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Effects of motivation, evaluativism and perceived social support on deep approach to learning at university

Abstract: Previous research has shown that motivation, epistemic beliefs and perceived social support each have an effect on the way students engage in their learning and can promote a deep approach. The first aim of this study was to measure and compare these effects. Some authors have argued that epistemic beliefs and perceived social support do not have a direct effect on approach to learning, but that this effect is mediated by motivation. The second aim of this study was to examine this hypothesis and, more specifically, to determine the extent to which the effects of evaluativist epistemic beliefs and perceived social support promote a deep approach to learning directly or indirectly through self-determined and controlled motivation. We adopted a cross-sectional study design and focused on the first year of university. This study is based on the responses of 2168 French first-year university students to a questionnaire. Linear regression shows that the strongest factor predicting a deep approach to learning is self-determined motivation, followed by evaluativism, and that the weakest factor is perceived social support, which is nevertheless a significant factor. Controlled motivation was found to have a weak negative effect. Mediation analyses, with self-determined motivation as a mediator, show the existence of both direct and indirect significant effects of evaluativism and perceived social support on deep approach to learning. These findings have important educational implications in that they help to identify key levers that teachers can activate to engage their students in deeper learning.

Keywords: learning approach; motivation; epistemic beliefs; social support; higher education

Introduction

A major challenge for higher education is to guide students who enter university towards a deep approach to learning, so that they consider academic knowledge in a critical, integrative and reflective way (Entwistle, 2009; Nelson Laird et al., 2008; Ramsden, 2003). For this reason, a number of studies have been conducted to identify the factors that may favour such an approach (Baeten et al., 2010; Hailikari & Parpala, 2014). In particular, research has highlighted close links between the deep approach to learning and other psycho-cognitive dimensions that describe students' relationships with learning and knowledge: motivation taken in its intrinsic forms, and epistemic beliefs that define an evaluativist profile (hereafter "evaluativism"). Because of these close links, these three dimensions have sometimes been combined conceptually to form a complex construct (Schommer-Aikins, 2004). The conceptual framework for describing the process by which students engage in their learning becomes even more complex when we consider its social dimension. To some extent, this social dimension can be captured by the perceived social support, which has also found to correlate with students' approach to learning (Dupont et al., 2015).

The aim of this study is to better understand how these multiple dimensions are related among first-year university students. This first year of university is particularly difficult for students, who are known to be at risk of failing their exams and dropping out (Fokkens-Bruinsma et al., 2021). They have to face a challenging transition from high school to higher education. This transition implies a new way of thinking (Entwistle 2009), of understanding, experiencing, and conceptualizing the world (Ramsden 2003). Students must undergo an intellectual, methodological and sociological metamorphosis in order to succeed in their first year (Paivandi, 2015). In this regard, one of the issues for students is that their approach to learning evolves to become deeper. Investigating the

links of the deep approach to learning with motivation, evaluativism, and perceived social support may be useful in order to better support students in their first year. We argue that in order to determine the respective roles of the different dimensions in the development of a deep approach to learning, these dimensions deserve to be clearly distinguished at the conceptual and methodological levels. The present study consisted first in defining these different dimensions and then in including them in a unique survey administered to first-year university students. Such a study has potentially important educational implications in that it can help teachers to identify the key levers that they should activate in order to engage their students in deeper learning.

Approach to learning

Broadly speaking, *approach to learning* can be defined as 'the ways in which students go about their academic tasks' (Biggs, 1994, p. 319). More precisely, it is a complex construct that includes two components: students' motivation to engage in a learning task, and the way they are actually engaging in the learning task. Conceptually, it is justified to combine these two components, as *motivation* can be understood as an internal force that gives *engagement* its intensity and direction (Reeve, 2012).

A body of research has highlighted the existence of three well identifiable approaches to learning: deep, surface and strategic approaches (Biggs & Tang, 2011; Entwistle et al., 2013). Deep and surface approaches are generally considered to be mutually exclusive (Diseth & Martinsen, 2003). In essence, *deep approach* combines intrinsic motivation for the learning task with a strong cognitive engagement into this task consisting in relating the various contents of knowledge being taught so as to better understand them. As for the *surface approach*, it combines extrinsic motivation with a shallow cognitive engagement consisting of simply memorizing as much knowledge contents as possible. More recently, both surface and deep approaches to learning have been described in more

details (Lindblom-Ylänne et al., 2019; Nelson Laird et al., 2008). Two main discriminating features have been highlighted. Students with a deep approach try to relate the different pieces of knowledge such as facts, concepts, models or formulae (integrative approach), and tend to question the learning tasks and self-evaluate the way they are processing them (reflective approach). In contrast, students with a surface approach tend to learn the different pieces of knowledge without considering their relationships (fragmented approach), and without questioning the learning tasks or self-evaluating the way they are processing them (unreflective approach). The strategic approach is not directly opposed to the surface or the deep approach: it combines a form of extrinsic motivation focused on achieving exams with a systematic organization of studying (Entwisle, 2009).

The existence of these three approaches which combine specific forms of motivation with specific forms of cognitive engagement in learning tends to justify empirically the linking of the two dimensions to form a single construct, namely approach to learning. However, from a theoretical point of view, it remains possible to imagine other conceptual combinations of motivations and cognitive engagements in learning. As Chiou et al. (2012, p. 171) have suggested, 'an individual may have a deep, intrinsic motivation, while adopting a surface, rote process to tackle a specific task.' Indeed, some alternative profiles have been identified empirically (Godor, 2016).

Other research has examined cognitive engagement as a dimension distinct from motivation and as part of a multidimensional construct that includes other forms of engagement, that is, behavioural, emotional, and agentic (Reeve, 2012; Sinatra et al., 2015). This research provides a conceptual framework that separates motivation from engagement and allows for the study of their respective relationships with other dimensions, such as self-efficacy (Greene, 2015). In addition, by distinguishing

motivation from cognitive engagement, it is possible to use a more refined construct for motivation.

Motivation

Based on many empirical studies of motivation, the self-determination theory (SDT) developed by Ryan and Deci (2000, 2020) provides an elaborate description of this construct. It refines the classic distinction between *intrinsic motivation*, which describes spontaneous interest in the activity due to the inherent satisfaction of doing it, and *extrinsic motivation*, where interest is conditioned by external consequences of doing the activity such as rewards or punishments. Ryan and Deci (2000, p. 55) stress that there are two very different forms of extrinsic motivation: 'students can perform extrinsically motivated actions with resentment, resistance, and disinterest or, alternatively, with an attitude of willingness that reflects an inner acceptance of the value or utility of a task.' In the second case, students internalize extrinsic reasons for engaging in an activity and associate a sense of volition with them. The more extrinsic motivations are internalized, the more individuals are self-determined in their behaviours. Several forms of extrinsic motivation have thus been distinguished according to their location on a self-determination continuum: *external*, *introjected*, and *identified regulation*.

Intrinsic motivation can also be seen as taking many forms. Vallerand and his colleagues (Carbonneau et al., 2012; Vallerand et al., 1992) have proposed to distinguish three sub-categories: intrinsic motivation *to know* (i.e., to experience pleasure while learning and trying to understand something new during the activity), *to accomplishment* (i.e., to experience pleasure in surpassing oneself in the activity), and *to stimulation* (i.e., to get sensations and excitement during the activity). The multiple forms of intrinsic and extrinsic motivation can be associated in the framework of SDT to provide a construct

that allows for a more detailed study of students' motivation and the identification of more specific profiles.

Various studies have shown that the distinction between intrinsic and extrinsic motivation is not clear-cut. Moderate positive correlations have been observed between intrinsic motivation and different forms of extrinsic motivation (Chue & Nie, 2016). Moreover, various motivational profiles have been found that correspond to associations of more or less high levels of both intrinsic and extrinsic forms of motivation (Ratelle et al., 2007; Cassignol et al., 2019).

In turn, these results question the idea of a sharp distinction between deep approach to learning, involving intrinsic motivation, and surface approach to learning, involving extrinsic motivation. They provide an additional reason to remove motivation from the approach to learning construct, and to reduce the latter to cognitive engagement. By making this split, it becomes possible to study which forms of intrinsic and extrinsic motivation have a stronger relationship to deep approach or to surface approach.

Epistemic beliefs

Moreover, students' reported approach to learning appears to be closely related to their epistemic beliefs (Chiu et al., 2016; Dahl e al., 2005; Lehmann, 2022; Lin et al., 2012). Early studies of epistemic beliefs intended to bring to light schemes of developmental stages encapsulating as a coherent whole their beliefs about knowledge and learning, and how they engage in learning (e.g., Baxter Magolda, 1992). The fact that epistemic and learning beliefs are both of the same nature (i.e., beliefs) has been a reason for bringing them together and to understand them as part of a belief system (Schommer, 1990). More fundamentally, according to Baxter Magolda (2004), these two types of beliefs are intertwined and for this reason should be associated in a single construct. In fact, they have been implemented jointly in several questionnaires presented as dealing with

epistemic beliefs, some of which including also insidiously questions related to the approach to learning, for example: 'When I study, I look for specific facts' (Wood & Kardash, 2002).

However, as Hofer and Pintrich (1997, p. 116) point out, learning beliefs 'do not explicitly deal with the nature of knowledge or knowing in terms of how knowledge is defined and justified as most philosophical and psychological treatments have defined this domain.' For conceptual clarity, learning beliefs should therefore not be included in the *epistemic beliefs* construct, which can be defined as 'beliefs on the nature of knowledge and the processes of knowing' (Hofer & Pintrich, 1997, p. 117). Distinguishing epistemic beliefs from learning beliefs, and thus also from approach to learning, does not mean that these constructs are independent of each other. Rather, this distinction provides a clear conceptual framework for studying the links between these constructs, and between each of these constructs taken in isolation and other constructs, such as motivation or self-regulated learning (Hofer & Pintrich, 1997; Schommer-Aikins, 2004).

Putting aside learning beliefs and approach to learning, Kuhn and her colleagues (Kuhn et al., 2000) have proposed to distinguish three main levels of epistemic beliefs development, which overlap to a large extent with the main stages identified in previous fine-grained qualitative studies: *absolutism* (i.e., individuals consider knowledge to be objective unshakeable truths and therefore always certain), *multiplism* (i.e., individuals view knowledge as subjective and fully uncertain, and assign to it the status of personal opinions which are freely chosen by individuals), and *evaluativism* (i.e., individuals admit both objective and subjective aspects of knowledge and consider that, to some extent, there are uncertainties, but these can be reduced by means of investigations and balanced evaluations).

Each of these stages can be described using the four dimensions proposed by Hofer and Pintrich (1997), which also exclude learning beliefs and approach to learning. Two dimensions concern the nature of knowledge: *certainty of knowledge* (i.e., from knowledge seen as absolute truth, being therefore certain, to knowledge viewed as evolving over time, and hence remaining uncertain to some extent) and *simplicity of knowledge* (i.e., from knowledge conceived of as an accumulation of facts to knowledge conceived of as an interdependent set of relative, contingent and contextual concepts). The other two dimensions are concerned with the process of knowing: *source of knowledge* (i.e., from the view of knowledge as residing outside the self and transmitted from external authorities to the view that oneself actively participates to the construction of knowledge) and *justification for knowing* (i.e., from the view that a knowledge claim is justified if based on an authority or a raw observation to the view that it is justified on the basis of an inquiry and a balanced evaluation). In each of these dimensions, the different beliefs can be seen from a developmental perspective, that is, as progressing towards the most expert beliefs which correspond to evaluativism.

Social support

How students engage in learning is also influenced by their social interactions at the university and outside. One way to capture this influence is through the notion of *perceived social support*. This construct describes the social resources that individuals perceive as being available (Sarason et al., 1983) and providing them with assistance in the face of difficulties they may encounter (Dorard et al., 2013). Different types of support can be distinguished, such as material aid, information provision, guidance, advice, feedback, esteem, or emotional sustenance (Malecki & Demaray, 2005). Moreover, different sources of support can be distinguished, such as family, friends, or colleagues, which constitute the social network of individuals (Malecki & Demaray, 2005). In the

school or university context, teachers are of course another important source of support. Several studies have shown that perceived support from family, peers and teachers promote students' motivation and their engagement in learning activities (Dupont et al., 2015).

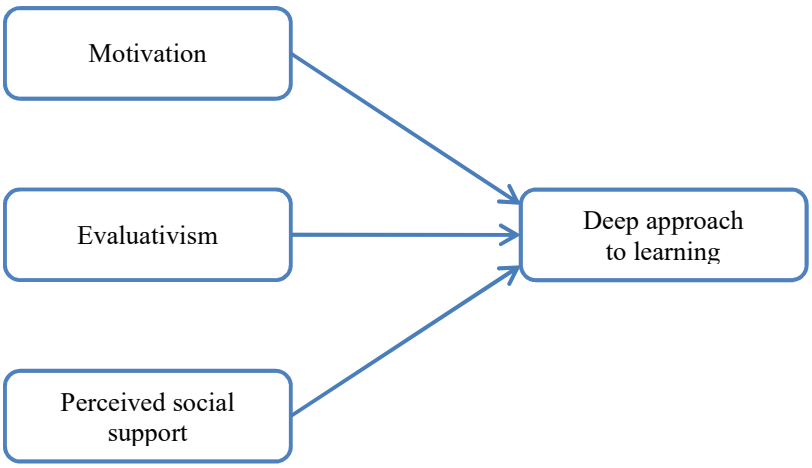
One could also identify in the approach to learning itself a social dimension. Indeed, students engage in learning tasks by interacting to a greater or lesser extent with their peers and teachers. Through these interactions, they may seek to better understand the content being taught, whether by asking for further explanations about that content, by confronting their ways of understanding it, or by critically discussing it. Accordingly, the way in which students tend to interact with other students and/or with teachers can be seen as a constitutive part of the approach to learning. In fact, some of the questionnaires used to study the approach to learning include items relating to such social interactions (e.g., 'Discussed ideas from your readings or classes with others outside of class [students, family members, coworkers, etc.]'; Nelson Laird et al., 2008, p. 478).

Possible models and research questions

In this study, motivation, epistemic beliefs, and perceived social support have been conceived as constructs that are related to, but conceptually distinct from, approach to learning. Taken together, these four dimensions allow considering students as complex individuals. To better understand how they engage in their learning, the links between these dimensions need to be clarified. Different models of these links are possible. We assume here a normative perspective on the approach to learning, motivation, and epistemic beliefs by considering the ideal toward which students should strive in university: students should be in a deep approach to learning, be motivated, and have evaluativist epistemic beliefs. This normative perspective guides the theoretical and methodological choices that follow.

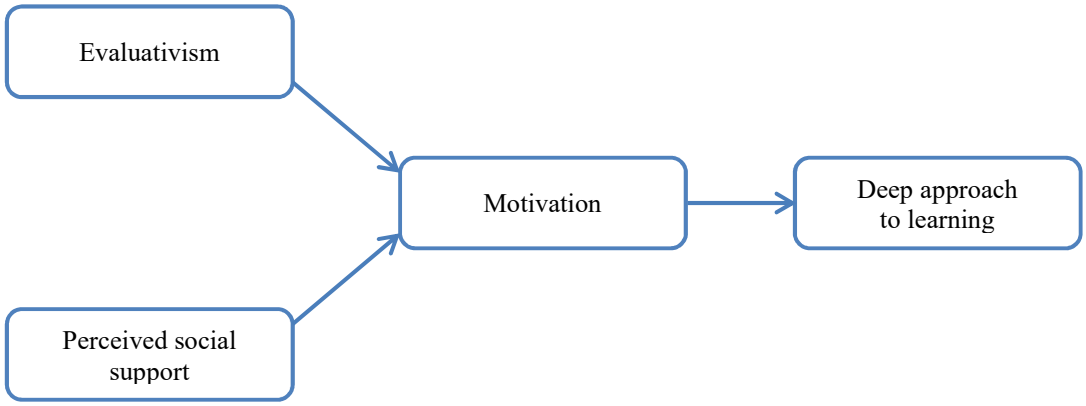
In the literature, at least three different models have been proposed to describe the links between the four dimensions considered in this study, namely motivation, evaluativism, perceived social support and deep approach to learning. A first model, labelled A, consists of describing motivation, evaluativism, and perceived social support as independent factors, each of which has a direct influence on deep approach to learning which may be more or less deep (Figure 1). Several descriptions of such direct relationships have been proposed. Regarding the influence of motivation on deep approach to learning, Biggs (1987, p. 9) explains that 'students who are intrinsically motivated tend to extract most meaning from their learning; they read widely, relating new content to what they already know.' With respect to the influence of evaluativism on deep approach to learning, Muis (2007, p. 181) points out that the more students believe knowledge is 'integrated and organized as complex networks,' the more they tend to 'construct connections between pieces of information.' Concerning the influence of perceived social support on deep approach to learning, Eley (1992, p. 250) stresses that the more students perceive teachers' support for their learning 'as explicitly focusing on the mental processing' or 'as emphasizing a capacity for independent learning,' the more likely they report 'deeper approaches to study.'

Figure 1. Model A with direct effects on deep approach to learning



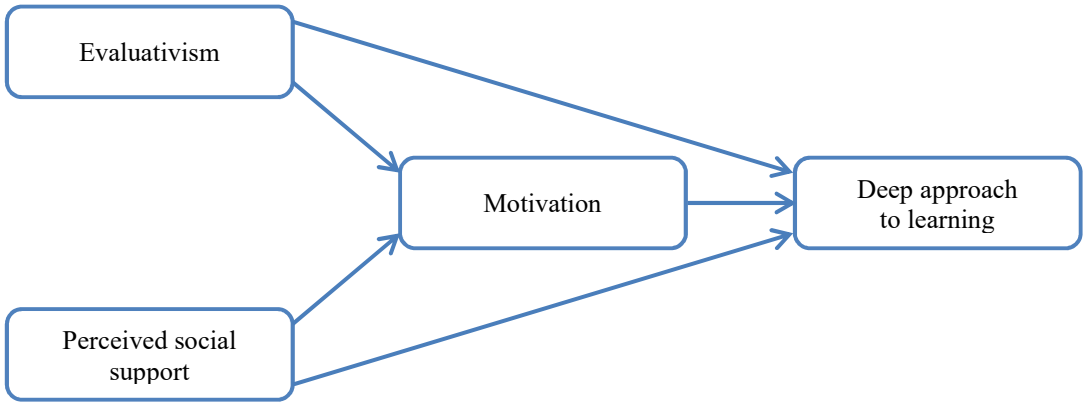
According to a second model, labelled B, motivation plays a central role as a mediator between evaluativism and perceived social support on the one hand, and deep approach to learning on the other (Figure 2). According to Entwistle and Peterson (2004), epistemic beliefs (dualistic or relativistic) influence motivation (extrinsic or intrinsic respectively) which in turn influences the approach to learning (surface or deep respectively). Similarly, according to several authors (Appleton et al., 2008; Dupont et al., 2015; Skinner et al., 2008), perceived social support influences motivation, which in turn influences engagement in learning.

Figure 2. Model B with indirect effects on deep approach to learning



In a meta-analysis, Baeten et al. (2010) used a model with a structure similar to that of model A to explore a large number of factors that promote deep approach to learning, including supportiveness of the teacher and motivation. However, they believe that reality is not so simple and that these factors may be interrelated. Following this line of thinking, a more complex model, labelled C, can be proposed that accounts for both direct and indirect effects (Figure 3).

Figure 3. Model C with both direct and indirect effects on deep approach to learning



Each of the three models, A, B and C, is potentially operative and may shed light on how students engage in their learning. The advantage of model A is that it makes it possible to identify in a simple way the different factors that promote a deep approach to learning and to determine their respective contributions. In other words, this model provides a guide for comparing the effect of these factors. It leads to the formulation of the following research question:

- RQ1: What are the relative effects of motivation, evaluativism, and perceived social support on deep approach to learning?

Models B and C consider the possibility of more complex relationships between the four variables under consideration, with potential mediating effects of motivation. They lead to the formulation of a second research question:

- RQ2: To what extent are the effects of evaluativism and perceived social support on deep approach to learning mediated by motivation?

Models B and C are based on different hypotheses: model B assumes that the effects of evaluativism and perceived social support on deep approach to learning are fully mediated by motivation; model C assumes that these effects are only partially mediated by motivation. Exploring RQ2 allows us to test both models and determine which one best fits the data.

Methodology

Participants and procedure

A cross-sectional study design was adopted. The participants were first-year students at a multidisciplinary university in the south of France welcoming a total of over 45,000 students. The first year of university is a year of transition during which many students find themselves in a position of failure. In France, about half of students do not complete their first year (Ménard, 2021). The question of their success is a major issue for the university institution. This justifies the choice to focus the study on the approach to learning of first-year students. This study is based on a questionnaire which was administered electronically three months after the start of students' first year of study. The questionnaire was submitted to 7301 students involved in ten different training programs, in science and/or social sciences. Prior to completing the questionnaire, all participants provided informed consent in compliance with the European General Data Protection Regulation (EU) 2016/679 and under the supervision of the Data Protector Officer of the university. 2168 students completed the questionnaire and could be considered in the study. The response rate of 29.7% can be considered relatively good compared to other studies based on online-questionnaires (Van der Zanden et al., 2019). Participants had a mean age of 18.5 (SD = 1.30) with 58.9% being females. The comparison between the sample of respondents and the total population surveyed shows some differences: respondents are marginally younger, female respondents are slightly overrepresented, and respondents' average high school mark is slightly better (see Tables S1 to S4 in the Supplemental materials).

Measures

The questionnaire, called 'DMEP' (for Deep approach to learning, Motivation, Evaluativism and Perceived social support),' was composed of 50 close-ended questions, some of which were adapted from the literature, while others were created by the researchers who conducted this study (for the complete questionnaire, see Tables S5 to S8 in the Supplemental materials). For items related to deep approach to learning, motivation, and evaluativism, students were asked to respond on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Deep approach to learning

In this study, the approach to learning refers to how students cognitively engage with their learning tasks. Motivation is not included in this construct. *The scale of deep approach to learning* is based on four subscales with a total of thirteen items (McDonald's $\omega = .87$). The literature review presented above has led us to identify two important subscales that are associated with the cognitive dimension of the learning approach. The first cognitive subscale measures the *integrative approach* ($\omega = .80$). It consists of five items. Three items, taken from the Biggs et al. (2001) and Entwistle et al. (2013) questionnaires, focus on the connections that students seek to make between the knowledge they acquire in different courses (e.g., 'Whenever possible, I try to relate new ideas presented in the course to those previously presented in the same course or in other courses'). Two new items have been created in this study to describe connections that students seek to draw between knowledge and new situations (e.g., 'I usually try to apply what I learn in courses to many new situations'). These two items supplement the previous questionnaires by better reflecting the aims of today's university education. The second cognitive subscale measures the *reflective approach* ($\omega = .69$). It is composed of four items also taken from the questionnaires of Biggs et al. (2001) and Entwistle et al. (2013) (e.g., 'Before tackling

a problem or task, I first seek to clarify the objectives'). Two additional subscales were created in this study to incorporate the social dimension of the approach to learning. The first, *interactions-with-peers approach* (Cronbach's $\alpha = .86$), measures students' tendency to interact with peers to learn deeply, and is based on two items (e.g., 'I often seek to discuss the content seen in courses with other students to better understand it'). The second, *interactions-with-teachers approach* ($\alpha = .80$), measures their tendency to interact with teachers to learn in depth, and is also based on two items (e.g., 'During or after the course, I try to discuss with the teacher the origin or the limits of the content being taught'). All items were formulated in French. The understanding of the new items was tested on the basis of semi-structured interviews with five students. Initially, the deep approach to learning scale consisted of 20 items. A first test with 648 students was carried out. The ω values led to the removal of two items from the integrative approach subscale and one item from the reflective approach subscale, and to revise one item of the interaction approach subscale. In a second test with 130 students, the reliability coefficient values were satisfactory, close to those obtained with the sample of the study (i.e., $\omega = .86$ for deep approach to learning, $\omega = .77$ for integrative approach, $\omega = .69$ for reflective approach, $\alpha = .86$ for interactions-with-peers approach, $\alpha = .81$ for interactions-with-teachers approach).

Motivation

Student motivation was measured by means of the Vallerand et al. (1989) scale, in line with SDT. This scale was adapted to the university context. It is based on seven subscales, each composed of four items answering a common general question ('Why do you study at the university?), giving a total of twenty-eight items: *intrinsic motivation to know* ($\omega = .88$) (e.g., 'Because I find pleasure and satisfaction in learning new things'), *to*

stimulation (ω = .83) (e.g., 'For the intense moments I experience when I communicate my own ideas to others'), *to accomplishment* (ω = .87) (e.g., 'For the pleasure I feel in surpassing myself in my studies'), *identified extrinsic motivation* (ω = .80) (e.g., 'Because I believe graduate school will help me better prepare for the career I chose.'), *introjected extrinsic motivation* (ω = .83) (e.g., 'To prove to myself that I am capable of having more than a high school degree'); and *external extrinsic motivation* (ω = .80) (e.g., 'Because just with a high school degree, I will not be able to find a job that pays enough'). According to SDT, these different forms of motivation are distributed on a self-determination continuum, that is, some are more self-determined and others more controlled. According to a conventional separation line on this continuum (Ratelle et al., 2007), we can distinguish the *self-determined motivation* scale, composed of the items of intrinsic motivation to know, to stimulation, and to accomplishment, and identified extrinsic motivation (ω = .92), and the *controlled motivation* scale, composed of the items of introjected and external extrinsic motivation (ω = .83). The scale of Vallerand et al (1989) is composed of items already formulated in French. The first test with 648 students confirmed the good reliability of the scales and subscales (i.e., with ω values ranging from .77 for identified extrinsic motivation, to .86 for intrinsic motivation to accomplishment)

Evaluativism

The scale of *evaluativism* is based on four items (ω = .62). These items correspond to the four dimensions of epistemic beliefs distinguished by Hofer and Pintrich (1997). The first item was adapted from Barzilai & Weinstock (2015), the other three were created in the context of this study to correspond as closely as possible to the meaning of the dimensions as defined by Hofer and Pintrich (1997): *certainty* ('According to you, the knowledge we

learn at the university is never completely certain but it tends to evolve constantly'), *complexity* ('According to you, the knowledge we learn at the university connects ideas and facts in a consistent manner'), *source* ('In the frame of my training at the university, I evaluate the different sources of information to know which ones I can trust), and *justification* ('In the frame of my training at the university, I believe an information after analysing what it is based on'). All items were formulated in French and their understanding was also tested on the basis of semi-structured interviews with five students. A relatively low ω value led us to revise the items and test them twice with 130 and 201 students respectively. These revisions did not result in higher ω values. The relatively low ω value obtained in this study is consistent with the low reliability coefficient values found in other studies, such as the three studies reported by DeBacker (2008), all of which include several scales with an alpha below .7 and sometimes as low as .4. Such values can be explained by the fact that an individual's beliefs about different aspects of knowledge (i.e., certainty, complexity, source, and justification) may be to some extent independent (Schommer, 1990) and therefore generally do not form a coherent system.

Perceived social support

With respect to perceived social support, we created items to measure both the size of the social network for different types of support and the relative importance of various sources of support. Five types of support were distinguished and for each type, the size of the network was defined by a score equal to the number of sources selected (from a choice of predefined sources): *material support* ('In case of material or financial difficulties during your studies at the university, who can you count on?'), *learning support* ('In your training, who can you count on to help you learn better?'), *course guidance support* ('To better understand how the university and degrees work, who

provides you with assistance?'), *confidence support* ('In your studies, who can you count on for your confidence?'), *project support* ('To build up your personal and professional project, who supports you?'). The mean of the scores on these five scales was used to construct a more general scale of *mean support* ($\omega = .84$). The ranking of the different sources selected for each type of support also allowed for the construction of scales of the relative importance of four different sources: *family*, *peers*, *teachers*, and *university services support*. The first test with 648 students confirmed the good reliability of the mean support scale (i.e., $\alpha = .80$).

Data analysis

As a preliminary step, a data cleaning was carried out and consisted of removing from the study all students (956) for whom there were missing data, i.e. incomplete answers to the questionnaire, or problematic outliers, i.e. repetitive and inconsistent answers.

To investigate the relative effects of motivation, epistemic beliefs and perceived social support on deep approach to learning (RQ1), we assumed Model A and performed three statistical analyses. First, Pearson correlations were calculated between deep approach to learning and its sub-dimensions on the one hand, and all the other variables of the study on the other. Second, a linear regression was performed to predict deep approach to learning as a function of self-determined motivation, controlled motivation, evaluativism, and mean support. To go into more detail, a second regression was conducted to predict deep approach as a function of the twenty variables corresponding to all the sub-dimensions of these dimensions. A backward method was used in this case. This method consists of starting with the full model which includes all the variables under consideration, then successively eliminating the least significant variable, namely the one with the highest *p*-value, until all the remaining variables have a *p*-value lower than a given threshold, in our case taken as .05.

Several analyses and tests were carried out to verify the hypotheses allowing the two linear regressions to be conducted (see Figures S1 to S4 and Tables S9 to S12 in the Supplemental materials). The plots of the residuals against the predicted values and against each covariate do not exhibit a quadratic trend, suggesting that a linear model is appropriate. These plots also show homogeneous distributions around a horizontal line, consistent with the homoscedasticity hypothesis. The histograms of the residuals and the density curves show that the residuals follow a centred normal distribution. Normality is confirmed by the Lilliefors and Anderson-Darling tests. The centred distribution is validated by the Student test. The Durbain-Watson test confirms the independence of the residuals. The variance inflation factor of the covariates does not exceed 3 and ranges between 1 and 1.5 for most covariates, indicating that there is no multicollinearity.

To investigate the mediating role of motivation between epistemic beliefs and perceived social support on the one hand, and approach to learning on the other (RQ2), we considered both Model B and Model C, and conducted two mediation analyses. Self-determined motivation was taken as the mediator and deep approach to learning as the outcome.

All of these statistical analyses were performed using JASP software (Version 0.14.1 running with R).

Results

Predicting deep approach

Pearson's correlations between deep approach and the other dimensions, as well as between their respective sub-dimensions are presented in Table 1 (for descriptive statistics and the full correlation matrix, see Table S13 in the Supplemental materials).

All correlations are positive and significant with one exception, namely the one involving family support.

Table 1. Pearson's correlations between deep approach and the other variables.

Variable	Deep approach to learning	Integrative approach	Reflective approach	Interactions-with-peers approach	Interactions-with-teachers approach
Self-determined motivation	0.651***	0.615***	0.558***	0.397***	0.385***
Controlled motivation	0.220***	0.189***	0.203***	0.139***	0.142***
Intrinsic motivation to know	0.580***	0.560***	0.527***	0.333***	0.306***
Intrinsic motivation to stimulation	0.577***	0.551***	0.455***	0.351***	0.387***
Intrinsic motivation to accomplishment	0.533***	0.501***	0.461***	0.309***	0.332***
Identified extrinsic motivation	0.413***	0.375***	0.368***	0.300***	0.203***
Introjected extrinsic motivation	0.278***	0.249***	0.246***	0.167***	0.182***
External extrinsic motivation	0.075***	0.053*	0.081***	0.057**	0.045*
Evaluativism	0.475***	0.479***	0.443***	0.237***	0.234***
Certainty	0.200***	0.216***	0.183***	0.090***	0.086***
Complexity	0.355***	0.356***	0.348***	0.177***	0.155***
Source	0.372***	0.362***	0.345***	0.201***	0.194***
Justification	0.367***	0.372***	0.333***	0.176***	0.198***
Mean support	0.167***	0.122***	0.109***	0.186***	0.122***
Material support	0.073***	0.062**	0.058**	0.068**	0.036
Learning support	0.143***	0.104***	0.093***	0.156***	0.109***
Course guidance support	0.138***	0.101***	0.098***	0.151***	0.091***
Confidence support	0.146***	0.088***	0.089***	0.197***	0.114***
Project support	0.158***	0.122***	0.092***	0.166***	0.127***
Family support	0.023	1.402e-4	0.024	0.065**	–0.007
Peers support	0.140***	0.076***	0.064**	0.269***	0.066**
Teachers support	0.242***	0.161***	0.145***	0.241***	0.255***
University services support	0.113***	0.117***	0.111***	0.058**	0.039

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

There is a strong positive correlation of deep approach with self-determined motivation, but also a positive, though weaker, correlation with controlled motivation. Self-determined and controlled motivation are positively correlated with each other.

Comparing the correlations of deep approach with the different forms of motivation defined along the increasing self-determination continuum of SDT, we observe increasing *r* values. The correlation of deep approach with evaluativism is also positive and with a relatively high value. The correlation with mean support is positive and significant, but lower. The correlations with the different types and sources of perceived social support are all positive and significant, except in the case of family support. The correlation is highest for teachers support.

The outcomes of the linear regression predicting deep approach to learning as a function of self-determined motivation, controlled motivation, evaluativism, and mean support, are presented in Table 2. This regression (*Adj.* $R^2 = .473$) shows the relative effects on deep approach of self-determined motivation, evaluativism, and mean support, which are strong ($\beta = .587$), moderate ($\beta = .221$), and weak ($\beta = .051$) respectively. In addition, controlled motivation displays a weak negative effect ($\beta = -.097$).

Table 2. Linear regression for the prediction of deep approach as a function of four major variables of the study.

Adj. R^2	*F*	*p*	Outcome	Predictors	Stand. coef. β	*t*	*p*
0.473	488	< .001	Deep approach to learning	Self-determined motivation	0.587	30.0	< .001
				Evaluativism	0.221	12.6	< .001
				Controlled motivation	–0.097	–5.48	< .001
				Mean support	0.051	3.25	0.001

The outcomes of the backward regression predicting deep approach to learning as a function of the specific variables of the study which measure the sub-dimensions of the main dimensions is presented in Table 3. Backward analysis stopped with model 8 (*Adj.* $R^2 = .489$), which contains twelve variables among the twenty considered at the outset. This model shows that, among the forms of motivation, intrinsic motivation to stimulation ($\beta = .249$) has the largest effect. Among the sub-scales of evaluativism, it is

observed that the most important are source (β = .130) and justification (β = .107). It also appears that teachers support (β = .089) and peers support (β = .066) have the most effect among all sources of support, and that no type of support, considered in isolation, has a significant effect.

Table 3. Backward regression for the prediction of deep approach as a function of twenty specific variables of the study.

Model	*Adj. R²*	*F*	*p*	Outcome	Predictors	Stand. coef. β	*t*	*p*
1	0.488	106	< .001	Deep approach to learning	Intrinsic motivation to stimulation	0.245	10.98	< .001
					Intrinsic motivation to know	0.180	752	< .001
					Intrinsic motivation to accomplishment	0.168	6.29	< .001
					Source	0.130	7.20	< .001
					Justification	0.106	5.78	< .001
					Identified extrinsic motivation	0.097	4.66	< .001
					Teachers support	0.085	4.35	< .001
					Introjected extrinsic motivation	–0.069	–3.18	0.001
					Peers support	0.067	3.46	< .001
					Complexity	0.043	2.37	0.017
					Certainty	0.040	2.45	0.013
					University services support	–0.040	–1.88	0.053
					Family support	–0.022	–1.22	0.223
					Learning support	0.016	0.68	0.456
					External extrinsic motivation	–0.015	–0.81	0.424
					Project support	0.011	0.49	0.615
					Material support	–0.008	–0.41	0.685
					Course guidance support	–0.007	–0.28	0.792
					Confidence support	–0.003	–0.12	0.888
8	0.489	174	< .001	Deep approach to learning	Intrinsic motivation to stimulation	0.249	11.24	< .001
					Intrinsic motivation to know	0.184	7.82	< .001
					Intrinsic motivation to accomplishment	0.168	6.32	< .001
					Source	0.130	7.21	< .001
					Justification	0.107	5.87	< .001
					Teachers support	0.089	5.34	< .001
					Identified extrinsic motivation	0.088	4.64	< .001

Introjected extrinsic motivation	–0.074	–3.59	< .001
Peers support	0.066	4.11	< .001
Complexity	0.041	2.29	0.022
Certainty	0.039	2.42	0.016
University services support	–0.038	–2.34	0.019

Four additional backward regressions were run with the same twenty-one specific variables to predict each of the four variables measuring the sub-dimensions of deep approach: integrative, reflective, interactions-with-peers, and interactions-with-teachers approaches (see Tables S14 in the Supplemental materials). These regressions show that no type and no source of social support have a significant effect on integrative and reflective approaches. In contrast, two sources of social support have a relatively large significant effect for the other two sub-dimensions: peers support for interactions-with-peers approach ($\beta = .236$) and teachers support for interactions-with-teachers approach ($\beta = .200$).

Mediating role of motivation

The results presented above show that self-determined motivation has a strong effect on deep approach, unlike controlled motivation. For this reason, we can assume that if motivation has a mediating role between the other dimensions and deep approach, it is more precisely self-determined motivation that plays this role. We performed two separate mediation analyses with self-determined motivation as the mediator and deep approach as the outcome. In the first analysis, evaluativism was taken as the predictor (Table 4). The data show that both direct and indirect effects are significant and are of the same magnitude (resp. $\beta = .229$ and $\beta = .253$).

Table 4. Standardized estimates of the direct and indirect effects of evaluativism on deep approach, with self-determined motivation as a mediator.

	Stand. estimate β	***z-value***	***p***	**95% confidence interval**	
				Lower	***Upper***
Evaluativism → Deep approach	0.229	12.8	< .001	0.194	0.265
Evaluativism → Self-determined motivation → Deep approach	0.253	18.9	< .001	0.227	0.280

In the second analysis, mean support was taken as the predictor (Table 5). The data show that both the direct and indirect effects are very small but significant, and that the indirect effect (β = .074) is larger than the direct effect (β = .046).

Table 5. Standardized estimates of the direct and indirect effects of mean support on deep approach, with self-determined motivation as a mediator.

	Stand. estimate β	***z-value***	***p***	**95% confidence interval**	
				Lower	***Upper***
Mean support → Deep approach	0.046	3.91	< .001	0.023	0.070
Mean support → Self-determined motivation → Deep approach	0.074	7.44	< .001	0.055	0.094

Discussion

What are the relative effects on deep approach? (RQ1)

Previous studies have shown that motivation, evaluativism, and perceived social support are three dimensions that each has an influence on the approach to learning (Baeten et al., 2010; Dupont et al., 2015; Schommer-Aikins, 2004). The first aim of this study was to go beyond these initial results and compare the respective influence of these three dimensions. We assumed Model A and compared the relative effect of self-determined

motivation, controlled motivation, evaluativism, and mean support on deep approach to learning. The results were obtained from a large sample of first-year students involved in different training programmes at a university in the south of France. They show that the strongest factor is self-determined motivation, followed by evaluativism, and that the weakest factor is mean support.

The fact that self-determined motivation is the strongest factor seems consistent, to some extent, with previous studies that associate intrinsic motivation with deep approach (Biggs & Tang, 2011; Entwistle et al., 2013). Similarly, the fact that controlled motivation has a negative effect seems consistent, to some extent, with these same studies that associate extrinsic motivation with surface and strategic approaches. However, the dichotomy between self-determined and controlled motivation (as well as between intrinsic and extrinsic motivation) needs to be qualified, as these two broad forms of motivation are positively correlated with each other but also with deep approach to learning. Regression analysis provides a better understanding of these different relationships by considering them jointly, and shows that for a given self-determined motivation, controlled motivation has a negative effect on deep approach to learning. Furthermore, self-determined motivation is not identical to intrinsic motivation as it includes identified extrinsic motivation. According to our study, this form of extrinsic motivation has a positive effect on deep approach, unlike the other two forms of extrinsic motivation. The decomposition of motivation into several forms of extrinsic motivation according to SDT allows for a finer understanding of the relationship with deep approach: the higher the form of extrinsic motivation on the self-determination continuum, that is, the more internalised the motivation, the stronger its correlation with deep approach. This result is consistent with a previous study (Chue & Nie, 2016).

Furthermore, the sub-dimensions of evaluativism that have greatest effect on deep approach to learning, and especially on the integrative approach, are source and justification. We did not find the pattern pointed out by Muis (2007) between complexity and integrative approach. This outcome may be explained by the fact that source and justification concern the process of knowledge construction and validation, and are therefore conceptually closer to the learning process than certainty and complexity which concern the status of already available knowledge (Hofer, 2004).

Regarding the relationship between perceived social support and deep approach, the study shows that teachers and peers are the only sources of support to have a significant effect, albeit a very small one. This result could be explained by the fact that teachers and peers are direct interlocutors with whom students can engage in learning. Looking at the different sub-dimensions of deep approach, it appears that peers support has a relatively strong effect on interactions-with-peers approach, and teachers support on interactions-with-teachers approach. This result shows the importance of the availability of these sources of support: the more a student can count on the support of her/his peers or teachers, the more inclined she/he is to learn in depth by interacting with them about the content being taught. Moreover, no type of support considered in isolation has a significant effect. One might have expected learning support to be more decisive, but this was not found in this study.

To what extent does motivation play a mediating role? (RQ2)

The second aim of this study was to examine the mediating role of motivation. Mediation analyses, with self-determined motivation as a mediator, allow us to test models B and C and determine which of the two is more consistent with the data. These analyses lead to the dismissal of model B and the acceptance of model C. In other words, the data collected in our study support Model C by showing the existence of both direct and indirect

significant effects of evaluativism and mean social support on deep approach. Self-determined motivation therefore only partially plays the mediating role put forward by several authors (Appleton et al., 2008; Dupont et al., 2015; Entwistle & Peterson, 2004; Skinner et al., 2008). How to interpret this finding? The fact that both direct and indirect effects are significant suggests that there are several psychological processes that explain how students engage in deep learning: a process of engagement in deep learning that is driven in a direct way by evaluativist epistemic beliefs and/or the social support that students perceive; and a process of engagement in deep learning that is indirectly driven by evaluativist epistemic beliefs and/or perceived social support, in that this influence is mediated by self-determined motivation, which then acts as a catalyst. When the effect is mediated by self-determined motivation, it may mean that there is an appropriation by students of the motives for engaging in learning, these motives corresponding to evaluativist epistemic beliefs or to the availability of social support. When the effect is not mediated, then evaluativism and perceived social support would not be viewed by students as sources of motivation for deep learning to learning. In this case, evaluativism could be described as a personal disposition and perceived social support as an external resource, both playing the role of a context conducive to deep approach to learning.

On the basis of these results, three potential levers can be highlighted: carrying out activities with students on the nature of knowledge and the processes of its construction and validation, which could lead students to be more critical about knowledge and tend towards evaluativism (Kuhn et al., 2000); providing students with greater social support, either directly from teachers and/or from peers in the context of the training (Dupont et al., 2015); helping students to internalise the motives for engaging in learning to bring them towards a more self-determined motivation (Ryan & Deci, 2020). These may be

seen as complementary levers that could be activated to engage students in deeper learning.

Limitations and future directions of research

A limitation of this study concerns the measure of evaluatism, which is based on four items each associated with a different sub-dimension, and which is characterised by a relatively low ω value. The partial independence of the epistemic beliefs associated to each sub-dimension for a given individual may explain this low value. It may also be due to the small number of items used. We could therefore construct the scale of evaluativism with a larger number of items, to try to improve its internal consistency. The fact that each sub-dimension was measured with only one item implies that the respective effects of these sub-dimensions highlighted in this study should be considered with caution. Research based on the measurement of these sub-dimensions with several items for each of them deserves to be carried out in order to consolidate or revise the results obtained.

As described in the 'Measures' section, the wording of some items from previous questionnaires was adapted to the study context and new items were created. Three tests were carried out with three samples of students in order to discard problematic items and adjust the wording of some items. The reliability of the constructs was assessed using McDonald's omega. Content validity was controlled by semi-structured interviews with students. However, no confirmatory factor analysis was carried out. Such an analysis could be used to deepen the assessment of the validity of the scales and subscales constructed in this study and possibly revise some items. A replication of this study with an improved instrument may sharpen the results presented here.

A more general limitation concerns the choice and definition of the dimensions investigated, which inevitably include a conventional part. Other dimensions could be included, such as students' conception of learning or self-efficacy. Other ways of

conceptually dividing the reality under study are also possible, such as those mentioned above in the literature review. However, the four dimensions selected allow us to consider the processes by which students engage in their studies with a certain degree of complexity, by integrating several of their cognitive, epistemic, motivational and social aspects. Furthermore, the distinction made between these dimensions clarifies the conceptual and methodological framework for exploring their possible relationships. The results of the present study demonstrate the fruitfulness of this framework.

It should be remembered that this study was conducted with a sample of first-year students at a multidisciplinary university in the south of France, with a response rate of 29.7%. The validity of the results obtained is therefore limited in several respects. Firstly, they may be relative to the profile of the respondents, who may differ from the non-respondents regarding some dimensions or sub-dimensions of the study. To overcome this problem, the questionnaire could be administered during a course in order to obtain a higher response rate. The problem of non-attending students would remain, however. Secondly, students' means on some of the dimensions of the study may differ across disciplines. For example, deep approach to learning has been found to be more prevalent among students in soft disciplines, such as social sciences, than among students in hard disciplines, such as physics or chemistry (Nelson Laird et al., 2008). The question arises whether the relationships found between the dimensions in our study are also different depending on the discipline. To investigate this issue, the variable 'training' could be included in the linear regression models. However, in our case, some of the trainings are multidisciplinary, while the others are mainly in the hard sciences and very few in the soft sciences. Our sample therefore does not allow us to study the influence of the hard-soft field parameter. A study extended to several universities and specifically controlling this parameter could therefore be conducted. Third, the study could also be extended to

other years of study. By conducting a longitudinal study over the years of a training program, it would be possible to assess the effect of the training on deep approach to learning and its relationships with motivation, evaluativism, and perceived social support. These are several research directions that this study invites for consideration.

Statements and declarations

The authors declare that they have no conflict of interest.

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