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Study orchestrations and motivational differences in a mathematical context

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ABSTRACT

The aims of this study are to examine the learning approach profiles, or study orchestrations, of 357 pre-university students and its relations to academic achievement and motivation. As study orchestrations are context-specific, the current research is based on the subject of mathematics. Results indicated that four types of study orchestrations emerged: high-high, high-low, high-mid and low-low in deep and surface learning. Students with a high-high and high-low study orchestration had the highest academic achievement and intrinsic motivation. The level of identified regulation differs across all clusters whereas there were no significant differences in introjection except for the low-low study orchestration. External regulation is associated mainly with surface learning. Amotivation is associated mainly with a lack of deep learning.

1. Introduction

Ever since the notions of a deep and surface learning approach first appeared (Entwistle, 1977; Marton, 1976c; Marton & Säljö, 1984), much research has been conducted based on the perception that a deep learning approach leads to positive learning outcomes whilst a surface learning approach leads to negative learning outcomes (Dinsmore & Alexander, 2012; Vermunt & Vermetten, 2004). Many of these studies have constructed their study by isolating the variables of deep and/or surface learning and subsequently investigating the relationships between these variables and academic achievement or motivation (Biggs, 1987; Entwistle, 1986; Severiens & Ten Dam, 1994; Watkins, Sternberg, & Zhang, 2001). However, students may not solely adopt a deep or surface approach when learning. In reality, many of them might have used a combination of both deep or surface learning, but nonetheless, many studies did not consider the inter-relations amongst the two types of learning approach. Thus, this study will examine this aspect by first profiling students into clusters according to their inclination towards deep and surface learning, followed by investigating the differences in academic achievement and motivation across the different profiles.

1.1. Learning approaches, study orchestrations and academic achievement

A deep learning approach is characterised by an intention to seek understanding and meaning. Students who adopt the deep learning approach search for relations with previous knowledge and connecting links with other subjects. They generally focus on the main ideas, concepts or applications of their subject content. On the other hand, a surface learning approach is characterised by a mere memorisation of facts as a substitute for understanding. "Students who adopt a surface learning approach tend to accept ideas and concepts without question. They generally aim to learn the minimum amount of material needed to pass (Biggs, 1987; Chamorro-Premuzic, Furnham, & Lewis, 2007; Entwistle, 1986).

A student's study orchestration is defined as the manner in which students combine their approaches to learning according to their perception of the learning context (Meyer, 1991). In some cases, the student might display 'conceptual consonance' between how the learning context is perceived and how learning takes place, i.e. the patterns of learning are theoretically interpretable. For example, a student might combine a high deep approach with a low surface approach in a specific learning environment. In other cases, the student might exhibit 'conceptual dissonance, i.e. the patterns of learning show an atypical linkage between some or all of the more common explanatory variations. For example, another student might combine a high deep approach with a high surface approach in the same learning environment (Cano, 2005; Lindblom-Ylänne & Lonka, 1998). Several studies have concluded that four clusters of students exist, namely two consonant approaches, i.e. high-low and low-high in deep and surface learning and two dissonant approaches, i.e. high-high and low-low in deep and surface learning (Cano, 2005; Entwistle, Meyer, & Tait, 1991; Entwistle, Tait, & McCune, 2000; Lindblom-Ylänne & Lonka, 1998; Vanthournout, Coertjens, Gijbels, Donche, & Van Petegem, 2013). Nevertheless, it is conceivable that students may adopt a level of deep and surface learning that is average relative to other students yet none of the

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previous studies managed to uncover the possibility of a fifth cluster.

Comparisons of academic achievement across the various clusters have led to different conclusions. The traditional view that deep learning leads to positive academic achievement and surface learning leads to negative academic achievement has been shaken by inconsistent empirical results (Cassidy, 2012; Cassidy & Eachus, 2000; Dennehy, 2014; Diseth, 2003; Duff, Boyle, Dunleavy, & Ferguson, 2004; Furnham, Monsen, & Ahmetoglu, 2009; Richardson, Abraham, & Bond, 2012; Swanberg & Martinsen, 2010; Yonker, 2011). The situation is also somewhat unclear when a student's study orchestration is taken into account. For example, a study conducted on a sample of high achieving medical students indicated that the grades between the various groups were not statistically significant (Lindblom-Ylänne & Lonka, 1998) whereas in two studies conducted on first year university students, students who adopted a dissonant approach had a lower academic achievement (Entwistle et al., 2000; Meyer, 1991). In a fourth study conducted on secondary school students, the mean academic scores across all subjects in the dissonant groups were below average, although students in the consonant groups, namely high-low and low-high in deep and surface learning, had the highest and lowest academic achievement respectively (Cano, 2005). These disparities in results might possibly be due to differences in learning contexts (Meyer & Watson, 1991), e.g. in the study conducted by Cano (2005), academic achievement was measured by taking the mean across all subjects and does not take into account the different learning contexts of individual subjects. For example, a particular subject, mathematics, consists of both conceptual and procedural elements (Hiebert, 2013). Students may adopt a deep approach when learning mathematical concepts, yet due its procedural nature of solving problems, they may also adopt a surface approach as well. For instance, in the topic of calculus, students may adopt deep approach to understand the concept of limits but may adopt a surface approach to find derivatives. In this instance, a combination of both approaches would be advantageous to attain good academic achievement and this may partially explain the previous inconsistencies regarding the relations of learning approaches and academic grades. Thus, in the current study, we will examine the students' study orchestrations in the context of a mathematics module.

1.2. Learning approaches and motivation

The motivational framework posited by self-determination theory will be applied in this study. In this framework, motivation can be conceptualised as distinct types that lie along a continuum. At one extreme end lies amotivation or the complete lack of motivation. Individuals who are amotivated do not act or act passively. At the other extreme end lies intrinsic motivation. Individuals who are intrinsically motivated act based on inherent satisfaction. In the middle band lies extrinsic motivation. Individuals who are extrinsically motivated perform activities due to some external stimuli. Extrinsic motivation can be further differentiated into three types, namely external regulation, introjection and identified regulation. External regulation occurs when the sole motivation is caused by externally imposed rewards or punishment. Introjection occurs when individuals self-impose their own constraints, e.g. guilt, shame or obligation. Identified regulation occurs when individuals identify with the reason for their actions, e.g. to achieve a better future for themselves (Deci & Ryan, 2002).

Previous studies have generally associated intrinsic motivation with deep processing and extrinsic motivation with surface processing (Entwistle, 1986; Lawson, 2012). Several studies have also combined the motivational constructs into autonomous (intrinsic motivation and identified regulation) and controlled motivation (introjected regulation and external regulation) and subsequently examined their relations with cognitive processing (Vansteenkiste, Sierens, Soenens, Luyckx, & Lens, 2009; Vansteenkiste, Simons, Lens, Sheldon, & Deci, 2004). However, there has been relatively few studies investigating the relationship between motivation constructs of self-determination theory and study orchestrations. Furthermore, the distinction between the various types of extrinsic motivation is essential because whilst external regulation is usually linked with negative learning outcomes, introjection has been linked with positive and negative learning outcomes and identified regulation is often linked with positive learning outcomes (Ng et al., 2012; Pelletier, Fortier, Vallerand, & Briere, 2001). By understanding the relationships between these types of extrinsic motivations and study orchestrations, appropriate intervention strategies can thus be designed by educators to alter a student's study orchestration to a more theoretically desirable one.

1.3. The present study

The present study will seek to address the gaps in literature by examining the following research questions: (1) What is the relation between learning approach, motivation and academic achievement for students learning mathematics? (2) What are the different study orchestrations in students enrolled in a mathematics module? (3) Which study orchestrations will predict a higher mathematics achievement scores? (4) What are the motivational patterns across study orchestrations?

We hypothesize that:

1) Deep learning will be a positive predictor of intrinsic motivation, identified regulation, introjected regulation and academic achievement whereas surface learning will be a positive predictor of external regulation but a negative predictor of academic achievement.
2) There will be four different types of study orchestrations, namely high-high, high-low, low-low and low-high in deep and surface learning.
3) Students with high-low in deep and surface learning will have the highest level of academic achievement, followed by students with high-high, low-low and low-high in deep and surface learning.
4) Students with high-high and high-low in deep and surface learning will have a higher level of intrinsic motivation and identified regulation. Students with low-low and low-high in deep and surface learning will have a higher level of introjected and external regulation.

2. Methods

2.1. Sample and procedure

The participants were 357 students enrolled in a diploma course. The diploma course was a prerequisite to an undergraduate program in business management. The sample consisted of 161 male and 196 female students. The mean age was 19.4 years, SD = 2.11. English was the medium of instruction.

The survey was conducted in the middle of the semester during a mathematics lecture. Students were asked to complete a questionnaire that related to their current mathematics module. In line with ethics procedures, approval was sought and granted by the university's institutional review board. Students were also informed that their responses would be confidential and that they had the option to withdraw from the survey at any given time.

2.2. Measures

Approaches to learning: Surface and deep learning were measured using a modification of the revised two-factor version of the Learning Process Questionnaire (LPQ) and the Motivated Strategies for Learning Questionnaire (MSLQ). The MSLQ was originally developed by Pintrich and his colleagues for a North American sample but it has been used extensively and translated into > 20 different languages. The LPQ was developed by Biggs and his colleagues based on a Chinese context. Both are relatively simple in item construction and are similar in the