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Modelling factors for predicting student learning outcomes in higher education

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Abstract

This paper presents a heuristic model of student learning as a means to understanding the scope of factors to be considered in making predictions about student learning. It is underpinned by a review of a wide body of literature. The model is drawn from Price and Richardson's 4P model (2004) that considered factors in improving student learning and argues that the same issues apply to predicting student learning outcomes. It builds upon existing research into learning and teaching. It is an articulation and an extension of Dunkin and Biddle's (1974) model, the Biggs (1985) original Presage-Process-Product model and research by Prosser and Trigwell (1999). The model has four main groups of factors: presage, perceptions, process and product. The presage group contains personological and situational factors such as context. Perceptions include how students conceive learning, how teachers conceive teaching, and the context. The process group of factors incorporates approaches to learning in students and teachers approaches to teaching. The model is presented as a basis for engaging in future research in a holistic manner that may bear further fruit in predicting student learning.

(Words 7,666)

Background

Considerable time and attention has been spent understanding and theorizing aspects of learning in higher education (Richardson, 2000), yet measuring learning remains difficult.

This is possibly due to uncertainty about what factors to examine in order to make predictions. There has been some criticism of the student learning literature in its failures to adequately demonstrate how learning can be improved. In a review of ten years of research of the Improving Student Learning Symposium research Gibbs' (2003) concluded that there had been few demonstrations of improvements. Richardson's review has provided a corner stone in assembling and critiquing student learning research. This encompasses conceptions of learning, approaches to learning, orientations to study, and a variety of ways in which to measure these such as study processes, approaches to study, and learning styles. He concluded that all educational research 'needs to be subjected to a continuing process of critical scrutiny and evaluation' (p. 174). It is in this spirit that this paper reflects on what we already know about student learning and considers the inter-relationships between established research on student learning in an attempt to model how we might examine this in a holistic manner. The proposed model is drawn from Price and Richardson's 4P model (2004) that considered factors in improving student learning. This paper presents a similar argument in relation to predicting student learning outcomes. It is structured by reviewing student learning, the influence of context, teaching, and the interrelationship of all of these with student learning outcomes. It begins by establishing why such an approach is necessary.

Rationale

There are several reasons why we need to model student learning outcomes in higher education. These are related to variations in ideology, theory, the nature of evidence, quality of the research and in understanding the scope of what needs to be considered in making predictions. In a recent review of the literature Price and Kirkwood (2011) examined claims that technology had improved student learning outcomes. The review showed that many studies lacked theoretical underpinning in their investigation and measurement of phenomena. The problems lay with a lack of understanding of what to examine, how to examine it, and how subsequent findings answered their research question. Limited use was made of existing theories and models to drive the educational development and interpret the results. This is underscored by a lack of a holistic definition and understanding of what impinges upon investigating student learning outcomes and its applicability in real world teaching situations to examining whether teaching interventions actually work.

Hargreaves (1996, 1997) argues that teachers could benefit from adopting evidence-based practices similar to the field of medicine, as both professions are people-centred, and require not just scientific application of knowledge, but also requires sophisticated professional judgement too. However this approach to understanding and improving student learning is not without its criticism (Elliott, 2001; Hammersley, 1997; Hargreaves, 1997; Oakley, 2001). Hammersley (1997, pp. 144–145) argues that this privileges positivist experimental studies not easily replicable in education. Although pragmatic and ethical difficulties inherent in such experiments in schools and colleges could be overcome, historically they are not the kind of research that attracts funding. In the USA, meta-analyses and systematic reviews of quantitative studies have been used to summarise ‘what works’ from large-scale studies as the basis of ‘evidence-based practice’ (Hattie & Marsh, 1996; Means, Toyama, Murphy, Bakia, & Jones, 2010; Slavin, 2008; Slavin, Lake, Davis, & Madden, 2011; Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011). Clegg (2005) expresses concern about this approach as it has implicit assumptions and fails to provide insights and understanding about actual practices that do impact on student learning outcomes. Hence there are ideological variations in the nature of research.

Research quality is also variable. There has been a growing expectation that teachers should be aware of evidence and research relating to student learning to underpin scholarly approaches to improving teaching and learning practices (Higher Education Academy, 2007; Kreber & Cranton, 2000; Trigwell, Martin, Benjamin, & Prosser, 2000). This is in no small part due to concerns about the quality of the scholarship of teaching and learning outputs (Kanuka, 2011) and the applicability of educational research to impact on educational outcomes (see UK Research Exercise Assessment 2009, Higher Education Funding Council for England (HEFCE), Scottish Funding Council (SFC), Higher Education Funding Council for Wales (HEFCW), & Department for Employment and Learning, Northern Ireland (DEL), 2009). The quality of research also lacks longitudinal data sets and cumulative research building also noted by the last UK RAE (2009) exercise.

In relation to the educational technology literature and findings on student learning outcomes, the use of existing research to drive quality investigations and interpret findings is limited (Price & Kirkwood, 2011). Evidencing technology and its influence on student learning is challenging as it needs to be investigated holistically in order to incorporate the complexities

involved in the whole educational enterprise (Kirkwood & Price, 2005; Oliver & Conole, 2003). Research into learning and teaching with technology mask more fundamental issues in relation to understanding and evaluating student learning outcomes in general.

Recognizing quality issues prompts questions about what outcomes might be expected, how they can be measured, and what influences variation. It also highlights some of the complexity in examining and measuring student learning outcomes. While in the past an important aspect of building knowledge in the field has been the in-depth modelling and analysis from a single dimension, such as conceptions of learning, approaches to learning, learning development, and learning patterns, it is now time to step back and reflect upon how this knowledge can be used as building blocks to examine student learning outcomes more holistically. This too needs to encompass other components in the educational enterprise such as teaching and context. This could bolster the quality of student learning research as well as fostering cumulative research of evidence to sustain and improve student learning. Arguably issues in relation to the quality of educational research could be understood in terms of the differences between researcher and practitioner traditions, where teachers are principally interested in what works while researchers are primarily interested in why (Hargreaves, 1997). Nonetheless as a field we need to develop theoretical models that can be used to understand both the *what* and *why* of improving student learning outcomes.

Student learning

Historically, research into learning had been predicated on an instructionist model where student learning was seen as a quantitative change in learning encompassing the memorisation of facts and procedures (see Bransford, Brown, & Cocking, 2000). Around the 1970s higher education research recognised that when learners were engaged conceptual rather than rote learning they could generalise and apply their learning better to a greater variety of circumstances (see Richardson, 2000, for a full review). Perry conducted longitudinal study during the 1950s and 1960s with students at Harvard University in the US on which he based his model of intellectual development. His scheme proposed nine stages on intellectual development ranging from a simplistic view of knowledge to a complex and multiple perspectives that acknowledges uncertainty.

Later, in Sweden, Säljö (1979) explored qualitative differences in the meaning and process of learning in higher education. He found that students described learning in different ways, which were categorised hierarchically into developmental conceptions of learning. These encompassed a qualitative change in the learner from

- *learning as the increase in knowledge*
- *learning as memorisation*
- *learning as the acquisition of facts and procedures*
- *learning as the abstraction of meaning*
- *learning as an interpretative process in understanding reality.*

He argued that his scheme had parallels with Perry's. This was further confirmed by a study conducted in the Netherlands by van Rossum and Schenk (1984) who investigated students' views of learning. Others have similarly confirmed this notion of development in learning (Hounsell, 1987; Martin & Ramsden, 1987; Vermunt & Rijswijk, 1988). A sixth conception, *learning as developing a person*, was later added to Säljö's original scheme (Marton, Dall'Alba, & Beaty, 1993) presupposing a yet more sophisticated conception.

Although Belenky et al. (1986) and Baxter Magolda (1992) have researched conceptions of learning and come up with different schemes, they too are developmental. Belenky et al. focused on women's ways of knowing. Through interviewing 135 women, who were a mix of students, graduates, or patients at a health clinic, she developed an alternative, but broadly compatible scheme of intellectual development to Perry's based on five ways of knowing. Baxter Magolda's scheme is based on interviews with 101 students that encompasses four ways of knowing. These too move through development stages of having absolute knowing through to contextual knowing.

Vermunt (1996) identified four conceptions of learning that he termed as mental models, which he identified through interviews with 35 Dutch students, 24 of whom were from a distance education university and the other 11 were from a traditional university. This formed the basis of his Inventory of Learning Styles (ILS) questionnaire that was used to

measure different aspects of learning (Vermunt, 1998). His study of 717 students confirmed the four learning dimensions of *Undirected*, *Reproduction-directed*, *Meaning-directed* and *Application-directed*. Each of these were distinguished by four learning components *cognitive processing*, *metacognitive regulation*, *mental learning models* and *learning orientations*. He suggests that learning styles in the ISL are not used in the traditional sense of deeply rooted personality traits but represents a more neutral interpretation of learning pattern (Vermunt & Vermetten, 2004). He argued that this integrated model can greatly reduce the overlap in learning conceptualisations while stressing the importance of process-oriented study as a means to improve the quality of student learning (Vermunt, 1998). Although some researchers have shown that cluster analysis of ILS scores illustrate qualitatively different conceptions of learning, they found they were not hierarchical or developmental in nature (Donche & Petegem, 2008; Lindblom-Ylänne & Lonka, 1999, 2000; Richardson, 2007; Vermetten, Vermunt, & Lodewijks, 2002). However a strong relationship between students' scores on the mental models scales of the ILS and their approaches to studying has been demonstrated, indicating some kind of developmental pattern (Edmunds & Richardson, 2009; Richardson, 2010).

The conceptions of learning schemes provide explanatory sources for variations in the production of learning outcomes (Meyer, 1997). This cumulative and developmental body of research provides reliable evidence that learning is *developmental* and hence is a factor that needs to be considered when examining student learning.

Approaches to learning

Marton and others carried out studies in Sweden gathering accounts of how students approached their learning (Dahlgren, 1975; Dahlgren & Marton, 1978; Fransson, 1977; Marton, 1976; Marton & Dahlgren, 1976; Marton & Säljö, 1976a, 1976b; Säljö, 1975; Svensson, 1976, 1977). These studies showed that students had qualitative differences in the process of learning. Marton and Säljö (1976a) described these as having two broad dimensions: surface-level and deep-level processing. Students oriented towards surface-level processing concentrated on the sign as in the content itself. Students oriented towards deep-level processing focused on what was signified and on comprehending what was being conveyed. Approaches to learning are important not only as a way of understanding how

students go about their learning, but also because of their relationship with how students conceive of learning (Marton, 1976). The mapping between these is illustrated in table 1.

Student Conceptions of Learning	Student Approaches to Learning
Learning as the increase in knowledge	Surface
Learning as memorisation	Surface
Learning as the acquisition of facts, procedures etc., which can be retained and/or utilised in practice	Surface
Learning as the abstraction of meaning	Deep
Learning as the interpretative process aimed at the understanding of reality	Deep

Table 1 of Student Conceptions of Learning and Students' Approaches to Learning

Approaches to studying have also been linked with attainment. The Approaches to Studying Inventory (ASI) was developed by Entwistle (1979), to examine approaches to learning in higher education. This was revised by Entwistle & Ramsden (1983), and later developed into a shorter form as the Revised Approaches to Studying Inventory (Tait & Entwistle, 1996) as an instrument to determine variations in study behaviour. Studies into approaches to learning have shown that students adopting deeper approaches to learning have higher quality learning outcomes. Comparatively those adopting surface approaches to learning have poorer learning outcomes (Entwistle & Ramsden, 1983; Svensson, 1977). So how students conceive of learning is important as it can affect how they approach their learning and their outcomes.

More recent research has also indicated that development in learning is neither linear nor in isolation of other factors

Learning is not to be looked upon as a linear process in which we first learn 'facts' ... and then try to understand these facts... Rather learning is to be regarded as a simultaneous processing of these levels where the learner is continuously oscillating between [them] ... In the beginning ... both the understanding of the meaning of facts

and the theoretical understanding are vague... When we are trying to learn something entirely new, our point of departure can perhaps only be constituted by common speech genre. However, when knowledge grows, the theoretical understanding as well as the ability to interpret empirical evidence become more articulated... If instruction is linearly organised, or if the theoretical context is not made explicit..., the learner has to invent higher order structures... [from] a common-sense view of the world. (Halldén, 2001, pp. 64–65)

Hence context too is an important and interrelated factor in student learning.

The student context

Laurillard (1978a, 1979, 1984) conducted a number of investigations into English university students' methods of studying. She found that students' approaches to study were also influenced by their overall orientation or conception of study and also by their perceptions of the demands of the task and the nature and style of the teaching. Hence task and context influence an individual's approach to learning (Laurillard, 1978b). They also impinge upon the approach that students adopt in different topic areas and these may vary not only between subjects but also within subjects.

Meyer et al., (1990) have shown that students' perceptions of the context can affect their learning outcomes. They introduced the notion of orchestration as a construct to represent an individual's approach to studying as a context-specific response that is influenced by a qualitative perception of key elements of learning context. They concluded that successful students had a well defined meaning orchestration and a holistic perception of the learning context. Comparatively unsuccessful students had a disintegrated orchestration and perception of the learning context. Meyer & Boulton-Lewis (1997), developed the Reflections of Learning Inventory (RoLI), and presented the two categories 'accumulative' and 'transformative'. They argue that conceptions of learning do not operate in isolation of other aspects of learning. Hence in the RoLI, conceptions of learning and other variants such as the context are analysed in relation to assessment and student learning outcomes (Meyer & Shanahan, 2000).

Lonka et al. (see Lonka & Lindblom-Ylänne, 1996) developed an open ended question booklet to examine the conceptualizations of learning that psychology students developed as they progress in their studies. The answers were classified into the three scales of *Active Epistemology*, *Constructivity*, and *Mental Representation*. They found that the constructivist approach to knowledge and learning was common among psychology students but was rare among teachers and lay people. Lonka and Lindblom-Ylänne (1996) argue that these conceptions are domain-specific and this suggests that context is influential. In further studies (Lindblom-Ylänne & Lonka, 1999, 2000) show differences in orchestrations between medical students and psychology students. Vermunt (2005) also found that academic performance is influenced by contextual and personal factors. In a study of 1279 Dutch students he showed that personal and contextual factors, such as type of academic discipline, prior education, age and gender influenced performance. This further confirms the role of context in influencing student learning.

Student learning outcomes

Perceptions of the task and context, as perceived through the demands of the task, have an impact on how students approach learning and indirectly on student learning outcomes. Marton and Säljö (1984) observed the ‘technification’ phenomenon where students’ study approaches to a task reflected the requirements of the task. Scouller (1998) also found that the demands of the assessment were instrumental in cueing students to adopt particular approaches to their learning. Meyer (1999) has also shown that conceptions of learning, perceptions of the context and the process of learning can influence learning outcomes. However using assessment grades as a measure of successful student learning is contentious as they can be distorted by variations in assessment practices – which in themselves can cue students to adopt less desirable approaches to learning and by the learning context. (see Richardson, 2000, for a full review). Price and Richardson (2003) argue that improvements in student learning should not solely be characterised by learning outcomes but should also include an examination of the learning process itself. Although associating study processes with academic attainment is not simple, better academic attainment tends ‘to be positively related to desirable forms of study behaviour and negatively related to less desirable forms’ (Richardson, 2006, p. 869).

Biggs (1987) developed the Study Process Questionnaire (SPQ), to examine whether assessment and other contextual elements in the teaching and learning system are constructively aligned to promote deep approaches to learning. It aims to help teachers research the learning environment in their own classrooms (Biggs, 1999; Kember, 2000). This instrument too incorporates the notions of deep and surface learning. The SPQ, and the later revised SPQ (Biggs, Kember, & Leung, 2001), were based on Biggs's (1985) Presage-Process-Product, 3P model of student learning. The 3P model illustrates how students enter the learning environment with a variety of factors, that is, prior knowledge, ability and their preferred approaches to learning and how these interact with the teaching context to culminate in student learning outcomes. This model brings together a number of important factors to consider when examining student learning outcomes.

However there is another aspect that requires consideration; that is the role of teaching in influencing students' awareness of their learning environment and how this impacts upon their approach to learning.. Ramsden (1992) illustrates that students' perceptions of their learning environment are related to their approaches to learning. Those who comprehend the nature of the assessment as fostering recall and memorisation, with a high workload, are more apt to adopting a surface approach. Comparatively students who perceive independence in their learning and clear perception of goals and standards, are more likely to be associated with deep approaches (Prosser & Trigwell, 1998; Trigwell, Prosser, & Taylor, 1994). Hence we need to also consider the role of teaching and its relationship with student learning.

Teaching

Similar categories to the research on student learning can be found in the literature about teaching (Vermunt & Vermetten, 2004, p. 362-363). Dall'Alba (1991) interviewed 20 teachers in an Australian University and identified seven different conceptions of teaching ranging from *teaching as presenting information* to *teaching as bringing about conceptual change*. Kember (1997) conducted a review of the conceptions of teaching literature and found similar conceptions. In a similar vein to the research conducted on approaches to learning, Trigwell, Prosser and Taylor (1994) conducted a phenomenographic study and identified five qualitatively different approaches to teaching. Further research by Trigwell and Prosser (1996) found that these were related to teachers' conceptions of teaching and also

to their commensurate conceptions of their student learning. These have broad parallels with the conceptions of learning literature. They relate as follows:-

Teachers Conceptions of Teaching	Teachers Approaches to Teaching
Transmitting concepts of the syllabus	Teacher focused – transmission of information
Transmitting the teachers knowledge	Teacher focused – transmission of information
Helping student acquire concepts of the syllabus	Teacher focused – students acquire discipline concepts
Helping students acquire teacher’s knowledge	Teacher-student interaction – students gain teachers knowledge through engaging
Helping students develop conceptions	Student centred – students develop their conceptions
Helping students change conceptions	Student centred – students change their conceptions

Table 2 Teachers Conceptions of Teaching and Teachers Approaches to Teaching

They argue that teachers’ conceptions of teaching and teachers’ conceptions of their students’ learning, represents the *what* and *how* of teaching. The *what* is the focus of the teaching intention and the *how* is the approach that a teacher adopts to addressing that perceived learning need. They found that teachers who conceive of learning as the accumulation of information also conceive of teaching as the transmission of information to students. Subsequently they approached their teaching in terms of teacher-focused strategies. Comparatively, those teachers who conceive of learning as developing and changing students’ conceptions, conceive of teaching in terms of supporting students development and approach their teaching in a student-focused manner (Trigwell & Prosser, 1996, p. 281).

Furthermore, teachers’ approaches to teaching are linked with student approaches to learning and this forms an important factor in considering influences upon student learning. Trigwell, Prosser & Waterhouse (1999) conducted a study investigating the relationship between

teachers' approaches to teaching and students' approaches to learning. The study showed that where teachers reported a teacher-centred approach to teaching aimed at transmitting knowledge, students correspondingly reported using surface approaches to learning. Contrastingly, where teachers adopted a student-centred approach to teaching aimed at changing the students' conceptions, students tended to report using deep approaches to learning, although to a lesser extent. Thus both teachers' conceptions of teaching and their subsequent approaches to teaching influences student learning. However, Richardson (2000) notes that

Although a teacher's approach to teaching may constitute part of the institutional context that influences a student's approach to learning, it is equally possible that teachers modify their approaches to teaching to respond to the preferences or predispositions of their students. (p.78).

The point of this comparison is that university teachers may have a view of teaching that is not commensurable with their students' view of learning. Hence it is not only important to consider students' conceptions of learning, their approaches to learning, and their influence upon learning outcomes, but also teachers' conceptions of teaching and their approaches to teaching, and their influence upon student learning.

The wider context for teachers and students

Teachers too operate within a professional context and are subsequently subjected to those influences. This can also have an influence upon their approach to teaching, or more precisely their teaching practices. Norton, Richardson, Hartley, Newstead & Mayes (2005) conducted a study by into teachers' beliefs and intentions. They distributed a questionnaire measuring nine different aspects of teachers' beliefs and intentions at four institutions in the UK (N=638). Although there was a high degree of overlap differences were found between beliefs and intentions. They were able to classify 556 respondents into three broad academic disciplines: arts, science and social science. These differed across institutions and between teachers and seemed to result from contextual factors. They found that disciplinary teaching differences remained significant even when institution, teaching experience and gender were taken into account. They concluded that these differences appear to represent 'genuine

differences in teaching conceptions across different disciplines' (p554). Teaching intentions thus reflect a compromise between teachers' conceptions of teaching and their academic and social contexts. Teachers in different disciplines and professional backgrounds may have undergone different processes of integration and adaptation. Furthermore, if teachers' conceptions of teaching are not aligned with the dominant culture of that discipline then teachers may feel marginalised. They may have to adapt their preferred *modus operandi* in order to be accepted or else remain in the margins. Their students too may question the value of the course they are studying if they perceive that the teaching it is not aligned with the rest of the curriculum in that discipline.

Tormey and Henchy (2008) acknowledge the ideological challenges that the teaching context presents. They recognize clashes between teaching values and teaching practices. While teachers may feel committed to relational, socially and politically transformative student-centred teaching, these values are difficult to realise when teachers have to lecture to large groups. As Laurillard argues the traditional lecture is seldom an appropriate context within which to support and engage students in learning. The lecture model persists partly because of tradition and partly because it is a convenient model for higher education institutions to 'deliver' education to large numbers of students (Laurillard, 2002, p. 94). Thus teaching context influences what teachers do. This suggests that teachers might have both *ideal* and *working* views about teaching. Thus the institutional context may constrain the teaching approach that teachers' would actually prefer to use by affecting how teachers perceive the teaching situation and thus how they respond. Similarly it can affect students' perceptions of the teaching situation and how they respond.

However there are contexts other than institutional ones that can impact on students and teachers. In the case of students this is the social context and in the case of teachers this is the professional context (although they too will have social influences). Social context can influence students' conceptions where family, peer group, cultural values and expectations contribute to the views that students form. Tinto (1975, 1982, 1987) conducted research into student attrition rates in the US. He argued that it was necessary to take account of the social interactions beyond the classroom as family situations, peer groups or local communities could impact upon whether students persisted with their studies. This is an especially important factor for students who may studying part-time or are conducting their

studies off-campus (Kember, 1995). While the social context is one that will be difficult to measure it should still be taken into account as a factor that may indirectly affect student learning outcomes.

The model

This review has shown that there are many interrelated factors that influence student learning outcomes. Hence these need to be considered when trying to examine student learning in order to make predictions. In this paper a heuristic model is presented (see figure 1) to illustrate the factors identified in the literature that appear to be influential in student learning. The model is holistic in nature and it gathers together research from a range of findings. While there may be some criticism of mixing a number of traditions to examining student learning, Lonka and Lindblom (2000; 1996) have successfully used Information Processing (IP) and Student Approaches to Learning (SAL) traditions together to get a holistic overview.

Biggs (1993) pointed out that mixing constructs derived from the IP position with those derived from the SAL tradition leads to problems of interpretation. We found that, as long as we were asking the students about what they would do (rather than making assumptions of their actual processing) our results and measures showed conceptual coherence and also construct validity. For instance, students' suggestions for their comprehension resting on the basis of Weinstein and Mayer's (1986) classification matched their epistemological beliefs as we expected. Mixing Perry's (1968; 1970), Ryan's (1984), and Lonka et al. (1994) measures in the same study with approaches to learning provided a chance to look at the interactions between different theoretical constructs. (Lonka & Lindblom-Ylänne, 1996, p. 20)

This holistic position is one that Vermunt (2005) too has adopted in considering the role of context and personal factors in examining student learning through the ILS. Vermunt and Vermetten (2004) argue that investigating and improving student learning requires that 'all learning components should be addressed in the interventions, not just learning strategies' (p. 379). This heuristic model extends this idea by including some other factors that may be pertinent to predicting student learning. The model at this point makes no suggestions as to how such measurements would take place, although there are some clear indications from Lindblom-Ylänne,

Lonka, Vermunt and Vemetten that using aspects of different inventories and research approaches can work.

The model presented in figure 1 originates from Price and Richardson's 4P model (2004) that considered factors in improving student learning. However the same issues apply to predicting student learning outcomes. The aim of this model is to provide a way of articulating the scope and interrelationships of factors in predicting student learning. It draws upon existing research into student learning and teaching. It is an expression and an expansion of Dunkin and Biddle's (1974) model as well as an expansion of Biggs (1985) original Presage-Process-Product model. It also incorporates research by Prosser and Trigwell (1999). The model in figure 1 presents factors discussed in this review and the interrelationships between them. Arrows have been drawn indicating some causal relationships that exist on the basis of the literature review. There are four main groups of factors: presage, perceptions, process and product.

Presage factors encompass personological and situational factors. It is understood that both students and teachers have their own personal characteristics (Richardson, 2000) and that these may influence conceptions of learning and conceptions of teaching, respectively. The social context is personal to the students while the professional context is particular to the teachers (although they too have influential social contexts). The institutional context is considered to be within the domain of the institution.

Perceptions are considered to be at the students' and teachers' levels of consciousness and are not directly observable. However they are important because they include how students conceive learning, how teachers conceive teaching and how both experience the contexts in which they find themselves.

Process contains personological variables and perceptions and their interactions with how students and teachers approach their tasks. This ranges from surface to deep learning in students and from teacher-centred to student-centred teaching in teachers. Students' experiences are determined by their perceptions of their social context, their perceptions of the institutional context and their conceptions of learning. Studies have consistently shown that students conceptions of learning relate to students approaches to learning (Crawford, Gordon, Nicholas, & Prosser, 1994; Entwistle & Ramsden, 1983; Marton & Säljö, 1997;

Prosser & Millar, 1989; van Rossum & Schenk, 1984). However Meyer et al. (1990) found that some students exhibit disintegrated perceptions and approaches to learning, where they adopt neither surface nor deep approaches. This is shown in the model as the interrelationships between the students' perceptions of the context, their conceptions of learning and their approaches to study. This space can also be considered as where self-regulation strategies are in effect (Vermunt & Rijswijk, 1988).

Teachers' conceptions of teaching and approaches to teaching are also important factors in this model. They too impact upon the students' approaches to learning (Trigwell, Prosser, & Waterhouse, 1999). Figure 1 illustrates a relationship between teachers' approaches to teaching and students' approaches to learning. The diagram also illustrates the inverse relationship. Teachers may change their approaches to teaching in response to the approaches that students display so as to engender more desirable approaches to learning. It is already well established that students' approaches to learning are related to their learning outcomes (Marton & Säljö, 1997). However, the way in which students approach learning are in turn affected by all of the factors mentioned thus far.

Conclusion

This model provides a way of considering important factors in predicting student learning and hence what might be important to measure. It draws upon a wide body of literature to portray factors that have already been identified as pertinent to predict student learning. It builds on previous arguing that students' perceptions and their conceptions of learning and teachers' perceptions and their conceptions of teaching are important elements related to the whole concept of improving student learning. Furthermore it shows an interrelationship between the context in which learning takes place, the learner themselves, the teacher and the outcomes. Epistemological conceptions about the process of teaching and learning should be viewed as an inter-related set, as should predictions about student learning. The model does not argue for a particular approach to examining these factors but presents it as a basis for engaging in future research in a holistic manner that may bear further fruit in predicting student learning.

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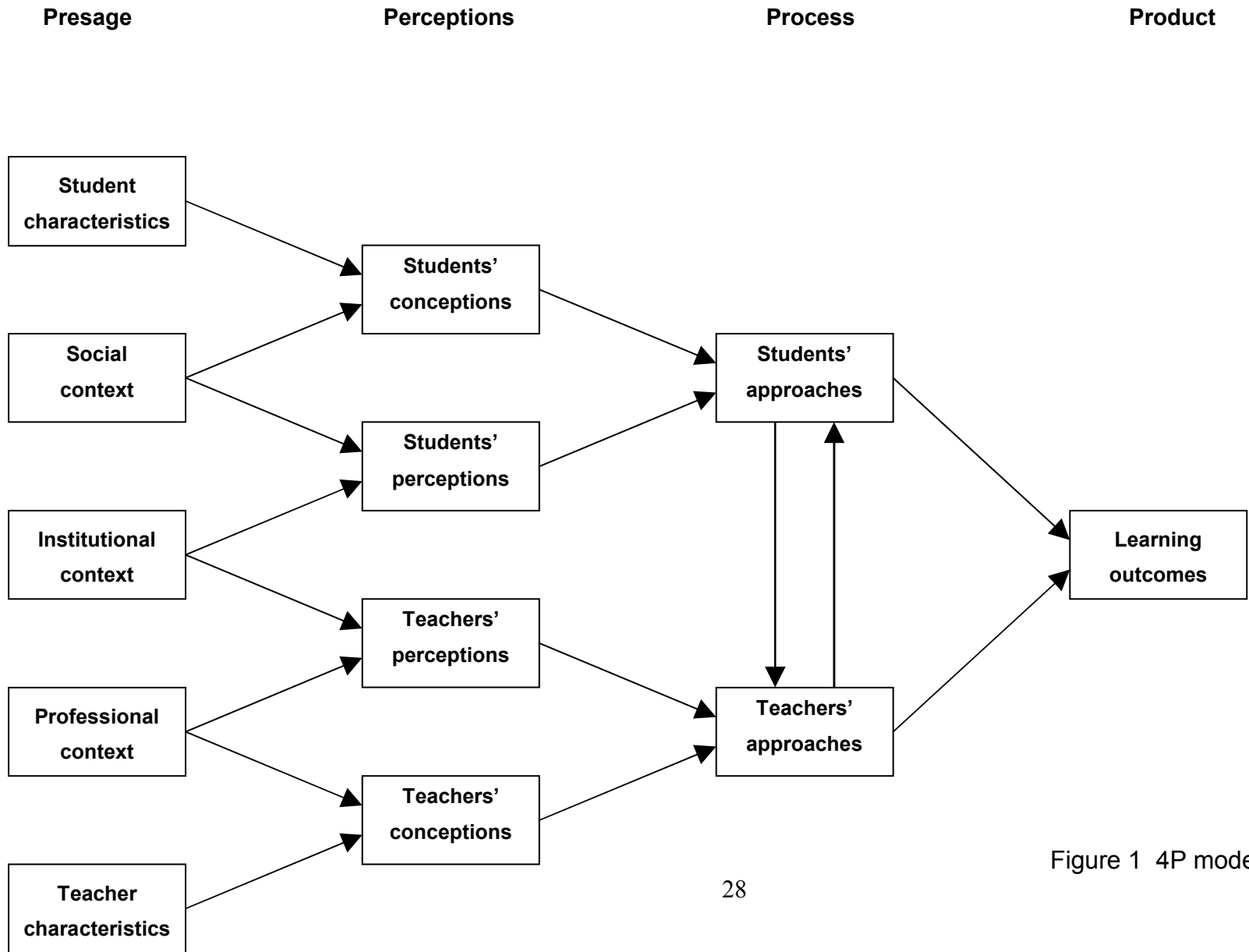


Figure 1 4P model