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REVIEW ARTICLE

Do Students Develop Towards More Deep Approaches to Learning During Studies? A Systematic Review on the Development of Students' Deep and Surface Approaches to Learning in Higher Education

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Abstract The focus of the present paper is on the contribution of the research in the student approaches to learning tradition. Several studies in this field have started from the assumption that students' approaches to learning develop towards more deep approaches to learning in higher education. This paper reports on a systematic review of longitudinal research on how students' approaches to learning develop during higher education. A total of 43 studies were included in the review. The results give an unclear picture of the development of approaches to learning and, thus, do not provide clear empirical evidence for the assumption that students develop towards more deep approaches during higher education. Neither methodological nor conceptual aspects of the studies investigated explained the ambiguity of the research results. Both theoretical and empirical implications for further research are discussed.

Keywords Approaches to learning · Higher education · Development on approaches to learning · Systematic review · Longitudinal studies

Introduction

Since the 2004 special issue in Educational Psychology Review on "Measuring Studying and Learning in Higher Education—Conceptual and Methodological Issues" (Lonka et al. 2004), a lot of research effort, from a variety of research traditions, has been invested in exploring the

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ways in which students learn in higher education. The focus of the present paper is on the contribution of the research in the student approaches to learning (SAL) tradition. Research in this tradition generally focuses on the different ways students engage in learning or handle learning tasks as reported by the students themselves (Biggs 2003; Entwistle 2009; Lonka et al. 2004; Schmeck 1988). For at least 40 years (Marton and Säljö 1976a, b), SAL has been interested in the different qualitative ways students go about learning and studying.

Approaches to Learning in Higher Education

Today's higher education faces the challenge of not only having to teach students a bulk of domain-specific frameworks and disciplinary insights but also having to foster skills that will enable them to become versatile experts in their own fields and lifelong learners. In order to reach these goals, successful learning and studying in higher education is expected to involve students in deep approaches to learning and towards more meaningful and critical learning instead of just repeating knowledge (Asikainen 2014; Biggs 2003). Although several studies have the (at least implicit) assumption that students' approaches to learning develop towards more deep approaches in higher education (Baeten et al. 2010; Entwistle and Ramsden 1983; Prosser and Trigwell 1999), there seems to be no clear theoretical foundation for this assumption and no clear empirical evidence. The rationale behind this assumption seems to be largely based on the idea that higher education is indeed increasingly required (and working towards) producing work-ready graduates who are prepared for a life as lifelong learners and that, given the scholarly nature of higher education, part of that should be the development of deep approaches to learning (Lake and Boyd 2015). Despite a general agreement on the basic assumptions, a multitude of conceptual models can be discerned within the SAL tradition, placing emphasis on different aspects of learning, using a variety of different but related concepts, and using a multitude of methods and measures (largely self-report questionnaires) to measure empirically their concepts (Coffield 2004; Richardson 2000; Entwistle and McCune 2004; Vanthournout et al. 2014). The present paper aims to put some "piles" in what is called by some "the swamp of student learning in higher education.". Therefore, we will systematically investigate the research on how students' approaches to learning develop during higher education and what conceptual and methodological aspects are related to this development.

In the next paragraphs, we will first situate the SAL tradition within the wider literature on student learning in higher education by giving a historical overview of the research from which the concept of approaches to learning originated and how it has been put into operation and measured longitudinally over the years.

Historical Situation

In the 1970s, Marton and Säljö (1976a) explored 30 educational psychology students' ways of processing a scientific article and the relationship with their learning outcomes. They found two different ways of processing: surface processing meant that students concentrated on memorizing the text as it was presented, whereas deep processing indicated that students concentrated on the meaning of the text or the main message of it (Marton and Säljö 1976a). In a related publication, Marton and Säljö (1976b) found similar differences in study processes but also found that students changed their study processes according to their perception of the requirements. They found that deep processing could be changed to surface processing by

asking students the kind of questions that provoke it. In a further elaboration of this study, Svensson (1977) found similar qualitative differences in students' study processes: students applying a holistic approach concentrated on the author's intention and tried to understand the meaning of the text and students applying an atomistic approach focused on separate details in the text and tried to memorize them. In addition, Pask (1976) also found similar categories to Marton and Säljö (1976a, b): students applying a *serialistic* strategy in studying focus on details and concentrate on learning linearly one thing at a time: A student using a *holistic* strategy tries to understand the connections between different matters and to form an understanding of matters as a whole.

Deep and Surface Approaches to Learning

These early studies concentrated on the processing, but moving forward from the early studies of Marton and Säljö, research now generally differentiates between two qualitatively different approaches to learning: the surface and the deep approach (Biggs 2003; Marton 1976; Marton and Säljö 1984; Prosser and Trigwell 1999). The deep approach to learning is associated with students' intentions to understand and to engage appropriately in meaningful learning, focusing on the main themes and principles and using strategies that are appropriate for creating such meaning. The surface approach to learning, on the other hand, refers to students selectively memorizing, based on motives or intentions that are extrinsic to the real purpose of the task, such as a fear of failure or keeping out of trouble (Vanthournout et al. 2014). A strategic (Entwistle and Ramsden 1983) or achieving (Biggs 1987) approach to learning has also been identified which referred to how students organized their studying or study according to the assessment of the course. Conceptually, the achieving/strategic approach differs from the deep and surface approach in that the deep and surface approach to learning describes ways in which students engage in learning, whereas the achieving/strategic approach to learning deals with how students organize their learning (Vanthournout et al. 2014). Some studies on approaches to learning refer to organized studying (Entwistle and Peterson 2004; Entwistle 2009) by emphasizing the organized effort in studying more and not emphasizing the effect of the assessment (Entwistle and Peterson 2004; Entwistle 2009).

Marton and Säljö (1976a, b) initially talked about ways of processing in reading an academic text, which were based on experimental data. These studies did not consider the way students generally go about studying, as it is assumed sometimes (see Richardson 2015) but the processing strategies of students and how these were affected by their perceptions of the teaching-learning environment. Marton (1976) first introduced the concepts of *deep* and *surface approach* to describe students' approaches to learning in everyday studies. These were built on studies based on both experimental data and student interview data about how students go about learning and studying. When talking about processing, Marton and Säljö (1976a, b) did not talk about everyday studies, but the concept *approach* referred to students' everyday studying. Svensson (1977) also used the concept of approach in his studies by referring to students' approaches in general studies. This is how the concept has been used in the large body of quantitative research.

Measuring Approaches to Learning

The studies from Marton, Säljö, and Svensson in Göteborg, discussed above, influenced John Biggs in Australia and Noel Entwistle and Paul Ramsden in the UK to explore the way

students usually go about their studying on a more general level. Biggs (1978) developed a Study Process questionnaire (SPQ) which differentiated between three different dimensions of study processes which include students' motivation and their study strategies for a specific course: (1) utilizing, (2) internalizing, and (3) achieving. *Utilizing* describes meeting minimum requirements in studying and using reproduction though rote learning, *internalizing* refers to students' interest in the academic subject and relating ideas with previous knowledge, and the *achieving* approach relates to competitive motives in learning and organized studying. Biggs later renamed these approaches to learning as surface, deep, and achieving approaches (Biggs 1987). Furthermore, in Lancaster, Entwistle and Ramsden (1983) also explored students' study processes on a more general level. The purpose of their study was to explore approaches to learning in larger contexts by developing an instrument, Approaches to Studying Inventory (ASI). The work of Biggs (1978) as well as of Marton and Säljö (1976a, b) and Pask (1976) influenced the development of ASI, and they found similar dimensions of approaches to learning. The deep approach to learning was defined as *intention to understand* and a *critical process in learning* which were measured with two components: relating ideas and use of evidence (Entwistle and Ramsden 1983).

In the early 1990s, Jan Vermunt in the Netherlands developed the learning patterns model in an attempt to provide a more comprehensive and integrated account of learning by bringing together four different learning components: cognitive processing strategies, regulation strategies, conceptions of learning, and orientations to learning (Vermunt 1996; Vermunt and Vermetten 2004). We do not elaborate on this model in this contribution, but refer to the paper by Vermunt and Donche in this special issue and the chapter by Vanthournout et al. (2011) for a review on the longitudinal research using this model.

The Teaching-Learning Environment

From the early studies of Marton and Säljö, it has been evident that the teaching-learning environment has an effect on students' approaches to learning. Or, to be more precise, students' experiences of the teaching-learning environment are related to students' approaches to learning (Ramsden 1997). Approaches to learning are thus seen as context specific (Entwistle and Ramsden 1983). In general, positive perceptions of the teaching-learning environment have been found to be related to a deep approach to learning and, respectively, negative perceptions, to the surface approach to learning (Entwistle and Ramsden 1983; Entwistle et al. 2003; Parpala et al. 2010; Richardson 2005, 2006).

Longitudinal Perspective

Learning Outcomes

The first longitudinal studies concerning students' learning outcomes were done in the 1970s, for example, Marton (1975) and Dahlgren (1975) had already explored students learning outcomes in a pre-post test design. Also, the seminal studies by Marton and Säljö (1976a, b) were longitudinal in nature. They found that students who used deep processing also remembered the main point of the text better after a while (Marton and Säljö 1976a). On the other hand, the students who used surface processing recalled just some details about the text in both cases even though they were provided with the information or correct answers in the first measurement. In the second study (Marton and Säljö 1976b), students' learning outcomes and

ways of processing were measured and manipulated by giving them assignments about the text which required surface- or deep-level processing (Marton and Säljö 1976b). It was shown that the way of processing and the learning outcomes could be influenced by the assessment demands. The group who received factual questions started to concentrate on details and tables more. In addition, some students in the group, who received questions requiring deep-level processing, started to concentrate on the main ideas of the text and deep-level processing. However, not all students did so. In conclusion, it was shown that the way of processing can be impacted by changing the demands of the task.

Learning Processes

Although the nature of the studies mentioned above were longitudinal, none of these studies measured students' way of processing longitudinally, but measured students' level of learning outcomes. However, Svensson (1977) used a longitudinal design in his study and also reported longitudinal data on students' normal ways of studying. His procedure built on the study by Marton and Säljö (1976b) and included three measurement points over a period of 5 weeks. He found that students' ways of processing the learning material were stable across the occasions. However, there were fewer students applying a holistic approach and some applying more of an atomistic approach after the first 5 weeks. This drop was not so evident in the next procedure concerning the second text.

It seems that interest in the development of student learning took a pause after these studies and concentrated more on developing the questionnaires and large-scale cross-sectional studies. The interest in studying the development of general-level approaches to learning rose again in the mid-1980s. Despite the emphasis on the contextual nature of the approaches to learning or processing in the early studies, a lot of longitudinal studies have been set up from a more general perspective. The first longitudinal quantitative study on the development of approaches to learning was conducted by Watkins and Hattie (1985). They explored 540 Australian tertiary students' approaches to learning in their first year and in their third year using the ASI, and found a decline in the deep approach during their studies. Since then, longitudinal studies have been conducted, but they seem to have had contradictory results. Some longitudinal studies suggest that the deep approach does not develop during studies in higher education (Ballantine et al. 2008; Lietz and Matthews 2010; Rodriguez and Cano 2007; Watkins and Hattie 1985; Watkins and Ismail 1994; Zeegers 2004). Other longitudinal design studies have also found a decline in the deep approach (Lietz and Matthews 2010; Wilding and Andrews 2006). In addition, some studies have found a decrease in the surface approach to learning during studies in higher education (Hall et al. 2004; Gordon and Debus 2002; Rodriguez and Cano 2007) but also an increase of the surface approach has been reported (Geitz et al. 2016; Zeegers 2001). Several longitudinal studies have also suggested that students' approaches to learning are relatively stable during studies (e.g., Edmunds and Richardson 2009; Zeegers 2001). However, a recent review of the literature in the field of health sciences indicated that higher education institutes that adopted a curriculum-wide problem-based approach to learning would foster their students' development of more deep approaches to learning (Dolmans et al. 2016).

The Present Study

In the present study, we will systematically review the longitudinal research on how students' approaches to learning develop during higher education and will take into account conceptual and methodological differences between the studies.

Method

Criteria for Inclusion

Before searching the literature, we determined the criteria for inclusion in our analysis. First, each study needed to be empirical, meaning that each paper needs to report on the data collection and analyses of qualitative or quantitative data. Second, the studies needed to include an explicit reference to student approaches to learning (SAL) as a research model; this could include a reference to either approaches to learning, processing strategies, or study strategies. As noted earlier, research using the learning pattern model (Vermunt and Vermetten 2004) was excluded. Third, the focus is on students in higher education. Fourth, longitudinal data about students' approaches to learning needed to be collected and reported upon, meaning that the study needed to report data on student (approaches to) learning with the same students for at least two measurement moments. Finally, the paper needed to include at least one research question or explicit results about the development of student (approaches to) learning.

For our literature search, the following databases were included: ERIC (Ebsco), PsycINFO, and the Web of Science (WoS). The search terms were "Students" and "learning approach," "studying approach," "learning strategies," "learning orientations," "learning patterns," and "processing strategies." Given the focus of this review study, these search terms were combined with the search terms "longitudinal" or "changes over time." The search was further delimited to students participating in higher education or post-secondary education. Only peer-reviewed publications published in the English language were selected. This initial search retrieved 543 articles from the ERIC database, 44 articles from PsycINFO, and 653 from the Web of Science. After screening the abstracts of these papers against the criteria for inclusion, 62 studies were taken to the next step in the selection procedure. In this next step, the authors read the full papers and evaluated these papers again in the light of the five criteria for inclusion described above. One study was excluded at this stage because the full paper could not be retrieved through the subscriptions held by the authors' institutions or through requests from the authors by email and Research Gate. The systematic search provided us with 26 papers that met the criteria for inclusion. In addition to this systematic search, potential studies were also sought by going through the references of the selected papers (snowballing). We also contacted several researchers active in the field of approaches to learning and asked them to provide relevant studies or to identify additional sources of studies. This additional search yielded 17 extra studies. Altogether, 43 studies were included for a systematic analysis.

In the final step, following the guidelines of Aveyard (2014), the papers were re-read and the relevant information from the papers was summarized in a review table (see Table 1). The following methodological and conceptual aspects of each paper were included in the table and will be discussed in the results section of this paper where relevant: number of measurements, level of education, time of measurement, field of study/subject, number of participants, number of courses, duration of the study, measurement instrument, theoretical framework, analysis, what was measured, and significant results/changes.

Results

Before we report how students' deep and surface approaches to learning develop during higher education, based on the results of our analyses of the review table in Table 1, we give an overview of the general characteristics of the studies included in our study.

Table 1 Descriptive study characteristics

Study	Measurements	Grade (Bachelor/Master)	Time of measurement	Field/subject	Participants (*N*)	Duration
Asikainen et al. (2014)	2	Bachelor	Spring of first year–spring in the third year	Bioscience	103	2 years
Ballantine et al. (2008)	2	Undergraduate	Week 3 (final year) → conclusion of the academic year	Undergraduate accounting and business students	286	~1 year
Biggs and Rihn (1984)	2	Bachelor	Before and after two LAC 1 course, at fall and at spring	Students from different faculties	55 (fall)/58 (spring)	9 weeks
Boulton-Lewis et al. 2004	3	Bachelor (12 had completed Year 12; the others had completed Year 10)	1997, 1998, 1999	Several	15	3 years
Chan and Tang (2006)	2	Bachelor	Beginning and end of first year	Hospitality students	37	Beginning and end of first year
Chen et al. 2015	2	Year 2 to Year 5	July (T1) and October (T2)	Medicine, students who were enrolled in the MBChB program (Year 2 to Year 5)	$N = 333$ at T1 and $N = 298$ at T2	4 months
Cleveland-Innes and Emes 2005	2	3rd and 4th year	Begin (Sept) and end (April) of two semester course	Science students participating statistical analyses for social sciences course	64	8 months
De Clercq et al. 2013	3	1st year	November of each year 2001, 2002, 2003	Freshmen engineering students	110	2 years
Edmunds and Richardson 2009	2	1st and final year students	1st and final year → 12–18 months later	15 departments teaching bioscience, business studies, and sociology	1371	~2 years
English et al. 2004	2	Bachelor	Week 1 and end of first year	Economics and commerce students	1060	~1 year
Fryer (2016)	2	Bachelor/Master (grade)	Beginning (after 1 month) and end of 1st year (during last month)	Japanese first year students from seven faculties (Management, Economics, Commerce, International studies, Information	920	1 academic year

Table 1 (continued)

Study	Measurements	Grade (Bachelor/Master)	Time of measurement	Field/subject	Participants (*N*)	Duration
				Sciences, Engineering, and Fine Arts)		
Geitz et al. 2016	3	Bachelor	A week 0, B week 4, C week 8	First-year higher education, mixed-nationality (Dutch and German) students in a problem-based learning context. Bachelor of Business Administration Program on Marketing	77	8 weeks
Gijbels et al. 2009	2	Master	During the first and final lecture	Teacher-training students	Two cohorts (100, 107)	7 weeks
Gordon and Debus 2002	3	1st year until 3rd year—Bachelor	1 month after start, similar time second year, conclusion of final year	Students from Bachelor of teaching course/Bachelor of education course	134 (3 cohorts)	3 academic years
Hall et al. 2004	2	First year	1st week of first semester, last week of 2nd semester	Account students	158	12 weeks
Iputo 1999	4	Bachelor	Beginning of first year and then yearly	Medicine/PBL	$N = 140$	4 years
Jackling (2005)	3	Bachelor	1st, 2nd, 3rd year	Account students	54	2 years
Lietz and Matthews 2010	3	Bachelor	1st, 2nd, and 3rd year	International arts and science	88 all three and 153 in two measurements	3 years
Lindblom-Ylanne et al. (2013)	2	Bachelor	Beginning and end of mathematics course	89 mathematics students	89	Beginning and end of mathematics course
	2	Bachelor	Beginning and end of theology course	79 theology students	79	Beginning and end of theology course,
	2	Bachelor	1st to third year	141 veterinary students	141	2 years

Table 1 (continued)

Study	Measurements	Grade (Bachelor/ Master)	Time of measurement	Field/subject	Participants (*N*)	Duration
	2	Bachelor	1st to 3rd year	Bioscience	104	2 years
López et al. 2015	2	Bachelor	When teaching began and when it ended	Pedagogy/social education students first year	133	Not mentioned
Matthews 2004	5			Australian university—only responses from sojourner students who said that they intended to return to their home country on completion of their studies were included in the data set	153	2 years
Muis and Duffy 2013	5	Graduate level	Week 2, 4, 8, 12 and 3 weeks after the course (week 15)	11 were studying a specialized bachelor degree program in Indigenous Primary Health Care. The others were studying bachelor degree courses in Built Environment and 7 Engineering, Business, Justice Studies and Arts/Law	$N = 63$	15 weeks
Nieminen et al. 2004	2	Undergraduates pharmacy	At beginning of studies and after 3 years of study	Pharmacy	66	3 years
Ova et al. 2012	3	5th and 6th grade undergraduates in their clinical phase	Three different rotations over a period of 30 weeks	Medicine	39	30 weeks, a questionnaire after each rotation
Phan 2011a	4	Bachelor	June 2006, November 2006, June 2007, November 2007	Education, arts and science students	264	1.5 years
Phan 2011b	3	Bachelor	t1 February 2007 (2nd year), t2 October 2007, t3 August 2008 (3rd year)	Teacher education students	252	2 years
Phan 2013	3	Bachelor		2nd year university students	195	16 months

Table 1 (continued)

Study	Measurements	Grade (Bachelor/ Master)	Time of measurement	Field/subject	Participants (*N*)	Duration
			T1: February, T2: November, T3: September following year			
Postareff et al. 2014	2 + interviews	Bachelor	Beginning and end of compulsory Bachelor-level course	Bioscience, educational science, mathematics, theology, veterinary medicine	(277) 34 remaining high on deep approach	
Postareff et al. 2015	2 + interviews	Bachelor	At the beginning and after a course	Bioscience, educational sciences, mathematics and theology	12, 4 students with a increase in DA, 4 with no change in DA, 4 with decrease in DA	At the beginning and after a course
Prat-Sala and Redford 2010	2	Bachelor	2 weeks after entering university and 4 months later	Psychology	163	4 months (one semester)
Quinnell et al. 2012	2	Bachelor	First year students at start and end of first semester	Biology	285	One semester
Rodriguez and Cano 2007	2	Bachelor	1st year, end of third year	Teacher education	81	2 years
Saravanamuthu and Yap 2014	4	1st year till second year	Interviews at beginning of first and second semester in year 1 and 2	Accounting sub-discipline	6	4 semesters
Svensson 1977	3	Bachelor	3 times, 5 weeks apart	First year education students	30	10 weeks
Volet et al. (1994)	2	Bachelor	Beginning and end of first semester, one course	First year students in Introduction to Economics unit	268 Australian and 91 Asian 1st year students	12 weeks
Vu et al. 1998	3	University medicine	Beginning of 2nd, 3rd, and 4th year	Medicine PBL	PBL = 21, traditional 101	2 years
Walker et al. 2010	2	Human body systems courses	Beginning of semester 1 and end of semester 2	Health sciences	705	1 year
Ward 2011	2		Beginning and end of the year	Osteopathy (medicine)	543	1 year

Table 1 (continued)

Study	Measurements	Grade (Bachelor/Master)	Time of measurement	Field/subject	Participants (*N*)	Duration
		(from 3 different graduating classes)				
Watkins and Hattie 1985	2	Bachelor	First year, end of third year	Students from different disciplines	244	2 years
Wilding and Andrews (2006)	2	Bachelor	1st 1 month before entry and middle of 2nd year	Undergraduate college university students	322	1.5 years
Wilson and Fowler 2005	3	Bachelor	Pre- (week 1) and post-semester measure	Third-year behavioral science students	50	1 semester, 13 weeks
Zeegers 2001	5	Bachelor	Week 2 of term 1, after 4 months, after 8 months, after 16 months, after 30 months	Science students	43	30 months
Zhu et al. 2009	2	1st year	Beginning and end of first semester	Freshmen in educational sciences	65 Chinese and 217 Flemish	1 semester

Study	Measurement instrument	Framework	Method/analysis	What was measured	Significant change
Asikainen et al. (2014)	ETLQ	Entwistle	Paired sample *t* test	Deep approach, organized studying	Deep approach +
Ballantine et al. (2008)	ASSIST	Entwistle	Repeated-measures ANOVA	Seeking meaning, relating ideas, use of evidence, interest in ideas, deep approach, organized studying, time management, alertness to assessment demands, achieving, monitoring effectiveness, strategic approach, lack of purpose, unrelated memorizing, syllabus-boundness, fear of failure, surface approach	Relating ideas + use of evidence + lack of purpose + surface approach + organized studying +
	SPQ	Biggs		Deep approach, surface approach	Deep + surface −

Table 1 (continued)

Study	Measurement instrument	Framework	Method/analysis	What was measured	Significant change
Biggs and Rihn (1984)			Repeated-measures ANOVA		
Boulton-Lewis et al. 2004	Semi-structured interviews	Boulton-Lewis	Phenomenographic methodology	Questions about learning and studying	Students reported highly repetitive strategies to learn and did not vary in their way of learning in the first year (all went over and over to memorize or learn)/less than half of the students did this at the end of the 3 years (so more variety in learning in year 3 and also active strategies such as elaboration are used 4 students in year 3)
Chan and Tang (2006)	SPQ	Biggs	Paired sample *t* test	Deep approach, surface approach, achieving approach	Surface approach −
Chen et al. 2015	R-SPQ-2F	Biggs	ANCOVA	Surface approach, deep approach	No significant change
Cleveland-Innes and Emes 2005	SPQ	Biggs	Not clear, no numbers given, results described	Deep motive/strategy, surface motive/strategy, achievement motive/strategy	Slight overall drop in deep strategies/slight increase in achievement motives and achievement strategies (no statistics reported)
De Clercq et al. 2013	Extensive review of the literature selecting various scales (i.e., Learning and Study Strategies Inventory, Inventory of Learning Styles…)	Entwistle and Ramsden, 1983; Vermunt 1994; Weinstein et al. 1988	Path analysis	Cognitive processing strategies: an overall deep processing scale, including relating, criticizing and contextualizing subscales	No change (not reported)

Table 1 (continued)

Study	Measurement instrument	Framework	Method/analysis	What was measured	Significant change
Edmunds and Richardson 2009	ETL Learning and Studying Questionnaire Modified LSQ	Entwistle	MANOVA	Deep approach, surface approach	No change
English et al. 2004	SPQ	Biggs	Comparing means	Deep approach/motive/strategy, surface approach/motive/strategy, achievement approach/motive/strategy	Deep approach −
Fryer (2016)	Approaches to Study Questionnaire	Trigwell and Ashwin	LPTA, SEQ	Surface approach, deep approach	(Low, middle, and high groups) A small increase in surface approaches was present for the Low group, while the Mid and High groups both presented small increases in deep approaches
Geitz et al. 2016	R-SPQ-2F	Biggs	A repeated-measures ANOVA	Deep learning, surface learning	Surface approach increased significantly from point A to C. Dutch students: deep learning increased from B to C AND increase from time A to C. German students: surface learning increased from time B to C
Gijbels et al. 2009	R-SPQ-2F	Biggs	Paired sample *t* test	Deep approach, surface approach	Surface + (feedback light)The difference between both years was significant
Gordon and Debus 2002	SPQ	Biggs	Repeated-measures MANOVA	Deep approach, surface approach, achieving strategy	Surface − deep +
Hall et al. 2004	SPQ	Biggs	Paired sample *t* test	Deep approach/motive/strategy, surface approach/motive/strategy	Deep strategy +, deep approach +, surface approach −, surface motive −
Iputo 1999	Lancaster Inventory of Learning Styles	Entwistle	ANOVA	Achieving orientation, reproducing orientation, comprehension learning, learning orientation,	No significant change in deep/surface approach

Table 1 (continued)

Study	Measurement instrument	Framework	Method/analysis	What was measured	Significant change
				operation learning, improvidence, globetrotting, versatile learning, pathological learning	
Jackling (2005)	SPQ	Biggs	Repeated-measures MANOVA	Deep motive/strategy, surface motive/strategy, achievement motive/strategy	Achievement motive − deep strategy +
Lietz and Matthews 2010	SPQ	Biggs	Paired sample *t* test	Deep approach/motive/strategy, surface approach/motive/strategy, achievement approach/motive/strategy	From 1, 2, 3: achievement approach − achievement strategy − achievement motiveFrom 1 to 3: deep approach −, deep strategy −
Lindblom-Ylanne et al. (2013)	ETLQ/Learn	Entwistle	Mixed-methods approach: paired sample *t* test, change profiles	Deep approach, surface approach, organized studying	MATHEMATICS: group level = deep −, organized −, but individual level: a lot of movement in every direction
	ETLQ/Learn	Entwistle	Mixed-methods approach: paired sample *t* test rank percentile groups	Deep approach, surface approach, organized studying	THEOLOGY = group level = deep approach −, rank = the lowest-ranked students' mean deep approach scores increased, whereas the mean scores for the three higher-ranked student groups decreased. In addition, a large individual variation in the amount and direction of change during the course is evident
	ETLQ/Learn	Entwistle	Mixed-methods approach: paired sample *t* test, scale profiles	Deep approach, surface approach, organized studying	Group level = no changes, SCALE PROFILES: one fifth of the students showed a decrease in their deep approach scores and one third scored higher on the deep approach in the second measurement.

Table 1 (continued)

Study	Measurement instrument	Framework	Method/analysis	What was measured	Significant change
					Although half of the students belonged to the same ranked group in both measurements, the same number changed their ranking group. Similar results were also found when we explored changes in the surface approach and in organized studying
	ETLQ/Learn	Entwistle	Mixed-methods approach: paired sample *t* test, scale profiles	Deep approach, surface approach, organized studying	Group level = surface +, deep +, scale profiles = in the second measurement, only one third of the bioscience students scored higher on the deep approach and that one third scored higher on the surface approach. Thus, there were more students whose scores on the deep and surface approaches either remained the same or decreased despite the fact that the group-level analyses showed a significant increase in both approaches
López et al. 2015	CPE (Spanish R-SPQ-2F)	Biggs	ANOVA, a repeated-measures general linear model	Deep approach/motive/strategy, surface approach/motive/strategy	Deep approach +, deep strategy +, deep motive, no significant changes in surface approach
Matthews 2004	SPQ	Biggs	Quantitative, hierarchical linear modeling (HLM)	Deep motive/strategy, surface motive/strategy, achievement motive/strategy	Surface motivation −, deep motivation +, deep strategy +, achievement motivation +, achievement strategy +
Muis and Duffy 2013	MSQL	Pintricht	Repeated-measures ANOVA with time as	Rehearsal, critical thinking, elaboration	In the intervention group, there was a significant increase for

Table 1 (continued)

Study	Measurement instrument	Framework	Method/analysis	What was measured	Significant change
			within-subjects variable and group (intervention vs. control) as between-subjects variable		self-reported use of critical think ing and elaboration strategies—no change in the control group. No change for rehearsal strategies in intervention or control group
Nieminen et al. 2004	Task booklet of learning (Lonka and Lindblom)	Entwistle/ Vermunt/Ryan	Repeated-measures analyses of variance, indices of effect size in addition to *p* values	Meaning orientation, deep approach, reproductions orientation, surface approach	No significant change on deep and surface approach or meaning orientation, reproducing orientation −
Ova et al. 2012	SPQ	Biggs	Repeated-measures analysis of variance	Deep approach/motive/ strategy, surface approach/ motive/strategy, achievement approach/motive/strategy	No significant change
Phan 2011a	SPQ	Biggs	LGM	Deep approach	Deep approach +
Phan 2011b	SPQ	Biggs	LGM	Surface approach, deep approach	The initial level of deep processing was positively related to the change in surface processing and the initial level of surface processing positively influenced the change in deep processing. A significant negative correlation was noted between the initial levels of deep processing and the change in deep processing and between the initial levels of surface processing and the change in surface processing
Phan 2013	R-SPQ-2F	Biggs	LGM	Deep approach	For a deep approach, significant variance of both intercept and slope indicated the presence of significant individual differences

Table 1 (continued)

Study	Measurement instrument	Framework	Method/analysis	What was measured	Significant change
					in initial levels and change in students' deep-learning approach. Both intercept mean and slope mean were significantly different from zero, suggesting that a deep approach increased over time
Postareff et al. 2014	ETLQ/Learn, qualitative content analysis	Entwistle	Mixed-method approach: scale profiles as basis for interviews	Deep approach	Students whose deep approach to learning decreased sharply during the course described problems in studying and did not show a strong commitment to understand. Students whose deep approach remained high or decreased only slightly described their studying and learning very similarly. The students whose deep approach decreased sharply described problems in their self-regulation skills, time-management skills, and study strategies. However, these students did not differ from the others in terms of their experiences of the teaching or their interest in the course. Some interviews showed that a lack of challenges or too many chal lenges decreased the deep ap proach level
Postareff et al. 2015	Modified ALSI, interviews	Entwistle	Change in mean, interviews	Deep approach quantitatively	Different reasons for the change/ stability. Deep + = study

Table 1 (continued)

Study	Measurement instrument	Framework	Method/analysis	What was measured	Significant change
					practices were well developed, devoted a good deal of time and effort throughout the course to studying the course content, deep approach is more frequently adopted if students are intrinsically motivated
Prat-Sala and Redford 2010	RASI	Entwistle	Regression, ANOVA	Deep approach, surface approach, achieving approach	Changes in approaches to learning over time were related to their self-efficacy beliefs, where students with low levels of self-efficacy decreased in their deep approach and increased their surface approach across time. Students with high levels of self-efficacy demonstrated no such change in approaches to learning
Quinnell et al. 2012	SPQ	Biggs	*t* test, cluster analyses and comparing learner profiles	Deep approach, surface approach	Surface approach +, deep approach −
Rodriguez and Cano 2007	SPQ	Biggs	Repeated-measures ANOVA	Deep approach, surface approach	Surface approach −
Saravanamuthu and Yap 2014	Interviews	Biggs	Longitudinal case study, semi-structured interviews	The interview questions explored all of the surface- and deep-learning attributes	Achievement-motivated Chinese learners move more towards independent, student-centered learning than surface-motivated Chinese learners. (1) Achievement-motivated CLs were more likely move towards independent, student-centered

Table 1 (continued)

Study	Measurement instrument	Framework	Method/analysis	What was measured	Significant change
					learning than surface-motivated CLs; (2) achievement-motivated CLs were less likely to normalize teacher-centeredness than surface-motivated CLs despite being exposed to examination tips early in their enrolment
Svensson 1977	Interviews	Marton and Säljö	Qualitative analysis—functional relationships between outcomes	Learning outcome, processing	After 5 weeks, fewer holistic approaches could be identified, but more students retained a holistic approach after reading the 2nd text
Volet et al. (1994)	SPQ	Biggs	Multivariate tests, *t* test	Deep motive/strategy, surface motive/strategy, achievement motive/strategy	Deep motive −, deep strategy −, achieving motive −, achieving strategy −, surface motive − (only local)
Vu et al. 1998	Inventory of Learning Processes (ILP)	Not described	*t* test, but not fully transparent in how data were collected and analyzed	Deep processing	Deep processing + in PBL group (1 to 2, 1 to 3), no changes in traditional group
Walker et al. 2010	ASSIST	Entwistle	ANOVA, with course as the within-subjects variable and gender as the between-subjects variable	Deep approach, surface approach, strategic approach	Dominance of the surface approach but by the end of the year, students were taking a deep and strategic approach to a greater extent and a surface approach to a lesser extent
Ward 2011	ASSIST	Entwistle	ANOVA	Deep approach, surface approach, strategic approach	66% no changes, 34% changed their approach to studying during the first year, of these 14.5% changed from strategic to deep, 3.2% changed from surface to deep,

Table 1 (continued)

Study	Measurement instrument	Framework	Method/analysis	What was measured	Significant change
					6.9% changed from deep to surface, and 2.5% changed from strategic to surface
Watkins and Hattie 1985	ASI	Entwistle/ Vermunt/Ryan	Repeated-measures ANOVA		Deep −
Wilding and Andrews (2006)	SPQ	Biggs	Paired sample *t* test	Deep approach, surface approach, achieving approach	Deep approach −, achieving approach −, surface approach +
Wilson and Fowler 2005	SPQ	Biggs	First measurement general, other two course specific. Repeated-measure MANOVA, typical deep/surface groups formed on the basis of scores	Deep motive/strategy, surface motive/strategy	From lecture course to action learning course: no change in surface/increase in deep approach (both strategy and motive): person oriented; typically deep: no change, typically surface: increase in deep strategies (no deep motive) in action learning course
Zeegers 2001	SPQ	Biggs	Repeated-measures ANOVA	Deep approach/motive/strategy, surface approach/motive/strategy, achievement approach/ motive/strategy	Achieving approach −, achieving motivation −, achieving strategy −, surface approach + (1 to 3) and − (3 to 5), surface strategy + (1 to 3) and − (3 to 5)
Zhu et al. 2009	MSLQ	Pintricht	Paired *t* tests, multivariate analysis	Rehearsal, Elaboration, Critical thinking, Metacognitive self-regulation, Peer learning	Flemish: no changes but a decrease on peer learning, Chinese student: increase in all learning strategies

A total of 43 studies met our criteria for inclusion. These studies took very different research perspectives. From those studies, 3 were qualitative, 3 were mixed-method studies, and the remaining 37 were quantitative studies. The duration also varied very much: 24 of the studies explored the development of the approaches to learning over a period of 1 year or more and 19 of the studies were for less than 1 year. A total of six studies explored the changes in approaches to learning at course level. In 25 of the studies, there were only two measurement points, 12 of the studies included three measurement points, three of the studies had four and three had five measurement points. Also, the analysis methods varied across the studies. Richardson (2013) talks about traditional or old ways of analyzing longitudinal data on student learning as methods with just a single dependent variable and encourages more advanced ways of exploring student learning longitudinally by including several dependent variables. By using this division, 27 of the quantitative studies used fairly simple methods with one dependent variable to measure the change (RM ANOVA) and 10 of the studies used more advanced methods (MANOVA, path analysis, latent profile transition analysis, multivariate growth model, structural equation modeling, hierarchical linear modeling).

Development of the Deep Approach

In 18 of the studies, a positive development of the deep approach was reported (Asikainen et al. 2014; Ballantine et al. 2008; Biggs and Rihn 1984; Fryer 2017; Geitz et al. 2016; Gordon and Debus 2002; Hall et al. 2004; Jackling 2005; López et al. 2015; Matthews 2004; Muis and Duffy 2013; Phan 2011a, 2013; Svensson 1977; Vu et al. 1998; Walker et al. 2010; Wilson and Fowler 2005; Zhu et al. 2009). In 18 of the studies, no statistically significant changes in the deep approach were found (Chan and Tang 2006; Chen et al. 2015; De Clercq et al. 2013; Edmunds and Richardson 2009; Geitz et al. 2016; Gijbels et al. 2009; Iputo 1999; Jackling 2005; Muis and Duffy 2013; Nieminen et al. 2004; Ova et al. 2012; Prat-Sala and Redford 2010; Rodriguez and Cano 2007; Svensson 1977; Vu et al. 1998; Wilson and Fowler 2005; Zeegers 2001; Zhu et al. 2009) and eight studies found a decrease in the deep approach (Cleveland-Innes and Emes 2005; English et al. 2004; Lietz and Matthews 2010; Prat-Sala and Redford 2010; Quinnell et al. 2012; Volet et al. 1994; Watkins and Hattie 1985; Wilding and Andrews 2006). Six studies found individual differences between different students (Boulton-Lewis et al. 2004; Fryer 2016; Lindblom-Ylanne et al. 2013; Saravanamuthu and Yap 2014; Ward 2011).

In one study, both a decline and stability of the deep approach was reported depending on the level of self-regulation (Prat-Sala and Redford 2010). Vu et al. (1998) and Muis and Duffy (2013) also found an increase of deep processing or critical processing in students belonging to an intervention group but found no increase in a traditional group. Geitz et al. (2016) found an increase of deep learning with Dutch students but no change with German students. Zhu et al. (2009) found no changes in deep-level learning strategies with Flemish students but an increase with Chinese students. Jackling (2005) found an increase in deep strategy but not in deep motive. Furthermore, six other studies found individual differences between different students (Boulton-Lewis et al. 2004; Fryer 2016; Lindblom-Ylanne et al. 2013; Saravanamuthu and Yap 2014; Ward 2011). For example, Fryer (2016) found different developments depending on students' initial approaches. Phan (2011b) reported that the initial level of deep processing was positively related to the change in surface processing and the initial level of surface processing positively influenced the change in deep processing. A significant negative correlation was also noted between the initial levels of deep processing

and the change in deep processing and between the initial levels of surface processing and the change in surface processing (Phan 2011b), thus indicating that change was more likely with students who initially had lower scores on deep or surface approach than students with high scores. In the studies by Postareff et al. (2014, 2015), students were interviewed based on their changes in means before and after a course. In the study by Lindblom-Ylänne et al., different students had different changes.

The 18 studies, which reported a positive development in the deep approach, varied a lot according to their methodological choices. These studies included one qualitative study (Svensson 1977) who also found individual differences and the remaining 17 were quantitative studies. The quantitative studies, which found a development of the deep approach to learning, varied a lot from one to another. Nine of the studies used Biggs framework and his study process questionnaire or the revised version of it (SPQ or R-SPQ-2F) (Geitz et al. 2016; Gordon and Debus 2002, Hall et al. 2004, Jackling 2005; López et al. 2015; Matthews 2004; Phan 2011b, 2013; Wilson and Fowler 2005). Biggs and Rihn (1984) used an early version of the SPQ. In three of the studies, Entwistle's framework was used. These studies used his ASSIST, the approaches and study skills inventory for students (Ballantine et al. 2008; Walker et al. 2010), or the Finnish version of his ETLQ, the Experiences of Teaching and Learning Questionnaire (Asikainen et al. 2014). Two studies used Pintrichs MSLQ, the Motivated Strategies for Learning Questionnaire (Muis and Duffy 2013; Zhu et al. 2009), one study used the Inventory of Learning Processes (ILP) (Vu et al. 1998), and one used the Approaches to Study Questionnaire by Trigwell and Aswin (Fryer 2016).

The duration between the measurements also varied a lot in the studies that reported a development in the deep approach. The measurements varied from one course to three academic years. In six other studies, the duration was less than a year: 8 weeks (Geitz et al. 2016), 9 weeks (Biggs and Rihn 1984), 10 weeks (Svensson 1977), 12 weeks (Hall et al. 2004), 13 weeks (Wilson and Fowler 2005), 15 weeks (Muis and Duffy 2013), and one semester which was not further elaborated (Zhu et al. 2009). In some studies, the data collection took a year or longer: 3 years (Gordon and Debus 2002), 2 years (Asikainen et al. 2014; Jackling 2005; Matthews 2004; Vu et al. 1998), 1.5 years (Phan 2011b), 16 months (Phan 2013), and 1 year (Ballantine et al. 2008; Fryer 2016; Walker et al. 2010). In the study by López et al. (2015), the duration was not clearly stated as students answered the questionnaire "when teaching began and when it ended." In addition, the number of measurements also varied from two to five measurements. Eight of the studies comprised two measurements (Asikainen et al. 2014; Ballantine et al. 2008; Biggs and Rihn 1984; Fryer, accepted; Hall et al. 2004; López et al. 2015; Walker et al. 2010), seven of the studies had three measurements (Geitz et al. 2016; Gordon and Debus 2002; Jackling 2005; Phan 2013; Vu et al. 1998; Wilson and Fowler 2005; Svensson 1977), one had four (Phan 2011b) and two had five measurement points (Matthews 2004; Muis and Duffy 2013). Thus, few similarities could be found in the studies that found the increase in the deep approach.

Development of the Surface Approach

When considering the development of the surface approach to learning, 11 studies reported a decrease (Boulton-Lewis et al. 2004; Biggs and Rihn 1984; Chan and Tang 2006; Gordon and Debus 2002; Hall et al. 2004; Matthews 2004; Rodriguez and Cano 2007; Svensson 1977; Volet et al. 1994; Walker et al. 2010; Zeegers 2001), 9 of the studies found an increase of the surface approach (Ballantine et al. 2008; Fryer 2016; Geitz et al. 2016; Gijbels et al. 2009;

Quinnell et al. 2012; Prat-Sala and Redford 2010; Wilding and Andrews 2006; Zeegers 2001; Zhu et al. 2009), and 20 of the studies did not find changes in surface-level learning (Chen et al. 2015; Cleveland-Innes and Emes 2005; De Clercq et al. 2013; Edmunds and Richardson 2009; Geitz et al. 2016; Iputo 1999; Jackling 2005; Lietz and Matthews 2010; López et al. 2015; Matthews 2004; Muis and Duffy 2013; Nieminen et al. 2004; Ova et al. 2012; Prat-Sala and Redford 2010; Watkins and Hattie 1985; Wilson and Fowler 2005; Volet et al. 1994; Vu et al. 1998; Zeegers 2001; Zhu et al. 2009). Zeegers (2001) found both an increase (from measurement one to three) and a decrease (from measurement three to five) of the surface approach. Prat-Sala and Redford (2010) found that students with high levels of self-efficacy demonstrated no change in surface approach but students with low self-efficacy increased in their surface approach. Zhu et al. (2009) found an increase on rehearsal strategies with Chinese but not with Flemish students. Matthews (2004) and Volet et al. (1994) found a decrease on surface motive but no changes on surface strategy. Six of the studies found individual differences in the development of the surface approach (Boulton-Lewis et al. 2004; Fryer 2016; Lindblom-Ylanne et al. 2013; Saravanamuthu and Yap 2014; Svensson 1977; Ward 2011). Five of the studies did not measure the change in surface approach (Asikainen et al. 2014; Phan 2011b, 2013; Vu et al. 1998; Postareff et al. 2014, 2015) and one study did not report the change (English et al. 2004). From the 11 studies that found a decrease in the surface approach, two were qualitative (Boulton-Lewis et al. 2004; Svensson 1977) and used three measurement points. The remaining studies were quantitative of which eight studies used the framework of Biggs and one study, the framework of Entwistle. Six studies had two measurement occasions, one had three and two had five measurement points.

Discussion

The main aim of this study was to review systematically the longitudinal research on how students' approaches to learning develop during higher education A total of 43 studies were included in our review of which 18 reported an increase in students' deep approach to learning and eight reported a decrease. On the other hand, 11 studies reported a decrease in students' surface approaches to learning and eight reported an increase. The conclusion, based on our review, could be that the results remain inconclusive as to the question whether students' develop deeper approaches during higher education. Probably, it would be more appropriate to conclude that these results give an indication that there is no empirical evidence for the assumption that deep learning should evolve during higher education (Asikainen 2014). However, the present paper also took conceptual and methodological aspects of the studies, included in the review, into account in order to explain differences in the results between the studies. These aspects are discussed below.

Conceptual Considerations

When considering the conceptual factors, it seems that the SAL framework lacks a clear conceptual grounding. There are a lot of different frameworks, evident also in this review, which all conceptualize approaches to learning a bit differently. It has been suggested that the use of different frameworks is one reason for the ambiguity of results concerning the quality of student learning (Dinsmore and Alexander 2012). Most of the studies included in our review were conducted with Biggs' Study Process Questionnaire; Entwistle's framework was the

second most commonly used. In Biggs' Study Process Questionnaire, measures of the deep approach included measures of both *deep motive*, comprising items measuring intrinsic interest and students' personal satisfaction or excitement in studying, and *deep strategy* measuring maximizing meaning (Biggs 1978). However, Entwistle's framework does not necessarily emphasize the deep motive but focuses on the students' *intention to understand* the main message of what they are learning, together with thinking processes such as *relating ideas* and *use of evidence* which are similar to Pask's (1976) holistic and serialistic strategies (Entwistle et al. 2003). Thus, the focus can be regarded quite different between these frameworks. However, in our review, consistency even between studies using the same framework was not evident. Most of the studies were conducted with Biggs' framework and no consistency was found within the results of those studies or for the studies using the framework of Entwistle. These results suggest that conceptual agreement is not enough to get consistent results about the development in the SAL framework.

A likely responsible factor for the inconsistency of the results can be found in the different contexts of the studies. Across the different frameworks, most studies measured the development of the approaches to learning at a very general level. Only five studies measured the change within one specific course. None of the studies explored the development of students' approaches to learning at the level of a specific task, although Svensson (1977) measured students' general way of studying between tasks. Most studies (N = 24) measured changes in students' approaches to learning over a timespan of 1 year or longer. There has clearly been a conceptual shift from the earlier studies and a somewhat surprising development, from studying and measuring task- and context-specific ways, the learning that is referred to as the starting point of the SAL framework (Marton and Säljö 1976a, b), towards studying and measuring more general orientations to learning in longitudinal studies. Although there has been some evidence that approaches to learning can be relatively stable across time and courses (Entwistle 1991; Zeegers 2001), there is the fundamental assumption that approaches to learning are context specific (Biggs 2003; Entwistle and Ramsden 1983; Marton and Säljö 1984) and can vary across different courses (Nieminen et al. 2004). Hence, when exploring the general development, there is the problem that, although the domain of the study remains largely stable, the contextual variables of the course (the topic, the course design, the assessment, the teacher…) probably vary to a great extent on the different measurement moments. Thus, the effect of the teaching-learning environment is not taken into account so much despite the largely accepted theoretical assumption in the SAL tradition that students' approaches to learning are not stable but change as a result of the interaction between the contextual aspects of the learning environment and the characteristics of the learners (Biggs 2003; Entwistle and Ramsden 1983). Therefore, it can be concluded that the way most studies measure change in students' approaches to learning are not in line with the theoretical assumptions of the theory under study. Furthermore, studies did not necessarily make it explicit whether the intention was to measure approaches to learning at a general level or in a particular course or context. For example, the SPQ (Biggs 1987) was used in most of the studies, although this instrument had been developed to measure approaches to learning at course level. Some studies did not bring this issue into question and used the questionnaire to measure the development of approaches to learning at a general level within a long time period, across different courses. Possible modifications of the questionnaire were not discussed. This also raises a question about the validity of these studies and brings us to the issue of methodological considerations.

Methodological Considerations

The lack of clarity in our results could also be due to methodological factors. One factor that could impact the diversity of the results is that the analyses to grasp change varied a lot between the different studies in our review. Of the quantitative studies, most (n = 27) used fairly old methods to measure the change (repeated measures methods or ANOVAs) and only a minority (10) of the studies used newer or more advanced methods such as Latent Profile Analyses. In addition, most of the quantitative studies included only two measurement points. With only two measurement points, the development or growth is hard to estimate and more sophisticated analyzing methods that could be more appropriate to capture longitudinal development, such as multi-indicator latent growth analyses, cannot be used. Nevertheless, most of the studies exploring the development have only two measurement points. One of the potential problems with two measurement points is the phenomenon of regression to the mean, which means that the scores in the second measurements tend to be closer to the mean (Barnett et al. 2005). One reason for the high number of studies measuring the change with only two measurement points could be the problem of subject attrition, meaning that the participants of the study do not participate in the next measurement but leave the study (Gustavson et al. 2012). The risk of subject attrition grows with more measurement and researchers may be tempted to use less measurement points, although three or more measurement moments would be more appropriate when the aim is to measure development (Singer and Willett 2003). To conclude, one might question whether the studies with only two measurement points are really longitudinal in nature as methodological studies, which use only two measurement points, may not necessarily grasp the development. However, the studies in our review, which used more advanced measures and had more than two measurement points, did not have consistent results either which could support the claim that deep approach to learning develops during studies.

Related to the kind of analyses that are reported in the studies included in the review, the idea could be raised that lack of change in the whole group level does not necessarily mean that there are no changes in subgroups of students with similar characteristics. Earlier, Haggis (2003) argued that it could be almost impossible to promote the development of the deep approach to learning if it was not already present. On the other hand, McCune and Entwistle (2011) have suggested that some students have a disposition to understand for themselves, which means that these students' deep approach to learning is high and stable across courses because they have a strong willingness to understand fully the subject they study. According to Richardson (2011), the stability of students' approaches to learning over time could indicate also the similarities in their learning environments during studies. All in all, this suggestion, that the deep approach to learning is more stable than the surface approach, was not confirmed by the results of our review. On the contrary, more studies found no significant changes in the surface approach than in the deep approach.

Recent studies (e.g., Fryer 2016; Vanthournout et al. 2013), making use of person-oriented rather than variable oriented longitudinal analyses, indicate that the stability or volatility of students' approaches to learning are associated with the initial subgroup they belong to, suggesting that students who start higher education with a deep approach are more likely to continue to do so. Studies that explored the development from a person-oriented perspective in our review had all somewhat consistent results: different subgroups of students develop differently and the development is individual in nature (Fryer 2016; Lindblom-Ylanne et al. 2013; Postareff et al. 2014, 2015; Svensson 1977; Saravanamuthu and Yap 2014). Thus, the individual nature of the development of approaches to learning seems to be supported by our

review. This could also be a reason why the group-level studies have such different results. As the study by Lindblom-Ylanne et al. (2013) showed that when there are no changes at group level, there can be a lot of individual variation at individual level. The early study of Marton and Säljö (1976b) and Svensson (1977) already showed that different students' levels of learning outcomes develop differently and different students respond to the requirements of the context more easily than others. It can be suggested that, in order to study the development in approaches to learning, it would be worthwhile to look further than the whole group level as indicated by some studies in our review (e.g., Asikainen et al. 2014).

A final methodological issue that is clear from this review is that all 43 studies are based on self-report data and that one way to advance the field would be to invest in other measures or at least to invest in data-triangulation (cf. Catrysse et al. 2016) which has been more common in the Self-Regulated Learning (SRL) tradition in the past years (see the paper by Zusho in this special issue).

The limitations of this review could be at least partly responsible for these results. The literature search was limited to three databases, the ERIC database, PsycINFO, and the Web of Science, and although relevant researchers in the field were consulted and snowballing was used to find relevant papers, it is possible that this widening the scope of databases and/or search terms might have had an impact on the conclusions.

To conclude, we argue that longitudinal research within the SAL tradition, aiming to investigate how students change their approaches to learning at group level during higher education, is a "dead end." First of all, there is no clear theoretical or empirical foundation in the SAL tradition for the claim that students should develop deeper or lesser surface approaches to learning across different years. In addition, there is a lack of clarity and consistency within the SAL framework and more work should be done to identify the differences and similarities in different traditions. Second, ignoring the contextual differences between different courses and study years within higher education is in contradiction to the theoretical assumption that students' approaches to learning change as a result of the individual characteristics of the learner and the characteristics of the context. Meaningfully investigating how students change their approach to learning in higher education from the SAL perspective should therefore always take this context into account and is therefore probably best done at course/topic or even at task level. From this perspective, it seems ironic that other theoretical models, such as the model of domain learning (Alexander 2003), are theoretically probably better elaborated compared to the SAL model in order to explain both stability and variability in deep and surface learning within a particular domain over a period of time. For longitudinal research across different courses, domains, and study years, other and more general models such as the learning pattern model (Vermunt and Vermetten 2004) are probably much more appropriate (see also the paper by Vermunt and Donche, this issue). These issues bring us back to the metaphor of the swamp of student (approaches) to learning in higher education and our failed attempt with this review to put some "piles" in it. We might be able to reach the other side of the swamp and make some progress in our understanding of student learning and its development in higher education by going back to the roots of the concept of approaches to learning. On the one hand, this could be achieved through studying approaches to learning within a clear context (e.g., at course or task level) and relying on other theoretical models, on the other hand, to strengthen the theoretical foundations (e.g., on the model of domain learning for the assumption that students develop deeper approaches with increasing domain expertise) and to explore new ways to measure students' approaches to learning (e.g., inspired by research in SRL).

References

Articles included in the review are marked with *

Alexander, P. A. (2003). The development of expertise: the journey from acclimation to proficiency. *Educational Researcher, 32*(8), 10–14. doi:10.3102/0013189X032008010.

Asikainen, H. (2014). Successful learning and studying in biosciences: exploring how students conceptions of learning, approaches to learning, motivation and their experiences of the teaching-learning environment are related to study success. Doctoral dissertation. Available from E-thesis.

*Asikainen, H., Parpala, A., Lindblom-Ylänne, S., Vanthournout, G., & Coertjens, L. (2014). The development of approaches to learning and perceptions of the teaching-learning environment during bachelor level studies and their relation to study success. Higher Education Studies, 4(4), 24–36. DOI: 10.5539/hes.v4n4p24.

Aveyard, H. (2014). *Doing a literature review in health and social care: a practical guide (3rd, [updated] ed ed.)*. Maidenhead: Open University Press.

Baeten, M., Kyndt, E., Struyven, K., & Dochy, F. (2010). Using student-centred learning environments to stimulate deep approaches to learning: factors encouraging or discouraging their effectiveness. *Educational Research Review, 5*(3), 243–260. doi:10.1016/j.edurev.2010.06.001.

*Ballantine, J. A., Duff, A., & McCourt Larres, P. (2008). Accounting and business students' approaches to learning: a longitudinal study. Journal of Accounting Education, 26(4), 188–201. DOI: 10.1016/j.jaccedu.2009.03.001.

Barnett, A., Van der Pols, J., & Dobson, A. (2005). Regression to the mean: what it is and how to deal with it. *International Journal of Epidemiology, 34*, 215–220. doi:10.1093/ije/dyh299.

Biggs, J. B. (1978). Individual and group differences in study processes. *British Journal of Educational Psychology, 48*(3), 266–279. doi:10.1111/j.2044-8279.1978.tb03013.x.

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

Biggs, J. B. (2003). *Teaching for quality learning at university: what the student does* (2nd ed.). Buckingham: Society for Research into Higher Education, Open University Press.

*Biggs, J. B., & Rihn, B. (1984). The effects of intervention on deep and surface approaches to learning. In J. R. Kirby (Ed.), Cognitive strategies and educational performance (pp. 279–293). New York: Academic Press.

*Boulton-Lewis, G., Marton, F., Lewis, D. C., & Wilss, L. A. (2004). A longitudinal study of learning for a group of indigenous Australian university students: dissonant conceptions and strategies. Higher Education, 47(1), 91–111. DOI:10.1023/B:HIGH.0000009807.00392.33.

Catrysse, L., Gijbels, D., Doche, V., De Maeyer, S., Van den Bossche, P., & Gommers, L. (2016). Mapping processing strategies in learning from expository text: an exploratory eye tracking study followed by a cued recall. *Frontline Learning Research, 4*(1). doi:10.14786/flr.v4i1.192.

*Chan, B., & Tang, W. (2006). Evaluating the impact of university teaching on approaches to learning of first-year hospitality students. Journal of Teaching in Travel & Tourism, 6(1), 41–59. DOI:10.1300/J172v06n01_03.

*Chen, Y., Henning, M., Yielder, J., Jones, R., Wearn, A., & Weller, J. (2015). Progress testing in the medical curriculum: students' approaches to learning and perceived stress. BMC Medical Education, 15(1), 1–8. doi:10.1186/s12909-015-0426-y.

*Cleveland-Innes, M., & Emes, C. (2005). Social and academic interaction in higher education contexts and the effect on deep learning. NASPA Journal, 42(2), 241–262. doi:10.2202/1949-6605.1475.

Coffield, F. (2004). *Learning styles and pedagogy in post-16 learning: a systematic and critical review*. London: Learning and Skills Research Centre.

Dahlgren, L. O. (1975). *Qualitative differences in learning as a function of content-oriented guidance*. Göteborg: Acta Universitatis Gothoburgensis.

* De Clercq, M., Galand, B., & Frenay, M. (2013). Chicken or the egg: longitudinal analysis of the causal dilemma between goal orientation, self-regulation and cognitive processing strategies in higher education. Studies in Educational Evaluation, 39(1), 4–13. doi: 10.1016/j.stueduc.2012.10.003.

Dinsmore, D., & Alexander, P. A. (2012). A critical discussion of deep and surface processing: what it means, how it is measured, the role of context, and model specification. *Educational Psychology Review, 24*(4), 499–567. doi:10.1007/s10648-012-9198-7.

Dolmans, D., Loyens, S., Marcq, H., & Gijbels, D. (2016). Deep and surface learning in problem-based learning: a review of the literature. *Advances in Health Science Education, 21*(5), 1087–1112. doi:10.1007/s10459-015-9645-6.

*Edmunds, R., & Richardson, J. T. E. (2009). Conceptions of learning, approaches to studying and personal development in UK higher education. British Journal of Educational Psychology, 79(2), 295–309. DOI: 10.1348/000709908X368866.

*English, L., Luckett, P., & Mladenovic, R. (2004). Encouraging a deep approach to learning through curriculum design. Accounting Education, 13(4), 461–488. doi:10.1080/0963928042000306828.

Entwistle, N. J. (1991). Approaches to learning and perceptions of the learning environment. *Higher Education, 22*(3), 201–204. doi:10.1007/BF00132287.

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

Entwistle, N., & McCune, V. (2004). The conceptual bases of study strategy inventories. *Educational Psychology Review, 16*(4), 325–345. doi:10.1007/s10648-004-0003-0.

Entwistle, N., & Peterson, E. R. (2004). Conceptions of learning and knowledge in higher education: relationships with study behaviour and influences of learning environments. *International Journal of Educational Research, 41*(6), 407–428. doi:10.1016/j.ijer.2005.08.009.

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

Entwistle, N., McCune, V., & Hounsell, J. (2003). Investigating ways of enhancing university teaching-learning environments: measuring students' approaches to studying and perceptions of teaching. In E. De Corte, L. Verschaffel, N. Entwistle, & J. van Merriënboer (Eds.), *Powerful learning environments: unravelling basic components and dimensions* (1st ed., p. 89). Amsterdam: Pergamon.

*Fryer, L. (2016). (Latent) transitions to learning at university: a latent profile transition analysis of first-year Japanese students. Higher Education, doi:10.1007/s10734-016-0094-9.

*Geitz, G., Brinke, D. J., & Kirschner, P. A. (2016). Changing learning behaviour: self-efficacy and goal orientation in PBL groups in higher education. International Journal of Educational Research, 75, 146–158. doi:10.1016/j.ijer.2015.11.001.

*Gijbels, D., Coertjens, L., Vanthournout, G., Struyf, E., & Van Petegem, P. (2009). Changing students' approaches to learning: a two-year study within a university teacher training course. Educational Studies, 35(5), 503–513. doi: 10.1080/03055690902879184.

*Gordon, C., & Debus, R. (2002). Developing deep learning approaches and personal teaching efficacy within a preservice teacher education context. British Journal of Educational Psychology, 72(4), 483. DOI: 10.1348/00070990260377488.

Gustavson, K., von Soest, T., Karevold, E., & Røysamb, E. (2012). Attrition and generalizability in longitudinal studies: findings from a 15-year population-based study and a Monte Carlo simulation study. *BMC Public Health, 12*(1), 918. doi:10.1186/1471-2458-12-918.

Haggis, T. (2003). Constructing images of ourselves? A critical investigation into 'approaches to learning' research in higher education. *British Educational Research Journal, 29*(1), 89–104. doi:10.1080/0141192032000057401.

*Hall, M., Ramsay, A., & Raven, J. (2004). Changing the learning environment to promote deep learning approaches in first-year accounting students. Accounting Education, 13(4), 489–505. doi:10.1080/0963928042000306837.

*Iputo, J. E. (1999). Impact of the problem-based learning curriculum on the learning styles and strategies of medical students at the University of Transkei. South African Medical Journal = Suid-Afrikaanse Tydskrif Vir Geneeskunde, 89(5), 550–554.

*Jackling, B. (2005). Analysis of the learning context, perceptions of the learning environment and approaches to learning accounting: a longitudinal study. Accounting and Finance, 45, 597–612. doi: 10.1111/j.1467-629X.2005.00142.x.

Lake, W., & Boyd, W. (2015). Is the university system in Australia producing deep thinkers? *Australian Universitie's Review, 57*(2), 54–59.

*Lietz, P., & Matthews, B. (2010). The effects of college students' personal values on changes in learning approaches. Research in Higher Education, 51(1), 65–87. doi:10.1007/s11162-009-9147-6.

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

Lonka, K., Olkinuora, E., & Mäkinen, J. (2004). Aspects and prospects of measuring studying and learning in higher education. *Educational Psychology Review, 16*(4), 301–323. doi:10.1007/s10648-004-0002-1.

*López, B., Esteban, P., Matero, P., Irene, P., & Rodríguez, M. (2015). Métodos centrados en el aprendizaje, estrategias y enfoques de aprendizaje en estudiantes universitarios = learning-centered methods, learning strategies and learning approaches in university students. Revista De Educación, 370, 229–254. DOI: 10.4438/1988-592X-RE-2015-370-304.

Marton, F. (1975). On non-verbatim learning: 1. Level of processing and level of outcome. *Scandinavian Journal of Psychology, 16*(1), 273–279. doi:10.1111/j.1467-9450.1975.tb00193.x.

Marton, F. (1976). What does it take to learn? Some implications of an alternative view of learning. In N. Entwistle (Ed.), *Strategies for research and development in higher education* (pp. 32–43). Amsterdam: Swets & Zeitlinger.

Marton, F., & Säljö, R. (1976a). On qualitative differences in learning I: outcome and process. *British Journal of Educational Psychology, 46*, 4–11. doi:10.1111/j.2044-8279.1976.tb02980.x.

Marton, F., & Säljö, R. (1976b). On qualitative differences in learning II: outcome as a function of the learner's conception of the task. *British Journal of Educational Psychology, 46*, 115–127. doi:10.1111/j.2044-8279.1976.tb02304.x.

Marton, F., & Säljö, R. (1984). Approaches to learning. In F. Marton, D. Hounsell, & N. Entwistle (Eds.), *Experience of learning* (pp. 39–58). Edinburg: Scottish academic press.

*Matthews, B. (2004). An examination of changes in the approaches to learning in a sample of sojourner students from Confucian heritage cultures (CHC) over time in a new academic environment using hierarchical linear modelling. APERA Conference 2006 28–30 November, Hong Kong.

McCune, V., & Entwistle, N. (2011). Cultivating the disposition to understand in 21st century university education. *Learning and Individual Differences, 21*(3), 303–310.

*Muis, K. R., & Duffy, M. (2013). Epistemic climate and epistemic change: instruction designed to change students' beliefs and learning strategies and improve achievement. Journal of Educational Psychology, 105(1), 213–225. doi: 10.1037/a0029690.

*Nieminen, J., Lindblom-Ylänne, S., & Lonka, K. (2004). The development of study orientations and study success in students of pharmacy. Instructional Science, 32(5), 387–417. DOI: 10.1023/B:TRUC.0000044642.35553.e5.

*Ova, E., Bloomfield, L., & Rotem, A. (2012). Measuring students' approaches to learning in different clinical rotations. BMC Medical Education, 2(114**).** DOI: 10.1186/1472-6920-12-114.

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. doi:10.1348/000709909X476946.

Pask, G. (1976). Styles and strategies of learning. *British Journal of Educational Psychology, 46*, 128–148. doi:10.1111/j.2044-8279.1976.tb02305.x.

*Phan, H. P. (2011a). Deep processing strategies and critical thinking: developmental trajectories using latent growth analyses. The Journal of Educational Research, 104(4), 283–294. doi:10.1080/00220671003739382.

*Phan, H. P. (2011b). Interrelations between self-efficacy and learning approaches: a developmental approach. Educational Psychology, 31(2), 225–246. doi:10.1080/01443410.2010.545050.

*Phan, H. P. (2013). Theoretical constructs that explain and enhance learning: a longitudinal examination. Higher Education Research & Development, 32(6), 1007–1021. doi:10.1080/07294360.2013.806445

*Postareff, L., Lindblom-Ylanne, S., & Parpala, A. (2014). Explaining university students' strong commitment to understand through individual and contextual elements. Frontline Learning Research, 2(1), 31–49. DOI: 10.14786/flr.v2i1.63.

*Postareff, L., Parpala, A., & Lindblom-Ylänne, S. (2015). Factors contributing to changes in a deep approach to learning in different learning environments. Learning Environments Research,, 1–19. doi:10.1007/s10984-015-9186-1.

Prat-Sala, M., & Redford, P. (2010). The interplay between motivation, self-efficacy, and approaches to studying. *British Journal of Educational Psychology, 80*(2), 283–305. doi:10.1348/000709909X480563.

Prosser, M., & Trigwell, K. (1999). *Understanding learning and teaching: the experience in higher education*. Buckingham: Society for Research into Higher Education.

*Quinnell, R., May, E., & Peat, M. (2012). Conceptions of biology and approaches to learning of first year biology students: introducing a technique for tracking changes in learner profiles over time. International Journal of Science Education, 34(7), 1053–1074. doi:10.1080/09500693.2011.582653.

Ramsden, P. (1997). The context of learning in academic departments. In F. Marton, D. Hounsell, & N. Entwistle (Eds.), *The experience of learning. Implications for teaching and studying in higher education* [second edition] (pp. 198–217). Edinburgh: Scottish Academic Press.

Richardson, J. T. E. (2000). *Researching student learning: approaches to studying in campus-based and distance education*. Buckingham: Open University Press.

Richardson, J. T. E. (2005). Students' perceptions of academic quality and approaches to studying in distance education. *British Educational Research Journal, 31*(1), 7–27. doi:10.1080/0141192052000310001.

Richardson, J. T. E. (2006). Investigating the relationship between variations in students' perceptions of their academic environment and variations in study behaviour in distance education. *British Journal of Educational Psychology, 76*(4), 867–893. doi:10.1348/000709905X69690.

Richardson, J. T. E. (2011). Approaches to studying, conceptions of learning and learning styles in higher education. *Learning and Individual Differences, 21*(3), 288–293. doi:10.1016/j.lindif.2010.11.015.

Richardson, J. T. E. (2013). Research issues in evaluating learning pattern development in higher education. *Studies in Educational Evaluation, 39*(1), 66–70. doi:10.1016/j.stueduc.2012.11.003.

Richardson, J. T. E. (2015). Approaches to learning or levels of processing: what did Marton and Säljö (1976a) really say? The legacy of the work of the Göteborg group in the 1970s. *Interchange, 46*(3), 239–269. doi:10.1007/s10780-015-9251-9.

*Rodriguez, L., & Cano, F. (2007). The learning approaches and epistemological beliefs of university students: a cross-sectional and longitudinal study. Studies in Higher Education, 32(5), 647–667. doi:10.1080/03075070701573807.

*Saravanamuthu, K., & Yap, C. (2014). Pedagogy to empower Chinese learners to adapt to western learning circumstances: a longitudinal case-study. Cambridge Journal of Education, 44(3), 361–384. doi:10.1080/0305764X.2014.914154.

Schmeck, R. R. (Ed.). (1988). *Learning strategies and learning styles*. New York: Plenum Press.

Singer, J., & Willett, J. (Eds.). (2003). *Applied longitudinal data analysis: modeling change and event occurrence*. New York: Oxford University press.

*Svensson, L. (1977). On qualitative differences in learning: III—study skill and learning. British Journal of Educational Psychology, 47, 233–243. doi: 10.1111/j.2044-8279.1977.tb02352.x.

Vanthournout, G., Donche, V., Gijbels, D., & Van Petegem, P. (2011). Further understanding learning in higher education: a systematic review on longitudinal research using Vermunt's learning pattern model. In S. Rayner & E. Cools (Eds.), *Style differences in cognition, learning, and management*. Oxford: Taylor & Francis.

Vanthournout, G., Coertjens, L., Gijbels, D., Donche, V., & Van Petegem, P. (2013). Assessing students' development in learning approaches according to initial learning profiles: a person-oriented perspective. *Studies in Educational Evaluation, 39*(1), 33–40. doi:10.1016/j.stueduc.2012.08.002.

Vanthournout, G., Doche, V., Gijbels, D., & Van Petegem, P. (2014). (Dis)similarities in research on learning approaches and learning patterns. In D. Gijbels, V. Doche, J. Richardson, & J. D. Vermunt (Eds.), *Learning patterns in higher education: dimensions and research perspectives* (pp. 11–32). London: Routledge.

Vermunt, J. D. (1994). *Inventory of learning styles in higher education*. Leiden University, The Netherlands: ICLON Graduate School of Education.

Vermunt, J. D. (1996). Metacognitive, cognitive and affective aspects of learning. *Higher Education, 31*(1), 25. doi:10.1007/BF00129106.

Vermunt, J., & Vermetten, Y. (2004). Patterns in student learning: relationships between learning strategies, conceptions of learning, and learning orientations. *Educational Psychology Review, 16*(4), 359–384. doi:10.1007/s10648-004-0005-y.

*Volet, S. E., Renshaw, P. D., & Tietzel, K. (1994). A short-term longitudinal investigation of cross-cultural differences in study approaches using Biggs' SPQ questionnaire. British Journal of Educational Psychology, 64(2), 301–318. doi:10.1111/j.2044-8279.1994.tb01104.x.

*Vu, N. V., Van, D. V., & Lacombe, G. (1998). Thinking about student thinking: medical students' learning processes: a comparative and longitudinal study. Academic Medicine, 73(10) cannot find doi.

*Walker, R., Spronken-Smith, R., Bond, C., McDonald, F., Reynolds, J., & McMartin, A. (2010). The impact of curriculum change on health sciences first year students' approaches to learning. Instructional Science, 38(6), 707–722. doi:10.1007/s11251-009-9092-y.

*Ward, P. J. (2011). First year medical students' approaches to study and their outcomes in a gross anatomy course. Clinical Anatomy, 24(1), 120–127. doi:10.1002/ca.21071.

*Watkins, D., & Hattie, J. (1985). A longitudinal study of the approaches to learning of Australian tertiary students. Journal of Practical Research & Applications, 4(2), 127–15. cannot find doi.

Watkins, D., & Ismail, M. (1994). Is the Asian learner a rote learner? A Malaysian perspective. *Contemporary Educational Psychology, 19*(4), 483–488. doi:10.1006/ceps.1994.1035.

Weinstein, C. E., Goetz, E. T., & Alexander, P. A. (1988). *Learning and study strategies*. New York: Academic Press.

*Wilding, J., & Andrews, B. (2006). Life goals, approaches to study and performance in an undergraduate cohort. British Journal of Educational Psychology, 76, 171–182. DOI: 10.1348/000709904X24726.

Wilson, K., & Fowler, J. (2005). Assessing the impact of learning environments on students' approaches to learning: comparing conventional and action learning designs. *Assessment & Evaluation in Higher Education, 30*(1), 87–101. doi:10.1080/0260293042003251770.

*Zeegers, P. (2001). Approaches to learning in science: a longitudinal study. Br J Educ Psychol, 71 doi:10.1348/000709901158424.

Zeegers, P. (2004). Student learning in higher education: a path analysis of academic achievement in science. *Higher Education Research & Development, 23*(1), 35-56. Doi: http://dx.doi.org/10.1080/0729436032000168487

Zhu, C., Valcke, M., & Schellens, T. (2009). A cross-cultural study of online collaborative learning. *Multicultural Ed & Tech Jnl, 3*(1), 33–46. doi:10.1108/17504970910951138.