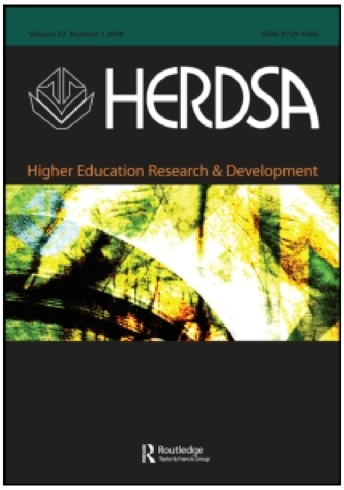

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Eva Kyndt[a]; Filip Dochy[b]; Katrien Struyven[a]; Eduardo Cascallar[a]
[a] Centre for Research on Teaching and Training, Katholieke Universiteit Leuven, Leuven, Belgium [b] Centre for Educational Research on Lifelong Learning and Participation, Katholieke Universiteit Leuven, Leuven, Belgium

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The direct and indirect effect of motivation for learning on students' approaches to learning through the perceptions of workload and task complexity

Eva Kyndt*[a], Filip Dochy[b], Katrien Struyven[a] and Eduardo Cascallar[a]

[a]*Centre for Research on Teaching and Training, Katholieke Universiteit Leuven, Leuven, Belgium;* [b]*Centre for Educational Research on Lifelong Learning and Participation, Katholieke Universiteit Leuven, Leuven, Belgium*

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The present study investigates the direct and indirect influence of motivation for learning, as understood by the self-determination theory, on students' approaches to learning. Concerning the direct influence of motivation, results show that autonomous motivation is positively related to a deep approach to learning and negatively to a surface approach. Motivation also has an indirect effect on students' approaches to learning through the perceptions of workload and task complexity, in particular through the perception of a lack of information. The greater the extent to which students are autonomously motivated, the less they perceive that they have a lack of information and the less they are inclined to adopt a surface approach to learning.

Keywords: approaches to learning; perceptions; self-determination theory; task complexity; workload

Introduction

The idea that motivation is a stable personality trait has been largely abandoned. To a certain extent motivation is understood as a variable concept in terms of context and subject areas (Heikkilä & Lonka, 2006). The same applies to approaches to learning, which also depend on the context in which a task is being experienced (Entwistle, 1991). To our knowledge no previous research has investigated the relationship between motivation for learning and students' approaches to learning. However, it has been shown that motivation for learning and approaches to learning are both important predictors for students' learning outcomes and competences (Deci & Ryan, 2004; Kember, Charlesworth, Dabies, MacKay, & Stott, 1997; Trigwell & Prosser, 1991). The aim of this study is to investigate the direct and indirect influence of motivation for learning on students' approaches to learning. The direct influence of motivation and student learning will be investigated in different educational settings. The indirect influence of motivation on students' approaches to learning will be investigated by looking at the perceptions of context characteristics, more specifically perceived workload and task complexity.

*Corresponding author. Email: Eva.kyndt@ped.kuleuven.be

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On the one hand, previous research has shown that a student's perception of a course (or context) can often differ considerably from the intention of the curriculum designer or the expectations of the teacher. On the other hand, it has been widely argued that students' learning approaches are not only influenced by the context and content itself, but primarily by their perceptions of that context (Hounsell, 1984; Ramsden, 1992). Moreover, Pintrich (2004) stated that 'self-regulatory activities are mediators between personal and contextual characteristics, and actual achievement or performance' (p. 388). These findings have lead to the hypothesis that motivation for learning can influence the perception of contextual characteristics of the learning environment and therefore can also have an indirect influence on students' approaches to learning.

In addition, this study will also investigate if the direct and indirect influences on students' approaches to learning differ when students are placed under different levels of intended workload and task complexity. These different levels are the research conditions in this study. Prior research has not made this distinction between different levels of intended workload and task complexity on the part of the teacher or curriculum designer. This study investigates whether the perceptions of workload and task complexity have the same or different relationship with students' approaches to learning when investigated under different inter-subjective workload and task complexity conditions. Concerning motivation, we wonder if there is some threshold that has to be exceeded or that cannot be exceeded for motivation for learning to have an influence? The different workload and task complexity conditions in this research study could offer a potential explanation for the diverse results of different research studies. The combination of the 'inter-subjective' conditions with the measurement of perceptions allows us to combine (more) objective and subjective workload and task complexity conditions when investigating the influence of these variables on student approaches to learning and the influence of motivation thereon.

Motivation for learning: the self-determination theory

In this study, motivation for learning is understood from the perspective of self-determination theory (Deci & Ryan, 2004). The self-determination theory studies the quality of motivation for learning (Deci & Ryan, 2004). The focus in this study lies on the reasons why people learn within a particular setting and why they engage in learning-related behaviours. A differentiation is made between learning for internal reasons (for example interest and personal fulfilment) or for external reasons (for example obligation or reward).

When discussing the quality of motivation, researchers used to make a distinction between intrinsically motivated or extrinsically motivated learning (Vansteenkiste, Lens, & Deci, 2006). Intrinsically motivated learning originates out of an inherent interest and enjoyment for learning. Extrinsically motivated learning is done to attain an outcome outside of, or separable from, the learning itself (Deci & Ryan, 2004; Vansteenkiste et al., 2006). Intrinsic motivation was seen as self-determined, while extrinsic motivation was considered to reflect a lack of self-determination. However, more recent findings have resulted in a more refined analysis of extrinsic motivation. Various types of extrinsic motivation were defined according to the degree of autonomy or self-determination. This degree of self-regulation is indicated by the extent to which people have internalized the initial external regulation of learning (Deci & Ryan, 2004; Vansteenkiste et al., 2006). In other words, it is the degree to which people experience the initial external regulation as a regulation coming from within themselves.

In general, two types are distinguished: autonomous motivation and controlled motivation, each containing two types of regulation. Controlled motivation contains the two types of regulation where the locus of causality is perceived to be external: external regulation and introjected regulation. External regulation is the least autonomous form of extrinsic motivation. The reasons for learning have not been internalized at all, because learning is caused by external contingencies like rewards and punishments (Deci & Ryan, 2004; Vansteenkiste et al., 2006). In the case of introjected regulation, the regulation has been partially internalized but is not considered as the individual's own and therefore causes a feeling of coercing or pressuring. Students with an introjected regulation for learning feel an internal pressure to pursue self-worth or to avoid guilt and shame (Deci & Ryan, 2004; Vansteenkiste et al., 2006).

Autonomous motivation comprises two types of regulation where the causality is perceived to be located internally. Identification refers to identifying with the value of an activity and accepting the regulation as its own. Students see the personal relevance of learning and will engage in learning quite volitionally or willingly, as, for example, when a student learns because he sees it as a way of getting further in life. Because of the fact that the student learns volitionally and willingly, it is said that identification approximates intrinsic motivation. The difference with intrinsic motivation is that a student with an intrinsic motivation learns out of sincere interest in the topic regardless of possible (positive) consequences. On the other hand, with identification, the reason for learning remains extrinsic in nature. Identification and intrinsic motivation are combined to shape autonomous motivation (Deci & Ryan, 2004; Vansteenkiste et al., 2006).

Motivation for learning and students' approaches to learning

Approaches to learning combine the intention of a student when starting a task and the learning processes and strategies used to carry out the task (Biggs, 2001; Entwistle, 1991; Marton & Säljö, 1997). A student can adopt one approach in a certain context and another approach in another context, depending on the characteristics of that context and the learner's interpretation thereof (Biggs, 2001). In general, two approaches to learning are distinguished: a surface approach and a deep approach (Marton & Säljö, 1997). A surface approach to learning is characterized by learning strategies such as rote learning and reproducing facts and a learning intention that sees the task as a hurdle to be overcome (Biggs, 2001; Entwistle, McCune, & Walker, 2001). A deep approach to learning embeds a sincere interest in the task and focuses on understanding the underlying meaning. Learning strategies that characterize a deep approach to learning can vary in terms of the characteristics and requirements of the task. Possible strategies are reflecting, discussing, using various information sources, relating ideas to previous knowledge, looking for patterns, checking evidence and critically examining arguments (Biggs, 2001; Entwistle et al., 2001).

Both self-regulation and students' approaches to learning are part of research traditions that have been widely applied when explaining student learning. In general, results show that autonomously motivated students thrive in educational settings. Besides higher achievements, these students also have a higher perceived competence and stronger perceptions of control (Deci & Ryan, 2004). With regard to approaches to learning, research has shown similar relationships. A deep approach to learning relates to study success and a high quality of learning outcomes (Trigwell & Prosser, 1991). Moreover, deep approaches to learning have also been associated with problem solving, critical thinking and self-management (Kember et al., 1997).

The perception of workload and task complexity

Perception of workload

Because of the difficulty in determining the correct objective workload, research has often measured the perception of the students concerning workload. Former research used to use 'hours of work or study' as a measurement, but Kember (2004) stated that this was not a good measurement of workload. Time is merely a component of what shapes the perceived workload of a student (Kember, 2004). Perceived workload is a feeling of pressure or stress (Kember, 2004) placed on students in terms of the syllabus and assessment demands (Entwistle & Ramsden, 1983). Hart and Staveland (1988) identified several possible sources of perceived workload, divided into two categories – the demands placed on the individual (mental, physical and temporal demands) and the interaction of the task with the individual (effort, frustration and performance).

Many empirical research studies have argued that a perceived excessive workload is associated with a surface approach to learning (e.g. Entwistle & Ramsden, 1983; Kember, 2004; Ramsden, 1992; Struyven, Dochy, Janssens, & Gielen, 2006). Perceived excessive workload can have a tendency to encourage surface approaches, students resort to short cuts and undesirable study approaches to cope with the perceived disproportionate demands (Kember, 2004). Other research has come to the conclusion that an appropriate workload relates positively to a deep approach to learning (e.g. Diseth, Pallesen, Hovland, & Larsen, 2006; Wilson, Lizzio, & Ramsden, 1997) and significantly negative to a surface approach to learning (Diseth et al., 2006; Wilson et al., 1997).

Perception of task complexity

There exists little consensus among researchers concerning the properties that make a task complex (Campbell, 1988). Complexity is like a multidimensional web of interactions (Mennin, 2007). A complex task can be defined as a task with multiple paths to a solution and multiple (not necessarily, but possibly equally valuable) solutions. Expertise can help, but may not be sufficient and an uncertainty of outcome remains (Glouberman & Zimmerman, 2002; Haerem & Rau, 2007). Complexity is not synonymous with difficulty – a certain task can be difficult (e.g. only a few people know the answer) without being complex, while other tasks are difficult because they are complex. On the other hand, a task of specified complexity may be difficult for one person but not for another (Braarud, 2001; Campbell, 1988). The perceived task complexity is a reaction to task characteristics which may be evoked for reasons other than the task characteristics (Braarud, 2001; Campbell, 1988), such as familiarity with the task, assessed cognitive resources, availability of tools, time etc. (Mangos & Steele-Johnson, 2001). It is important to take the subjective task complexity and the individual's perception of how complex the task is into account when studying the influence of task complexity on human performance and behaviour (Braarud, 2001; Mangos & Steele-Johnson, 2001).

Task complexity has been studied a lot in relation to performance (Campbell, 1988; Haerem & Rau, 2007; Mangos & Steele-Johnson, 2001). Findings show a negative main effect: when subjective task complexity increases, the performance decreases (Mangos & Steele-Johnson, 2001). Research has shown that approaches to learning are also related to the learning outcomes of students (e.g. Minbashian, Huon, & Bird, 2004; Trigwell & Prosser, 1991). Moreover, the research study by Stahl, Pieschl and Bromme (2006) showed that students acknowledge task complexity and plan their goals and strategies accordingly.

The present study

The aim of the present study is to investigate whether motivation for learning has an influence on students' approaches to learning. Both the direct and indirect relationship between motivation for learning and students' approaches to learning will be investigated. Figure 1 gives a schematic overview of the relationships that will be studied.

Expectations for the direct relationship between motivation for learning and student approaches to learning are that autonomous motivation will relate positively to a deep approach to learning and negatively to a surface approach to learning. For a controlled motivation, the opposite is expected. Regarding the indirect influence of motivation for learning on students' approaches to learning, the expectations are that motivation for learning has an influence on students' perceptions of workload and task complexity. These perceptions have, in turn, an influence on students' approaches to learning. Autonomous motivation is expected to have a negative relationship with perceived workload and task complexity, meaning that highly autonomously motivated students will perceive the workload and task complexity to be less than students with a lower level of autonomous motivation. For controlled regulation the opposite is expected. The expectation is that students with a high controlled motivation will perceive workload and task complexity to be higher than students with a lower controlled motivation. For the relations between the perceptions of workload and students' approaches to learning, the expectations are that a high workload will relate negatively to a deep approach to learning and positively to a surface approach to learning. For a high perceived task complexity, similar relations are expected.

Methods

Sample

Participants in this study were 128 students enrolled in a course on the theory of learning and working in teams. The course was mandatory for students in the second year

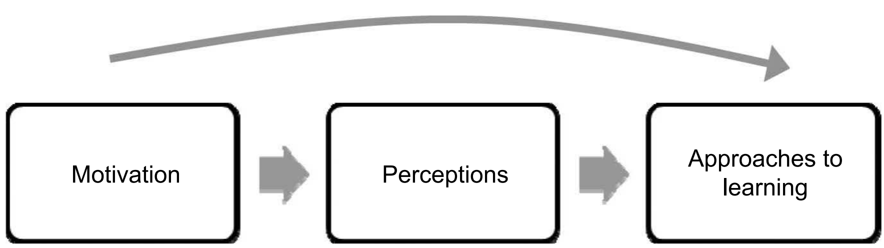

Figure 1. Schematic overview investigated relationships.

of the bachelor of educational sciences program and was taught during the first semester of the academic year. There were 122 female and 6 male participants, a proportion that is representative of students of educational science. Students were between 18 and 21 years old, with a majority of the students being 19 years old (64.8%), 26.6% were 20, 6.2 % were 18 and only 2.3% were 21 years old.

Design

This study was conducted within the setting of an authentic educational context. After an introduction to theory in several lectures, students were asked to undertake four assignments regarding four themes of the course. The assignments were constructed in such a way that they would induce a specific workload and task complexity. The participants were randomly divided into two groups, each group having the same four conditions and themes but in a different combination and order. These groups were implemented to control the effect of a gradually implemented condition and the effect of the content. At the beginning of the course students completed the motivation questionnaire. After each assignment, the learning approach questionnaire and the questionnaire on perceived workload and task complexity was completed.

Assignments

The assignments were constructed in collaboration with the lecturer and the teaching assistant of the course. The variation in workload was approached in a quantitative way, the high workload condition was designed in such a way that students would have to invest more time and effort in comparison with the low workload condition. The requirements for the 'output' were also higher. For example a low workload assignment asked students to describe three examples of cooperative teaching methods they had experienced. The high workload assignment asked them to prepare and conduct an interview of one hour and to write a paper (10–15 pages) about that interview. For the induction of task complexity the variation was performed on the characteristics that were used to define task complexity: familiarity, multiple paths to a solution and an uncertainty of outcome. Concretely, this meant that students were asked to apply the theories from the course to actual practice. This application of theory is something that is rather unfamiliar for novice university students. In addition, there are multiple ways of interpreting situations and applying theory. Finally, since practice seldom corresponds entirely with a theoretical model, students were in general uncertain about their solution. A high task complexity assignment that students were given was, for example, analysing and assessing the effectiveness of a team based on the theories in the course. A low task complexity assignment was more theoretical, for example students were asked to make a table with the criteria for team effectiveness sorted by level (individual, team and organisation) based on two texts that discussed those criteria and levels.

Eight students who had completed the course successfully the previous year were asked to judge the assignments regarding their workload and task complexity. They were not informed of the intended conditions of each assignment. These 'judges' confirmed the hypothesized conditions. The intra-class-coefficients average measure (the inter-rater reliability coefficient) equaled .82 ($p < .001$).

Instruments

Motivation for learning is measured by means of an adapted version of the Self-Regulation Questionnaire (SRQ: Ryan & Connell, 1989). The SRQ was developed within the framework of Ryan and Deci's (2000) Self-Determination Theory. This questionnaire focuses on the reasons why people learn within a particular setting and why people engage in learning-related behaviours. The SRQ consists of two subscales: autonomous regulation (α = .83) and controlled regulation (α = .79). Items are scored on a 5-point Likert scale.

Students' approaches to learning were measured by means of the Revised Two-Factor Study Process Questionnaire (R-SPQ-2F: Biggs, Kember & Leung, 2001). The R-SPQ-2F comprises twenty items, scored on a five-point Likert scale. It measures two types of approaches to learning: surface approaches and deep approaches to learning. In this study, a translated validated Flemish version of the R-SPQ-2F was used (Stes, De Maeyer, & Van Petegem, 2008). Both factors have good reliabilities for each post-test (Table 1).

The perceived workload of the task was measured by means of the NASA-TLX questionnaire (Braarud, 2001; Hart & Staveland, 1988). The items of the NASA-TLX measure mental demands, physical demands, temporal demands, own performance, effort and frustration (Hart & Staveland, 1988). Based on a validation study with 113 Bachelor students in educational sciences who had to make an exercise for a course on didactics, it was decided to leave the performance item out of the questionnaire, since it did not load significantly on the workload factor (factor loading = −.123). After dropping this item, the workload factor explained 40.13% of the variance (α = .81) when using the maximum likelihood extraction method.

The perception of task complexity was measured by a newly developed questionnaire. The questionnaire is based on the literature concerning task complexity (Braarud, 2001; Campbell, 1988; Haerem & Rau, 2007; Mangos & Steele-Johnson, 2001; Mennin, 2007) and contains items such as 'There were multiple possible solutions' and 'I have undertaken similar tasks in the past'. The students were asked to mark, on a five-point Likert scale, the degree to which the statement applied to them. The goal of the questionnaire is to determine if the students experienced the assignment as a complex one.

Table 1. Reliability learning approaches.

Test	Approach	Reliability (α)
Post-test high workload	Deep	.85
High task complexity	Surface	.80
Post-test high workload	Deep	.84
Low task complexity	Surface	.80
Post-test low workload	Deep	.85
High task complexity	Surface	.84
Post-test low workload	Deep	.81
Low task complexity	Surface	.77

Analysis

An exploratory factor analysis was performed on the data collected from the 128 participants in this study regarding perceived workload and task complexity. First, we checked whether the data were suited for this kind of analysis. We calculated the determinant of the correlation matrix in order to rule out extreme correlations between different variables. This determinant equalled 0.0001, meaning that there were no extreme correlations. A Kaiser-Meyer-Olkin measure of sampling adequacy of 0.83 and a Bartlett's test of sphericity with a significance of $p < .001$, also confirmed that this data was suitable for factor analysis.

Four factors were selected based on the eigenvalues criterion (eigenvalues > 1). These four factors explained 67.91% of the variance. The extraction method that was used was maximum likelihood. The first factor explained 33.77% of the variance ($\alpha = .89$) and contained all the items of the workload questionnaire plus two items asking how difficult and how complicated the assignment was. This first factor will be called 'perceived workload'. The second factor focused on the 'familiarity' of the student with the type of assignment and explained 13.35% of the variance ($\alpha = .96$). The third factor asked if there were multiple (correct) ways of finding a solution. This third factor explained 11.14% of the variance ($\alpha = .84$). We will refer to this variable as 'solutions'. The final factor, called 'lack of information', explained 9.65% of the variance. It contained statements about the availability of information and its accessibility in order to complete the assignment ($\alpha = .71$). The factors 'familiarity', 'solutions' and 'lack of information' represent different aspects of task complexity. Items and factor loadings can be found in Appendix 1.

In order to be able to proceed with the analysis, it needed to be checked for significant differences between groups A and B regarding motivation and approaches to learning. When the group effect can be ruled out, we can analyze both groups as if they were one group, otherwise the groups will have to be analyzed separately. An ANOVA analysis was performed for motivation and approaches to learning under every condition. Group A and B did not differ significantly concerning motivation. Regarding the approaches to learning only the surface approach, if attempting to induce a low workload and low task complexity, differed significantly. Group B scored higher on the surface approach than group A ($F[1,126] = 6.221$, $p < .05$). This is the only approach that had to be analyzed separately for groups A and B.

To investigate the relationship between the different variables correlations and linear stepwise regressions were calculated. These analyses were performed for each induced research condition concerning workload and task complexity. This gave us the opportunity to not only look at the relationship between motivation and students' approaches to learning and students' perceptions of workload and task complexity, but also to compare the influence of motivation on the above mentioned variables under different conditions. Questions that will be considered in this respect are: 'Is the influence of motivation consistent across conditions or not?' and 'What do differences across the conditions tell us concerning the influence of motivation?'

Results

The results for all induced conditions will be reported by research question. The first research question focuses on the *direct influence of motivation on students' approaches to learning*. The results show that in the two conditions where the induced workload is high, autonomous motivation has a positive relationship and influence on a deep approach to learning and a negative relationship and influence on a surface approach to learning (Table 2). The more a student is motivated to study the course for autonomous reasons such as learning the course because they find it a pleasant or valued activity, the more they will be inclined to use a deep approach to learning and the less they will adopt a surface approach to learning. For the two conditions with a low workload, no significant results were found.

The second research question investigated the *indirect influence of motivation, via students' perceptions of workload and task complexity, on students' approaches to learning*. The analysis for this research question was performed in two steps. First, the relationships between motivation and students' perceptions of workload and task complexity were analysed. Task complexity was represented by the factors 'familiarity', 'solutions' and 'lack of information'. Secondly, the relationship between students' perceptions of workload and task complexity and students' approaches to learning were analysed. Table 3 gives an overview of the results concerning the relationship between motivation and students' perceptions of workload and task complexity. With the exception of the high workload-high task complexity condition, results for the other three conditions consistently showed a negative relationship between autonomous motivation and the perception of lack of information. The more autonomously motivated students are, the less they will have the perception of not having enough information to solve the assignment or problem. In the high workload-high task complexity condition, an additional relationship was found. In this specific condition, controlled motivation related positively to the perception of workload. Students with a high controlled motivation perceived the workload to be higher than students with a lower controlled motivation. Apparently, this effect is only significant when controlled regulated students are placed in a particular situation of high workload and high task complexity.

The results concerning the relationship between students' perceptions of workload and task complexity and students' approaches to learning can be found in Table 4. The results concerning this relationship are less clear-cut than the previous results. However, there are several consistent results across the conditions. For example it was found that a lack of information relates positively to a surface approach to learning under every condition. The more students perceive that they have too little information, the more they will adopt a surface approach to learning. Under the extreme conditions, that is conditions with both high or low workload and task complexity, it was also found that the perception of a lack of information relates negatively to a deep approach to learning. In the mixed conditions, with workload being high and task complexity low or the reverse, this relationship was not significant. Finally, only in conditions with a low workload and high task complexity did perceived workload relate positively to a deep approach to learning.

The results of the two steps taken to analyse the indirect relationship show that the motivation for learning has an indirect effect on students' approaches to learning through the perceptions of workload and task complexity. In particular, it exercises this effect through the perception of a 'lack of information'. Autonomous motivation influences the perception of a lack of information negatively, while the perception of a lack of information relates positively to a surface approach to learning. The greater the extent to which students are autonomously motivated, the less they perceive that they lack information and the less they are inclined to adopt a surface approach to learning.

Table 2. Results relation between motivation and approaches to learning.

	High workload High task complexity	High workload Low task complexity	Low workload High task complexity	Low workload Low task complexity
Correlations	Autonomous & deep (ρ =.50**) Autonomous & surface (ρ = –.33**)	Autonomous & deep (ρ = .34**) Autonomous & surface (ρ = –.29*)	n.s.	n.s.
Stepwise regression	Autonomous → deep (t = 6.478, β = .50**) Autonomous → surface (t = –3.944, β = –.33**)	Autonomous → deep (t = 4.115, β =.34**) Autonomous → surface (t = –3.459, β = –.29*)	n.s.	n.s.

Notes: * $p < .01$; ** $p < .001$; n.s. = not significant.

Table 3. Results relation between motivation and perceptions of workload and task complexity.

	High workload High task complexity	High workload Low task complexity	Low workload High task complexity	Low workload Low task complexity
Correlations	Controlled & workload (ρ = .19*)	Autonomous & lack of information (ρ = –.21*)	Autonomous & lack of information (ρ = –.20*)	Autonomous & lack of information (ρ = –.23**)
Stepwise regression	Controlled → workload (t = 2.109, β = .19*)	Autonomous → lack of information (t = –2.393, β = –.21*)	Autonomous → lack of information (t = –2.27, β = –.20*)	Autonomous → lack of information (t = –2.68, β = –.23**)

Notes: *$p < .05$; **$p < .01$.

Table 4. Results relation between perceptions of workload and task complexity and approaches to learning.

	High workload High Task complexity	High workload Low task complexity	Low workload High task complexity	Low workload Low task complexity
Correlations	Lack of information & surface (ρ = .21*) Lack of information & deep (ρ = –.25**)	Lack of information & surface (ρ =.25**)	Lack of information & surface (ρ = .22*) Workload & deep (ρ = .18*)	Lack of information & surface (Group A: ρ = .38**) (Group B: ρ = .31*) Lack of information & deep (ρ = –.19*)
Stepwise regression	Lack of information → surface (t = 2.349, β = .21*) Lack of information → deep (t = –3.148, β = –.27*) Familiarity → deep (t = 2.002, β =.17*)	Lack of information → surface (t = 2.91, β =.25**)	Lack of information → surface (t = 2.48, β =.22*) Workload → deep (t = 2.067, β =.18*)	Lack of information → surface (Group A: t = 3.22, β =.38**) (Group B: t = 2.78, β =.33**) Lack of information → deep (t = –2.20, β = –.19*) Familiarity → surface (Group A: n.s.) (Group B: t = 2.09, β =.25*)

Notes: *$p < .05$; ** $p < .01$; n.s. = not significant.

Conclusion and discussion

The present study investigated the direct and indirect influence of motivation on students' approaches to learning. Concerning the direct influence of motivation, it can be concluded that autonomous motivation is positively related to a deep approach to learning and negatively related to a surface approach to learning when the induced workload is high. In the low workload conditions, no significant direct relationship between motivation and students' approaches to learning was found. By investigating the relationship between motivation for learning and students' approaches to learning under different conditions, this study is able to refine previous results. Apparently, motivation for learning, more specifically autonomous motivation, is only significant or important when students are placed in a context that is designed to have a high workload. However, it has to be pointed out that apparently the perception of workload and difficulty are not entirely perceived separately by the students. The distinction Nijhuis, Segers and Gijselaers (2008) made between the quantitative workload (for example a lot of literature to go through) and the quality of work (such as a complicated or difficult) seems to apply here. The perceived workload factor seems to measure both aspects of workload, despite the fact that this study focused on the quantitative aspect of workload when operationalising the variable.

Concerning the indirect influence of motivation on students' approaches to learning, this study confirms Pintrich's (2004) statement that self-regulatory activities mediate the influence of contextual characteristics. In conclusion, the results showed that autonomous motivation has an influence on the perceptions of workload and task complexity, especially on the perception of lack of information which, in turn, has an influence on students' approaches to learning. The influence of autonomous motivation seems to mediate the influence of the perception of task characteristics on students' approaches to learning. For controlled motivation, results only showed a significant influence in the high workload and high task complexity condition. Controlled motivation has a significant influence on the perception of workload in this specific condition. Unfortunately, this study is not able to show why this influence is only significant in this condition. A possible explanation is that this specific condition evokes a stronger influence of controlled motivation on the perception of students. Students with a controlled motivation learn because of an external reason such as obligation or avoidance of shame. The combination of high workload and high task complexity might exceed their threshold in terms of the amount of effort they are willing to invest. Future research is needed to fully explain this phenomenon.

A limitation of this study is that the different conditions were induced by means of assignments for which students had two or three weeks to complete. Although the induction of the different conditions was thoroughly carried out, two or three weeks is a relatively short period of time. Future research could repeat this study with (larger) assignments to be completed over a longer period of time. Furthermore, the participants in this research study were students studying educational sciences. Prior research has shown that students from different disciplines can differ significantly from each other regarding learning approaches (e.g. Kember, Leung, & McNaught, 2008; Smith & Miller, 2005). As a consequence, it would be interesting to investigate if students in other disciplines differ regarding the relationship between motivation and approaches to learning. Another limitation of the study is associated with the crossover design (different treatments sequentially over time with the same persons). One of the pitfalls of this type of design is the carry-over effect. This means that the effect of one treatment still has an influence on the following treatment. To maintain the comparability of the treatments as many different sequences of the treatments should be considered. In this study two different sequences of the treatments were applied (see design). Moreover, both groups were compared by means of ANOVA analyses in order to rule out a group/sequence effect. Ideally, several additional sequences of treatments would have had to be implemented, but the number of participants did not allow this. Therefore it remains important to keep a possible carry-over effect in mind when interpreting the results.

This research study has obtained some interesting findings that offer the potential to present some implications for practice. The results of this research study indicate that when stimulating students towards deep approaches to learning, teachers and educators in general should be careful not to exceed students' thresholds of workload and task complexity, especially when working with students who are studying out of obligation or other external reasons. However, from a motivational point of view, it is important that the workload is high enough, so that autonomous motivation can have an effect on students' approaches to learning. For practitioners it is important to find the balance between asking 'enough' of students to keep them motivated and not asking too much so that they don't get discouraged by the demands placed upon them. One way of maintaining a balance could be to work with so-called mixed-assignments in terms of workload and task complexity. In these mixed-assignments one of the two characteristics is rather high while the other is kept low. For example in this research, an assignment with high task complexity and low workload was limited in length and time but asked students to apply theory to practice. For example, students were asked to analyse the shared mental model of a team described in a one-page case. This type of exercise is suited when the goal is to see whether or not students really understand a topic. An example of an exercise with high workload and low task complexity is answering ten specific and simple questions based on an observation of a team meeting. This type of exercise is suited when students are getting themselves acquainted with a topic.

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Appendix 1. Items and factor loadings perceived workload and task complexity

	Factor			
	1	2	3	4
WL1: Mental demand: how mentally demanding was this task? How much mental activity (for example: thinking, deciding, calculating, remembering, searching …) was required?	.852			
WL2: Physical demands: how physically demanding was this task?	.498			
WL3: Temporal demands: How 'rushed' was your work pace for this assignment? How much time pressure did you experience?	.677			
WL4: Effort: How hard did you have to work to obtain your level of achievement?	.804			
WL5: Frustration: How insecure, discouraged, irritated, stressed or annoyed did you feel while undertaking this task?	.703			
WL6: I found it a hard task.	.876			
TC1: I've undertaken similar tasks in the past. I was familiar with the design of the task.		.922		
TC2: I had too little information, information resources and aids at my disposal while completing this task.				.741
TC3: There were multiple possible ways to come to a solution for this task.			.998	
TC4: There remains an insecurity about the solution to this task.	.561			
TC5: I found it a difficult task.	.869			
TC6: The task wasn't completely unknown to me, I've undertaken similar tasks in the past.		.983		
TC7: I could have solved the task in a different way than the way I have used.			.733	
TC8: I found it a complicated task.	.731			
TC9: The information resources were difficult to access.				.675

Rotation: Varimax with Kaiser Normalization