outcomes among first-semester psychology students. *Journal of Further and Higher Education*. DOI: 10.1080/0309877X.2016.1206856.

Appendix 1. Factor loadings of the items measuring approaches to learning and self-efficacy beliefs.

Deep approach scale, $\alpha = .80$	Factor loading
Ideas I've come across in my academic reading set me off on long chains of thought.	.85
I looked at evidence carefully to reach my own conclusion about what was being studied.	.75
I tried to relate new material to what I already knew on that topic, as I was reading it.	.65
I tried to relate what I had learned in one course to what I learned in other courses.	.63
Surface approach scale, $\alpha = .74$	
I often had trouble making sense of the things I had to learn.	.87
I was unable to understand the topics I needed to learn because they were so complicated.	.81
Much of what I learned seemed no more than unrelated bits and pieces.	.80
Often I had to repeat things in order to learn them.	.62
Organised studying scale, $\alpha = .77$	
I carefully prioritised my time to make sure I could fit everything in.	.80
I organised my study time carefully to make the best use of it.	.73
I put a lot of effort into my studying.	.65
On the whole, I was systematic and organised in my studying.	.44
Self-efficacy scale, $\alpha = .88$	
I'm certain I can learn the skills required in my study field well.	.93
I'm confident I can understand the basic concepts of my own study field.	.92
I believe I will do well in my studies.	.87
I'm certain I can understand the most difficult material in my studies.	.86
I expect to do well in my studies.	.82