

3rd International Seminar on Research on Questioning

‘Critical inquiry and academic growth in Higher Education’

Organization:

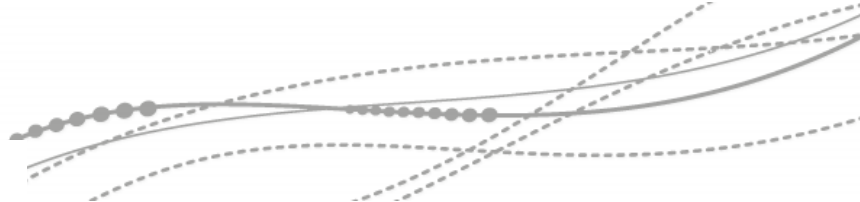
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Prof. Mike Watts (Brunel University London - UK)

SEMINAR PROCEEDINGS

19th June 2015

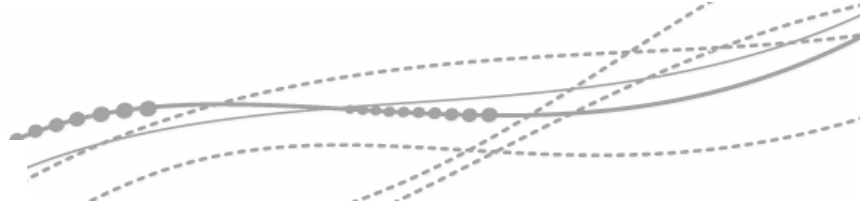
University of Aveiro
Department of Education
Research Centre "Didactics and Technology in Teacher Education"



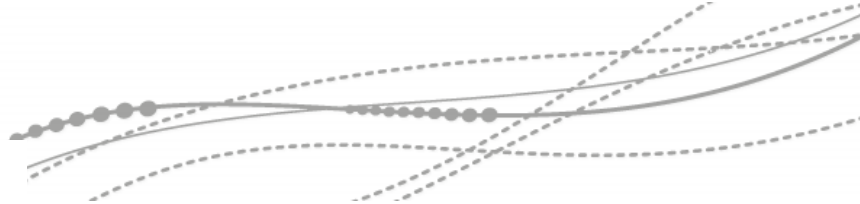
Outline:

Building on the 1st and 2nd international seminars on research on questioning, this 3rd international seminar draws on an accumulated body of knowledge from over a decade of research and study at Aveiro. The focus here is upon supporting university teachers to initiate, facilitate and support inquiry-based learning and critical reflective practice, across a variety of educational settings. The seminar show-cases a wide range of contributions that explore teacher development and growth in relation to innovative approaches to teaching and learning, and contributions are open to a range of methodologies and subject disciplines. The format of the day relies upon short presentations highlighting key issues from pre-circulated papers to allow ample time for discussion, debate and networking. The intention is to develop a published text with an established educational publisher as the final outcome of this work.

Helena Pedrosa-de-Jesus & Mike Watts



| PROGRAM | |
|---------------|--|
| 9h00-9h30 | Opening session |
| 9h30-10h00 | Helena Pedrosa-de-Jesus <i>et al.</i> A study of academic development in universities through innovative approaches in teaching, assessment and feedback Pag. 7 |
| 10h00-10h30 | Carol Evans Using an understanding of cognitive styles to enhance pedagogy Pag. 15 |
| 10h30-11h00 | Coffee break |
| 11h00-11h30 | Domingos Fernandes Reinventing assessment and teaching practices in higher education: reflections built on the AVENA project Pag. 31 |
| 11h30-12h00 | Yoshinori OYAMA Promoting university students' inquiry-based learning through use of questioning: Review of previous research and description of new research in Japan Pag. 39 |
| 12h00-12h30 | Nilza Costa Challenging physics lessons through questioning and collaborative work: research developed in Portuguese higher education institutions Pag. 49 |
| 12h30 – 14h30 | Lunch |
| 14h30-15h00 | José Otero Critical inquiry, question asking and the structure of conscious ignorance Pag. 57 |
| 15h00-15h30 | Mike Watts <i>et al.</i> Academic growth and scholarship of teaching and learning: the impact of research Pag. 63 |
| 15h30-16h00 | Coffee break |
| 16h00-18h00 | Final discussions |



A study of academic development in universities through innovative approaches in teaching, assessment and feedback

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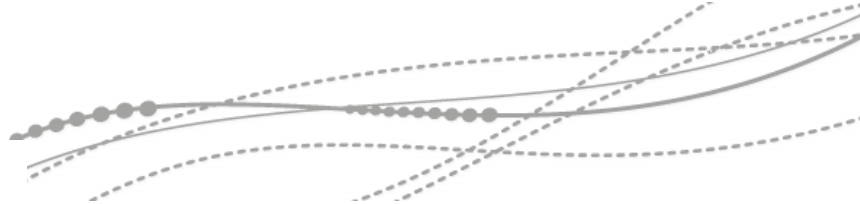
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ABSTRACT

Our study is based on the assumption that the scholarship of teaching and learning (SoTL) should emphasize principles of academic growth through collaboration, action, critical thinking and inquiry into and about university teachers' practices (Hutchings, Huber, & Ciccone, 2011). Following a co-researcher model, educational researchers have been working with four biology University teachers from the University of Aveiro, in Portugal, since 2006. The collaboration has provided a strong basis for understanding the dynamics of student-generated questioning, inquiry-based learning and teachers' academic development. Working in natural settings of several curricular units, these teachers were able to analyse, evaluate and reflect upon new practices. Teaching innovations were designed with the intention of student participation, inquiry-based learning and criticality (Pedrosa-de-Jesus, Moreira, Lopes, & Watts, 2014; Pedrosa-de-Jesus, Guerra, Moreira, & Watts, 2014). The research methodology was based on a critical social paradigm, assuming principles of action-research. Data were collected through non-participant observations of various classes, participant observation during the informal contacts with teachers (before or after classes), regular meetings with the research group, and semi-structured interviews conducted with four teachers and twelve selected students. All the written documents produced by the participants (i.e. learning products), as a consequence of the research innovations introduced, were selected for analysis. Content analysis was the main methodology adopted. The framework developed by Weston & McAlpine (2001) was adapted in our research to chart teachers' academic development, their collaboration with disciplinary colleagues, and their reflections to the SoTL. Results from the teachers' critical reflections indicate how they have interpreted their academic experiences concerning the design of some innovative strategies. However, there is clear evidence that it is important to provide suitable individual coaching to enhance the university teachers' academic development.



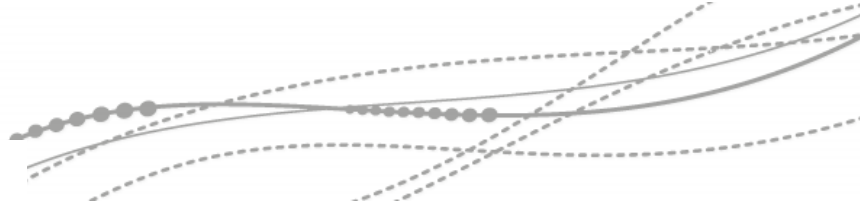
EXTENDED SUMMARY

Rationale

Many of the changes in higher education that derive from Europe-wide initiatives such as the Bologna Process have given increased attention to student-centred teaching approaches, allied to growth in teachers' academic development (Clarke & Reid 2013, Higher Education Academy (HEA) 2011). Our current study is one of the components of a long-standing project focused on promoting academic development and growth in higher education. Work developed since 2001 has provided a strong understanding of the dynamics of student-generated questioning, inquiry-based learning and associated academic practices (Pedrosa-de- Jesus, Lopes, Moreira & Watts 2012).

According to Biggs (1999), a constructive alignment between teaching strategies, learning outcomes and assessment methods is essential for promoting students' critical thinking. A Report to the European Commission on Improving the Quality of Teaching and Learning in Europe's Higher Education Institutions (European Commission, 2013, p. 13) states that: *'A good teacher, like a good graduate, is also an active learner, questioner and critical thinker'*. The same report recommends that: *'All staff teaching in higher education institutions in 2020 should have received certified pedagogical training'* (p. 64).

Hutchings, Huber and Ciccone (2011) argued that scholarship of teaching and learning (SoTL) should emphasize principles of learning through inquiry, reflection and action into and about practices for the improvement of teachers' academic growth. Barefoot and Russell (2014) advocate that collaborations can improve students' learning and assessment within a discipline-specific context. The successful self-reflection of university teachers should move beyond the personal perspective and focus on dialogue with colleagues about the innovations of teaching and learning in their particular disciplines (Clarke & Hollingsworth, 2002; van Schalkwyk, Cilliers, Adendorff, Cattell, & Herman, 2013). We believe that new understandings and altered perspectives on teaching practices may come as the inevitable product of the reflection of university teachers on their own performance.

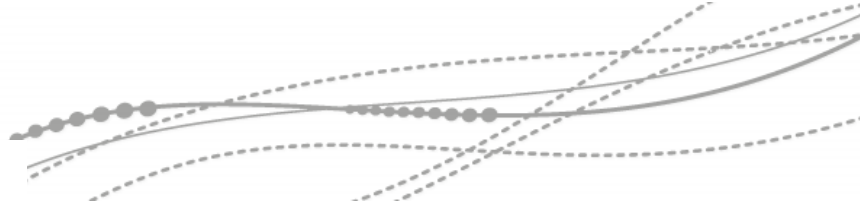


Context

This communication presents a study of collaboration between researchers and four university biology teachers over a period of eight years (from 2006 to 2014), and weighs the impact of the collaboration on their academic development and growth. The main goals was to: (i) work alongside university teachers in designing and adopting novel practices to meet new demands on their time and teaching; (ii) evaluate such innovative teaching and learning strategies in action, and (iii) promote university teachers' academic reflection on issues of teaching and learning at this level.

The four teachers at the heart of this discussion are staff members of the Biology Department teaching in different fields: Teachers A and B focused on microbiology and genetics, Teacher C on evolution and D on microbiology and pharmacology. Work with these academics has provided a strong understanding of the dynamics of student-generated questioning and inquiry-based learning (Pedrosa-de-Jesus, Lopes, Moreira & Watts, 2012), the relationship between teaching, learning conceptions and questioning practices (Pedrosa-de-Jesus and Lopes, 2012) and academic practices (Guerra, Pedrosa-de-Jesus, Correia, Cunha, Almeida, & Watts, 2014).

Our collaborative study shows that experimentation with innovative strategies by these university teachers is strongly influenced by their particular conceptions of teaching. Making changes to teachers' conceptions of teaching and learning is very difficult and challenging in the context of higher education (Pedrosa-de-Jesus & Silva Lopes, 2012). In fact, the four academics had different starting-points and diverse 'growth opportunities' for their academic personal trajectories. In the past, a strong emphasis on memorization of scientific concepts, assessed through examinations was predominant on university teachers' practices. In fact, opportunities for generating learning tasks and assignments to encourage students' higher-order competences, such as questioning and critical thinking, were previously infrequent and rarely taken (Pedrosa-de-Jesus, Moreira, Lopes & Watts, 2014; Pedrosa-de-Jesus, Lopes, Moreira & Watts, 2012).



This project has been focused on ways to (a) work together with university teachers in designing and adopting novel practices to meet new demands on their teaching; (b) investigate innovative teaching and learning approaches; (c) promote university teachers' critical reflection about their academic practices. It was important to find answers for the following research question: how to design teaching, learning, assessment and feedback strategies to foster university teachers' academic growth within the context of higher education?

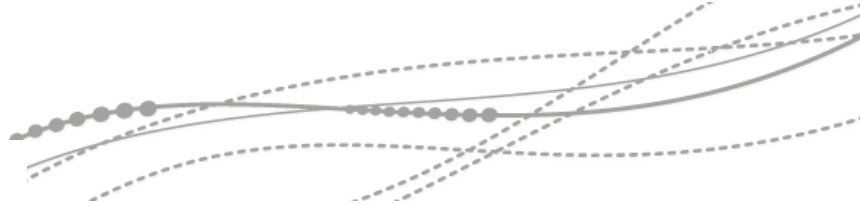
Methodology, Research Instruments or Sources Used

The research approach was based on a critical social paradigm, assuming principles of action-research (Cohen, Manion, & Morrison, 2007; Schmuck, 2006). The researchers collaborated with university teachers in identifying practical problems, their causes, and possible forms of intervention.

The collaboration followed a model of co-researcher (Macaro & Mutton, 2002), which allows each participant to benefit from the interactions. The researchers had the opportunity to undertake research in natural teaching-learning settings and the university teachers used the curricular units to analyze, reflect, practice and evaluate new approaches to teaching and learning in a supported way.

The project was organized in three phases: the first involved an analysis of the pedagogic materials (teaching content, type of assessment and means of feedback) and the teaching and learning strategies implemented in four curricular units during the academic year; the second was used for designing innovative teaching, learning, assessment and feedback strategies. These approaches aimed at encouraging students' higher order competences, such as learning autonomy and critical thinking, as well as new modes of assessment and improved forms of feedback within each of these curricular units. The third phase included an evaluation of these strategies in terms of effectiveness in practice.

An 'instructional coaching approach' (Schrum, English and Galizio, 2012) was adopted in order to contribute for the academic development of the university teachers involved. Several 'instructional coaching meetings' were promoted during two academic years (2012/2013 and 2013/2014) with the participation of



the educational researchers, the university teachers and the external consultant.

The aims of these meetings were (a) to identify educational problems; (b) to design and implement solutions to the educational problems identified; (c) and to reflect about the solutions designed for educational problems previously identified. It was considered that academic development occurred when the discussion over a particular topic, during the ‘instructional coaching meetings’, generated personal change in teachers’ initial knowledge, beliefs and attitudes, in their teaching practices, and their reflections about the salient outcomes of their practices.

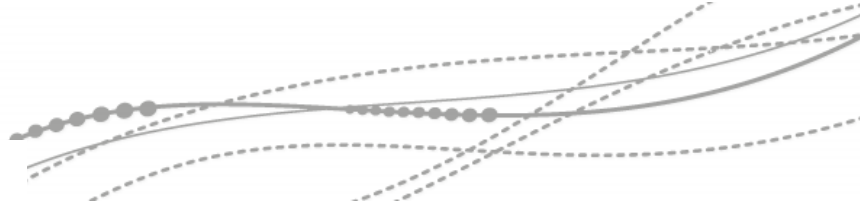
Data were collected through non-participant observation of various classes in naturalistic contexts, participant observation during the informal contacts with teachers (before or after classes), regular meetings with the research group, and semi-structured interviews conducted with both teachers and selected students at different points in the project.

The observed situations were ‘authentic’ in keeping with the essence of a naturalistic approach (Cohen, Manion & Morrison, 2007). All the written documents produced by the participants, as a consequence of the research innovations introduced, were also selected for analysis.

Since the data gathered were mainly qualitative and descriptive, the principal methodology adopted has been content analysis (Bardin, 2000), using an analytic framework based on Weston & McAlpine’s (2001). This allowed the analysis of these university teachers’ ability to enact upon their teaching and the changes in their critical thinking.

Conclusions, Outcomes and Findings

Making changes to teachers’ practices and conceptions of teaching and learning is very difficult and challenging in the context of higher education (Pedrosa de Jesus & Silva Lopes, 2012). This collaborative study, developed since 2006, has already shown the extent to which experimentation with innovative strategies by this group of university teachers is strongly influenced by their particular conceptions of teaching (their ‘personal domains’).



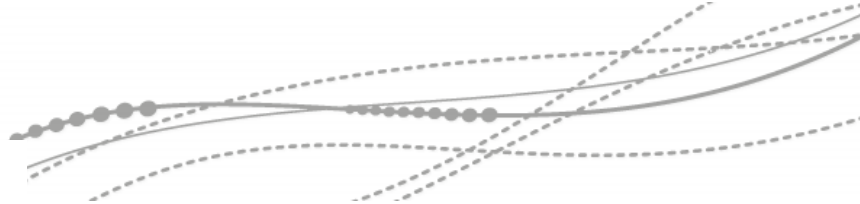
The close collaboration between colleagues has occurred across different curricular units, resulting in new ideas and shared understandings. The four teachers introduced a number of innovative tools in their teaching such as MicroTalks, peer observation, using students' own questions on Moodle, Scitable, dialogic classroom processes, tasks for critical thinking and analysis. Some of these innovations were designed with the collaboration of the researchers but others were autonomously conceived by the teachers.

Data were organized according to the framework constructed for the analysis of the academic development, using Weston and McAlpine's (2001) framework. This allowed analysing the university teachers' ability to enact upon their teaching and how their critical thinking generated changes in the domain of practice and domain of consequence. Teachers' individual interviews indicate how they have interpreted their academic experiences concerning the design of some innovative approaches.

Overall comments of teachers on the project impacts indicate that they would not have undertaken and benefitted from this type of educational enquiry without the collaborative input and support from each other and from educational researchers. Their analysis of the innovations is clear. Benefits to students were acutely weighted against teaching effort and time demand.

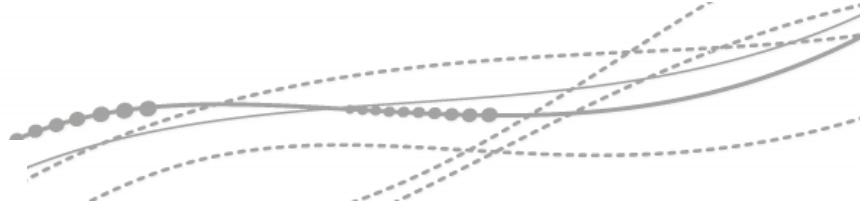
The four university teachers expressed their intention to continue refining and improving academic practices. More 'situated' and 'reflexive' comments on the role of the institution in the innovation of teaching practices, addressing organizational structures constraints and diversity of contexts, were also produced.

The role of the project on the academic development of teachers was of a supportive co-researcher, encouraging changes and highlighting achievements. Results demonstrate the importance of supporting/coaching university teachers in the design and implementation of innovative, diverse, and efficient teaching strategies. The 'instructional coaching approach' (Knight, 2004) was the main way to achieve the proposed goals, by co-sharing the design of innovative approaches and promoting university teachers' critical reflection about their innovation in teaching, learning, assessment and feedback.



References

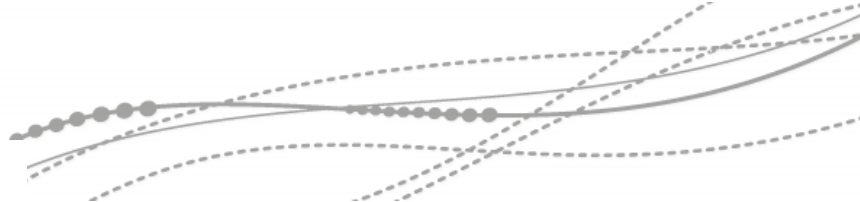
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Using an understanding of Cognitive Styles to enhance Pedagogy

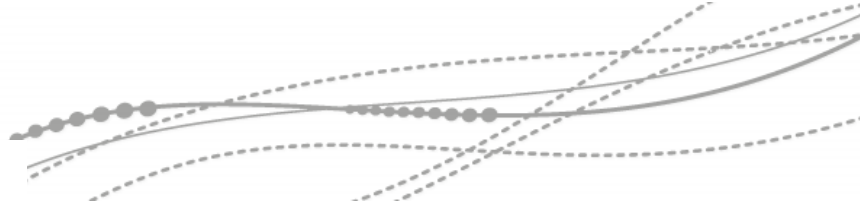
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ABSTRACT

Enhancing the quality of learning and teaching in higher education (HE) is of international concern. There has been considerable debate about what constitutes “high impact pedagogies” and teaching excellence within HE contexts. However, little attention has been given to how an understanding of cognitive styles can contribute to enhancing pedagogy. This omission of cognitive style is surprising given that it is “an adaptive system that moderates the effects of both an individual’s predispositions [both innate and learned] and the external environment” (Kozhevnikov, et al., 2014, p. 22). We know that cognitive style does matter (Zhang & Sternberg, 2009); it impacts on how individuals interact with the learning environment and an understanding of this is crucial in developing teaching expertise (Waring & Evans, 2015; Zhang, Sternberg, & Rayner, 2012). However, the application of such information in the form of explicit guidance on how an understanding of cognitive styles can be applied to learning and teaching in HE has been relatively limited. To address this lack of translation issue, using a research informed and evidence-based approach - the Personal Learning Styles Pedagogy Framework (PLSP) (Evans & Waring, 2014; Waring & Evans, 2015), a number of pedagogical priorities are highlighted informed by the fact that cognitive styles operate at different levels of information processing and comprise different style families; and can be developed. A key message underpinning this approach is the importance of adapting instruction to the requirements of the context rather than to the learner’s cognitive style profile. It is important for teachers to work with learners to develop the most appropriate cognitive styles for the requirements of the context. The PLSP is an example of participatory pedagogy that stands apart from other models of inclusive pedagogy in its consideration of cognitive styles to inform instruction.

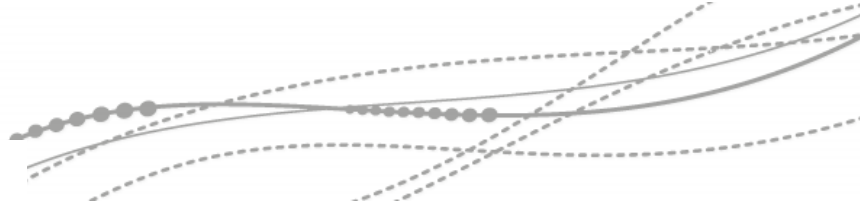


EXTENDED SUMMARY

Enhancing the quality of learning and teaching in higher education (HE) is of international concern. There has been considerable debate about what constitutes “high impact pedagogies” (Gibbs, 2012; Kuh, 2008) and teaching excellence within HE contexts (HEA) (Gunn & Fisk, 2013; Land & Gordon, 2015). However, little attention has been given to how an understanding of cognitive styles can contribute to enhancing pedagogy. This omission of cognitive style is surprising given that it is “an adaptive system that moderates the effects of both an individual’s predispositions [both innate and learned] and the external environment” (Kozhevnikov, *et al.*, 2014, p. 22). We know that cognitive style does matter (Zhang & Sternberg, 2009); it impacts on how individuals interact with the learning environment and an understanding of this is crucial in developing teaching expertise (Waring & Evans, 2015; Zhang, Sternberg, & Rayner, 2012). In attending to the sustainable lifelong learning agendas of HEIs Sadler-Smith (2012) contributes to this debate by arguing that it is impossible for learners to adopt a metacognitive approach without an informed awareness of their own habitual and information processing preferences.

While there has been considerable development in our understanding of cognitive styles with research demonstrating integration of education, neuroscience, and cognitive psychology perspectives (Kozhevnikov, Evans, & Kosslyn, 2014) along with evidence of enriched cognitive styles pedagogies (Evans, 2013a), explicit guidance on how such understandings of cognitive styles can be applied to learning and teaching in HE has been relatively limited (Evans & Waring, 2012).

Evans (2013) in defining what an enriched cognitive styles pedagogy constitutes places emphasis on the existence of an integrated approach in the consideration of: (a) theoretical frameworks from a range of disciplines (education, psychology, neuroscience); (b) a focus on overarching principles of styles applications to practice; (c) specialist development of knowledge and skills as well as the importance of supporting adaptation and transfer of learning to new contexts; (d) building on the strength of learner attributes; (e)



use of methodologies appropriate to context (quantitative and qualitative); (f) teacher and learner perspectives; (g) understanding of learners' cognitive styles profiles; (h) the role of other individual difference and contextual variables in addition to cognitive styles; (i) focus on the requirements of a specific learning task and overall learner development; (j) relationship between learning context and broader contexts (institution, society); (k) learning within the immediate context and wider networks (academic and social).

The Personal Learning Styles Pedagogy (Evans & Waring, 2014) is an example of an enriched cognitive styles pedagogy acknowledging the multifaceted nature of cognitive style working at different levels of cognitive functioning and in relation to different style families (Kozhevnikov et al., 2014). The PSLP framework has been successfully applied across a range of HE contexts (institution; discipline). It combines cognitivist and socio-cultural theoretical perspectives (Cobb, 1994; Packer & Goicoechea, 2000; Saxe, 1991; Tynjälä, 1999), and social critical theory (Butin, 2005). The framework is the outcome of evidence-based research and practice in naturalistic settings over the last fifteen years, including the systematic analysis of 707 full peer-reviewed journal articles from a total of 9073 articles (Evans, 2013a; Evans & Waring, 2012). It comprises five interrelated components of educational practice which together provide the holistic framework essential to the design of effective learning and teaching in higher education.

The five components of the framework are: (A) Exploration of learners and teacher beliefs / modelling and support; (B) Careful selection and application of models to suit the requirements of the learning context; (C) Optimising conditions for learning; (D) Design of learning environments - to promote an integrated approach to the application of cognitive styles to learning and teaching; (E) Supporting learner autonomy: choices in learning and learner voice (See Table 1).

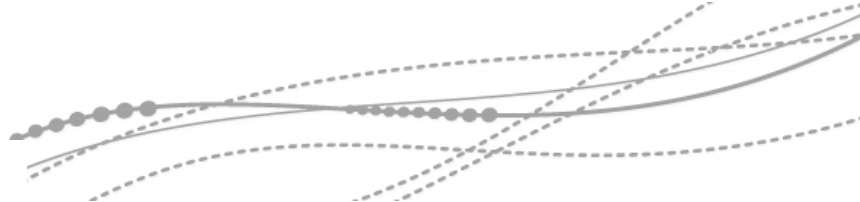


Table 1. Components of a Personal Learning Styles Pedagogy (Evans & Waring, 2014)

A. Exploration of student and teacher beliefs/ modelling and support

- (i) Focus on the learning histories of student and teacher.
- (ii) Holistic understanding: Consideration of the whole experience of the learner.
- (iii) Exploration of learner (student and teacher) beliefs about learning (e.g., ability, self-efficacy, identity and sense of fit within learning contexts).
- (iv) Enhancing learner awareness and application of styles as part of ongoing instruction on individual learning differences. Understanding of individual differences central to the design of learning environments.

B. Careful selection and application of styles

- (i) Judicious and informed use of instruments /styles models.
- (ii) Critical analysis of styles as part of instruction on individual learning differences. Appropriate application of styles models: Instruments used as metacognitive tools to support understanding of the learning process.
- (iii) An integrated approach: Awareness of the interdependence of cognitive style and other individual learning differences – role of cognitive style as a moderator variable.
- (iv) Development of cognitive styles as an integral element of culturally responsive pedagogies.

C. Optimising conditions for learning: Sensitivity to learner context

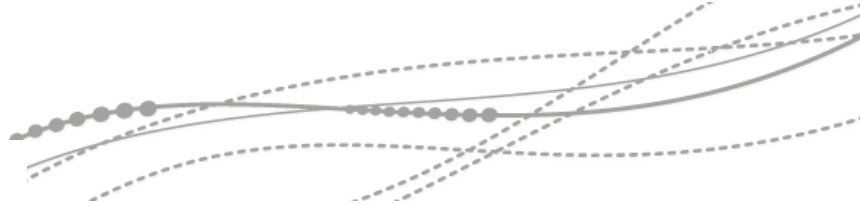
- (i) Sensitivity to needs of the learner: Recognising unique starting points. Addressing the emotional dimension of learning: Working with students to ensure readiness (will and skill).
- (ii) Enabling a positive learning environment: Focusing on supporting students during important transition points in their learning.
- (iii) Care afforded to how new ideas introduced as to the level of cognitive complexity in order to support learner flexibility.
- (iv) Supporting learners' integration into communities of practice.
- (v) Attention given to learners' networks of support and development of identity within academic context.

D. Design of learning environments

- (i) Housekeeping attended to (organisation of resources; information for students and lecturers etc).
 - (ii) Teaching methods informed by an understanding of cognitive styles and attuned to the requirements of the content and context (constructive alignment).
 - (iii) Aimed at supporting learners in developing understanding of learning to think within a specific discipline and to become part of that community.
 - (iv) Judicious use of accommodation of cognitive styles and the concept of matching.
 - (v) Judicious approach in promoting development of the most appropriate cognitive styles for specific contexts.
 - (vi) Teaching strategies aimed at stretching the student through careful addition and removal of scaffolding and sufficient constructive friction: Aimed at developing and broadening cognitive styles and strategies as and when appropriate.
 - (vii) Designs focused on encouraging learners to adopt deeper and more self-regulated/directed approaches to learning (constructivist approaches with a strong emphasis on the development of metacognitive skills).
- Supporting learners to reflect critically on the learning process to include self- and co-regulation. Appropriate use of tools to support process.
- (viii) Maximising learning opportunities: Design of learning environments focused on enhancing awareness of different learning strategies through explicit guidance and exposure to diverse learning experiences: Different ways of seeing and doing, observation, modelling, practice, application, reinforcement, and transfer.
 - (ix) Authentic and appropriate assessment designs to support the development of deep approaches to learning.
 - (x) Appropriate use of technology to support learning.

E. Supporting learner autonomy: Choices in learning / student voice

- (i) Focus on the centrality of the learner as a co-creator of knowledge.
- (ii) Focus on the role of the student in managing the learning process. Learners as co-designers of their learning experience(s).
- (iii) Learner control afforded through design of curriculum (content, process, product) including e-learning possibilities.
- (iv) Flexible designs facilitated through, for example, organisation of resources to maximise access; choices in pathways through programmes; nature of assessment.
- (v) The importance of guided/informed choice for learners.
- (vi) Informed and responsible use of groupings individual and group work. Collaborative learning opportunities informed by understanding of styles (e.g., dangers/limitations of labelling, justification for groupings).



The PLSP is a flexible framework; it can be used in the implementation of specific innovations or can serve as an overarching holistic framework. Using this framework to address Goswami's (2006) concern about making ideas accessible to practitioners it is possible to highlight key messages for learning and teaching; selected examples will be provided for each component of the PLSP (for a fuller elaboration, please see Waring & Evans, 2015 where explicit elaboration of each component and subcomponent is provided).

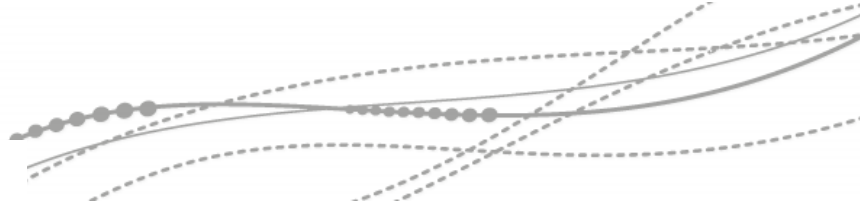
Exploration of learners and teacher beliefs / modelling and support

It is fundamental to attend to learner beliefs and perceptions about learning in order to effect positive change (Pilitsis, & Duncan, 2012). Positive perceptions of the learning environment lead to the adoption of a deep approach to learning, higher levels of learner engagement with programmes of study (Ullah, Richardson, & Hafeez, 2011), better engagement with assessment (Segers, Gijbels & Thurlings, 2008), and higher levels of learner retention (Van Bragt, Bakx, Teune, Bergen, & Croon, 2011). Failure to explain the rationale of new learning designs aimed at promoting deeper approaches to learning can have significant unintended negative side effects, with learners adopting more surface approaches to learning (Balasooriya, Tetik, & Harris, 2011).

Careful selection and application of models to suit the requirements of the learning context

How and indeed whether cognitive style instruments need to be used are fundamental questions for teachers to address. Such tools where applied should be used as teaching tools to promote understanding of learning processes rather than as labelling tools (Yates, 2000). Using tools requires an understanding of the hierarchical, multidimensional, pejorative nature, and relative flexibility of cognitive style. If cognitive tools are required emphasis must be on the appropriate use of robust, reliable and valid tools that are appropriate for use within the specific context.

The mapping of empirically derived cognitive style families (*perception, concept formation, higher order cognitive processing, and metacognitive processing*) to



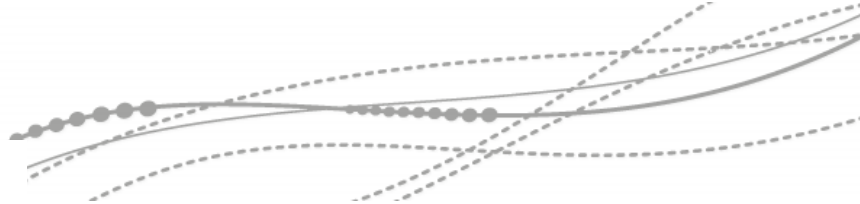
four different levels of information processing (*context-dependency vs. independency, rule-based vs. intuitive processing, internal vs. external locus of control, and integration vs. compartmentalization*) (Kozhevnikov et al., 2014) enables learners (students and teachers) to identify those styles that might be particularly useful in the completion of specific learning tasks.

Optimising conditions for learning

It is important to acknowledge that there are many potential cultural layers that impact on the development of an individual's cognitive styles profile; from the micro (individual) to macro level (society). Of high interest is how an individual's involvement in many different cultures existing at all levels (individual, family, education, professional, society, ethnicity) impacts on the development of his / her cognitive styles profile. How an individual filters information, and moves between different cultures reinforcing or adapting his/ her cognitive styles profile is important in seeking to understand and support learner development especially within 21st century learning environments (Signorini, Wiesemes, & Murphy, 2009).

Attending to the relational dimension of learning is important in order to support learners to effectively navigate the many different communities of practice (academic and social) that they participate in and to choose their level of membership and engagement in different communities. Of particular importance is the nature of the relationship between learners' cognitive styles, their perceptions of the environment, identity development, and self-efficacy in their membership of different learning communities within and across different learning environments. A high sense of membership within an academic community along with active engagement in learning has been found to be related to the adoption of deep approaches to learning (Kek & Huijser, 2011) and to completion rates (Bluic et al., 2011).

While cognitive style is a relatively flexible construct some individuals are capable of greater style flexibility than others. It is also evident that exposure to different roles, experiences, cultures can promote style flexibility (Zhang, 2013). The key issue for teachers is in providing sufficient challenge and support.



Some learners may be particularly vulnerable at key learning transition points (Choi, Lee, & Kang, 2009) and will require additional scaffolding to be able to adapt ways of learning to suit a specific context. Three broad recommendations have been made to address both learner variations in cognitive style flexibility and the potential impact of

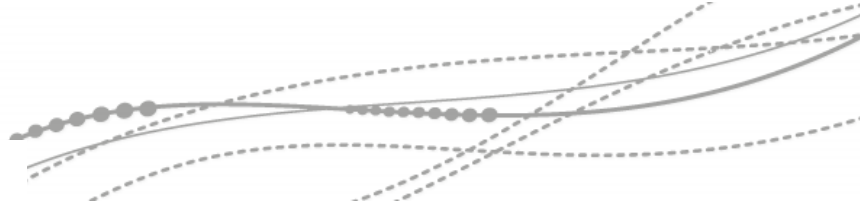
the learning environment to reinforce or ameliorate potential style flexibility in learners: (i) reducing the complexity of the learning environment in order to reduce cognitive complexity and cognitive overload in learners (Kyndt, Dochy, Struyven, & Cascallar, 2011); (ii) enhancing learner strategy development – e.g., working with learners to improve the efficiency of working memory and development of long-term memory (Minear & Shah, 2006); (iii) using a reflective and critical approach whereby instructors are encouraged to consider how their approach to planning could assist/restrict learner learning and to consider alternative learning and teaching

approaches to assist style flexibility within their learners to encourage independence and not dependence on a particular mode of delivery (Renzulli & Sullivan, 2009; Waring & Evans, 2010).

Design of learning environments - to promote an integrated approach to the application of cognitive styles to learning and teaching

The PLSP approach advocates implementing overarching principles of effective learning for all learners rather than individual instruction for each and every learner. It is concerned with empowering learners to take responsibility for their own learning through an informed understanding of cognitive style. In order to support the development of learner self-regulatory skills housekeeping issues are of fundamental importance (provision and organisation of resources and teaching, explicit guidance, timing of assessment, authentic assessment; development of blended learning environments) see Evans & Waring, 2009; Waring & Evans, 2015 for an overview.

The PLSP approach acknowledges the pejorative nature of cognitive styles in that certain cognitive styles may be more useful and fruitful in the completion of specific tasks in specific contexts (Zhang & Sternberg, 2009); the role of the

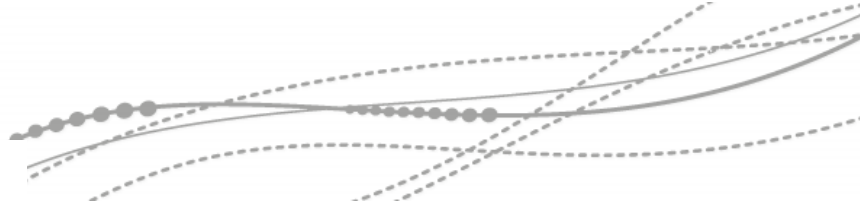


teacher should be to actively promote learner development of certain cognitive styles and to actively discourage the development of other styles to meet the requirements of specific contexts (Fan, Zhang, & Watkins, 2010).

Caution regarding the value of trying to match learner and teacher styles is advocated given that each learner has a cognitive styles profile comprising different layers of the cognitive style hierarchy and different cognitive styles families (Kozhevnikov et al., 2014; Nosal, 2009).

In supporting learning the emphasis should be on developing ways to encourage learners to adapt to different learning environments rather than to design adaptive systems (Choi, et al., 2009). Emphasis should be placed on supporting learners' development of self-regulation skills; an important area of this is acknowledging the role of cognitive styles on learners' abilities to access, make sense of, and give feedback. Understanding how learner's access and process information and facilitating them to map their feedback networks can be highly effective in identifying and supporting learners with impoverished feedback profiles (Evans, 2013b; Evans & Waring (in press); in this way learners can be supported to maximise feedback opportunities as part of sustainable learning.

Effective e-learning environments informed by a cognitive styles perspective also promote adaptive rather than adapted systems. Given that learners styles profiles are complex and changeable it is important that an e-learning environment enables flexibility in how learners can engage with it. An enriched e-learning pedagogy is about more than matching pedagogical preferences or increasing awareness of different styles. It is about an integrated understanding drawing on research about deep learning, diversity, authentic learning with IT and the relationship of these elements with the personalising learning process (Jones & McLean, 2012). Effective cognitive styles mediated e-learning environments promote sustained interactivity (Samah, Yahaya, & Ali, 2011). Developing e-learning environments that "discourage the 'grab-and-go' strategy associated with surface learning, and encourages the more explorative and interactive strategies associated with deep and active learning", is identified by Knight (2010, p. 74) as key to increasing learner understanding and potential

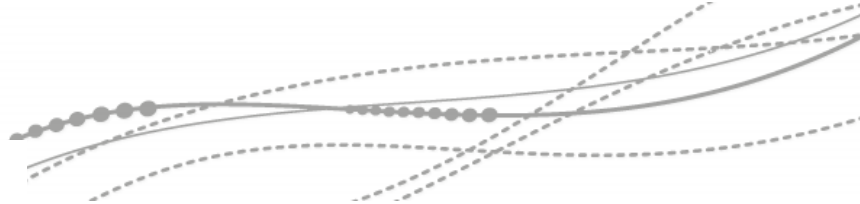


performance. In summary, cognitive styles mediated e-learning pedagogies incorporate key elements of good design that are applicable to all learners regardless of their styles (Chen & Liu, 2011).

Supporting learner autonomy: choices in learning and learner voice.

It is important to acknowledge the centrality of the learner within the learning process as a co-constructor of knowledge mindful of the fact that learners vary considerably in their ability, readiness and willingness to engage within learning environments (abilities – e.g., self-regulatory capacity, cognitive style flexibility, subject knowledge, personal learning histories). Curriculum design should support informed choice for learners especially in relation to group and individual activities (Renzulli & Sullivan, 2009). Exposure to a broad range of learning experiences and the opportunities afforded to deepen understanding by leading on projects of interest and participating in authentic assessment are important (Renzulli & Sullivan, 2009). Such approaches require careful scaffolding and training given the varying levels of self-regulation among learners. Judicious and effective training in the use of cognitive styles to support learning can enable learners to be more autonomous in their control over their learning over a sustained period of time (Mayfield, 2012) and specifically in making more informed and effective choices in learning (Leithner, 2011).

To support learner autonomy learners need support in managing their learning transitions. Supporting learner transitions requires (i) empathetic awareness of the fact that individuals learn in different ways (Campbell, Smith, Boulton-Lewis, Brownlee, Burnett, Carrington, & Purdie, 2001); (ii) clarifying with learners that cognitive styles are just as important as abilities are in their learning in order to support them in developing more adaptive attributions (Zhang, 2010); (iii) supporting students' basic psychological needs which are linked to intrinsic motivation (Devi, 1971) to enhance satisfaction and adoption of deeper approaches to learning (see Betoken, & Artiga, 2011); (iv) supporting students to develop different/ more appropriate frames of reference for new learning environments (Yang & Tsai, 2010); (v) working with students to enhance cognitive flexibility (Vitiello, Greenfield, Munis, & George, 2011); (vi) ensuring

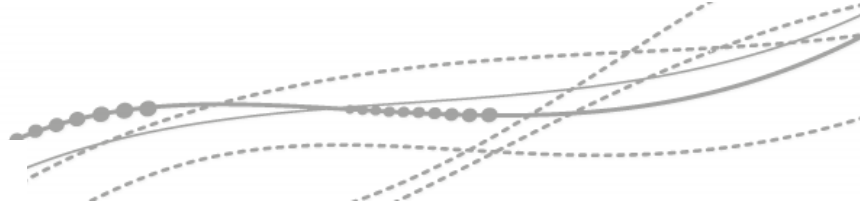


coherent programme design (Wilson & Fowler, 2005); (vii) explicit introduction, and induction into the requirements of new learning environments and purposes of specific learning activities (Karagiannopoulou & Christodoulides, 2005).

The cognitive styles perspective as articulated in this article and associated literature base provides an important tool for teachers to use in reviewing how they can use and develop their practice by integrating a cognitive styles approach within instruction. The PLSP is an example of a participatory pedagogy but what separates it from other models of differentiated instruction is its focus on cognitive styles. The cognitive styles emphasis as a fundamental element in developing learner self-regulatory practice should be an essential feature of any differentiated instruction to maximise the potential and efficacy of learning environments for all learners and teachers in order “to take the best of what theories have to offer and apply the concepts in artistic ways within the [learning context]” (Minter, 2011, p. 8).

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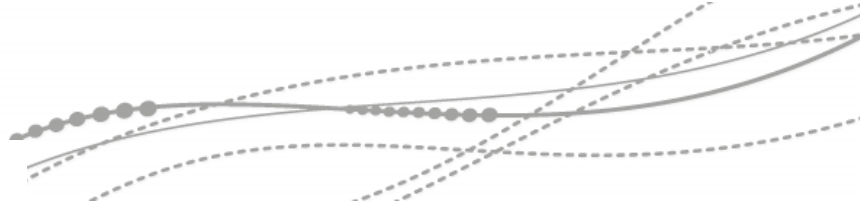
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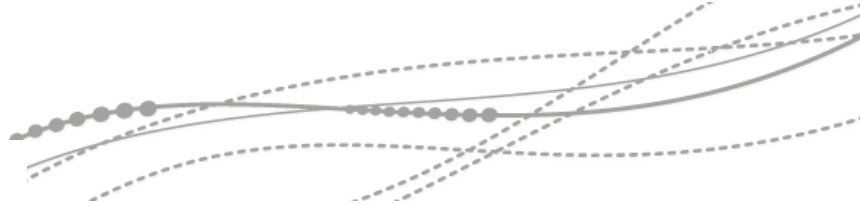
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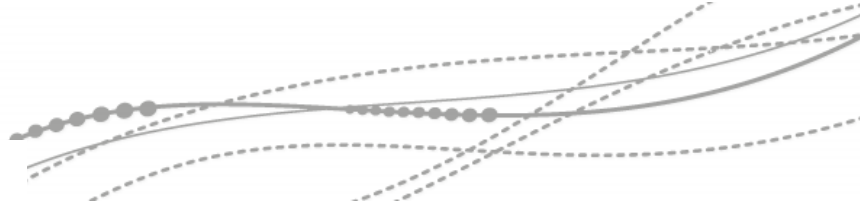
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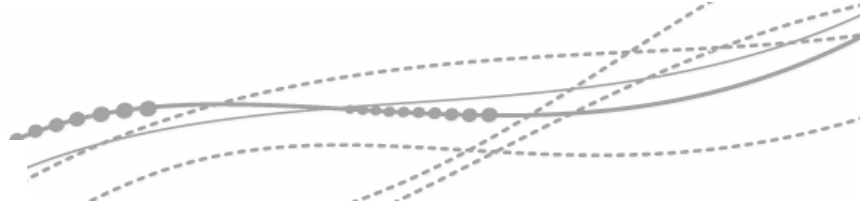
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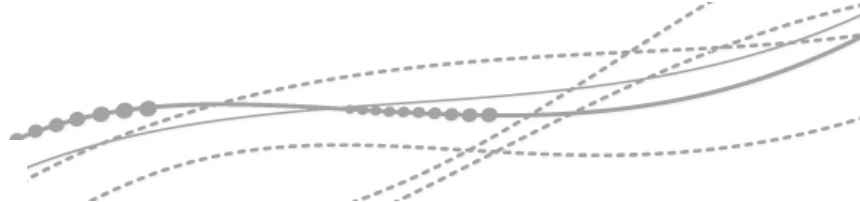
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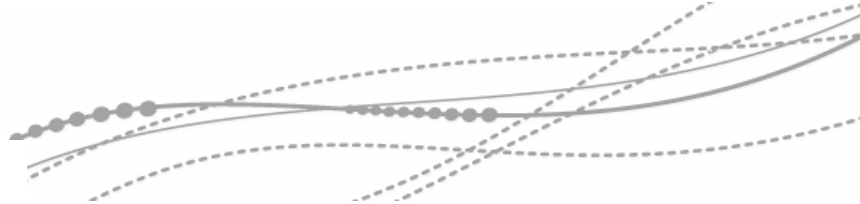
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Reinventing assessment and teaching practices in higher education: reflections built on the AVENA project

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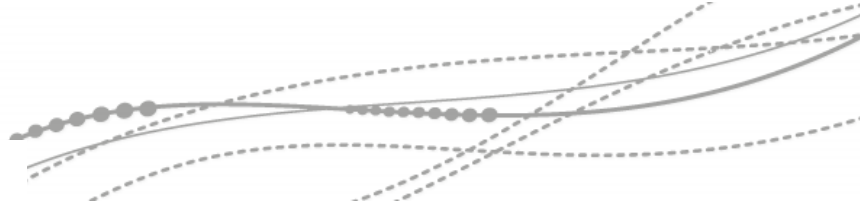
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ABSTRACT

Research reported and discussed in this presentation was developed within a 42-month international research project (2011-2014) involving 36 researchers from four Portuguese and three Brazilian universities. The Project – Avaliação, Ensino e Aprendizagens em Portugal e no Brasil: Realidades e Perspectivas - has been financed by National Funds through Fundação para a Ciência e Tecnologia (FCT) - Foundation for Science and Technology – Project PTDC/CPE-CED/114318/2009.

The overall purpose of the project was to describe, to analyse, and to interpret teachers' teaching and assessment practices in a variety of undergraduate foundational courses of either practical or theoretical/practical nature in each one of the following knowledge domains: Social Sciences, Arts and Humanities, Health Sciences, and Sciences and Technologies. Besides, the project was also aimed at studying teacher and student perceptions on a variety of assessment, teaching, and learning dimensions.

This presentation will be based upon the study that was developed within the four Portuguese universities that participated in the investigation. Thus, pedagogical aspects such as the following has been analyzed: a) teaching organization and classroom dynamics; b) teaching and assessment tasks as well as teacher and student roles; c) feedback; and d) utilization of assessments. Data were collected through classroom observations and both teacher and student interviews. Besides, in order to study student's and teacher's perceptions, a 45-item questionnaire on teaching, learning, and assessment issues was administered. Results have shown that although different professors shared quite similar pedagogical perspectives, they made use of different teaching and assessment practices. The study also showed that structured classes with clear and well defined purposes; diversified teaching and assessment dynamics; utilization of carefully selected tasks; student active participation in the learning and assessment processes; distribution of high quality feedback; utilization of formative assessment; and utilization of self and combined modes of assessment, are closely related to better student learning, according to both professors and students accounts. Questionnaire results illustrate that teachers and students share the same perceptions concerning many assessment, learning, and teaching issues. However, one could also notice that there are some critical issues on assessment and teaching that clearly divide teacher's and student's perceptions. Besides, this research enabled one to come up with some reflections on task nature, student participation, feedback, and quality of learning.



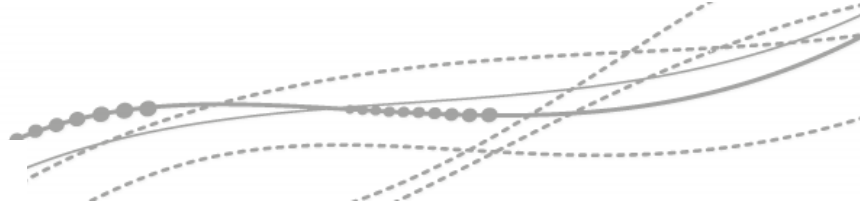
EXTENDED SUMMARY

Research reported and discussed in this presentation was developed within a 42-month international research project (2011-2014) involving 36 researchers from four Portuguese and three Brazilian universities. The project – Avaliação, Ensino e Aprendizagens em Portugal e no Brasil: Realidades e Perspectivas (AVENA) - has been financed by National Funds through Fundação para a Ciência e Tecnologia (FCT) -Foundation for Science and Technology – Project PTDC/CPE-CED/114318/2009.

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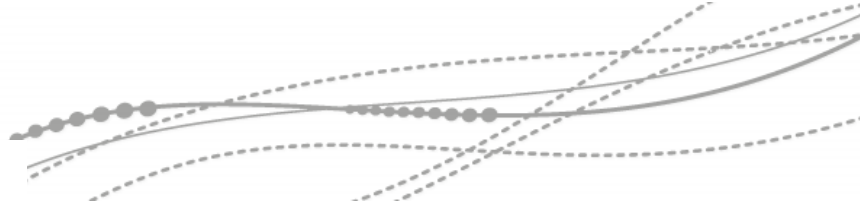
Research literature has been pointing out that students learn better when assessment and, in particular, formative assessment or assessment for learning, is integral to the organisation and development of teaching. Nevertheless, it is acknowledged that curricular practices at the higher education level, namely teaching and assessment, are mostly based in the so-called telling paradigm meaning that teaching is essentially a process where teachers are supposed to talk and students are supposed to listening and taking notes. Learning, under these circumstances, is generally assessed through tests and/or final examinations (e.g. Biggs, 2006).

In the last decades students have been entering higher education as never before. As a result, both traditional teaching and assessment practices have been questioned and under pressure to change. Besides, in the European context, in 1999, the so-called Bologna process put together a framework aiming at transforming and improving pedagogy and curricular practices in higher education. Consequently, there is a growing body of publications claiming, for example, that: a) there is a need for a greater integration of learning, teaching, and assessment; b) more attention should be put on the

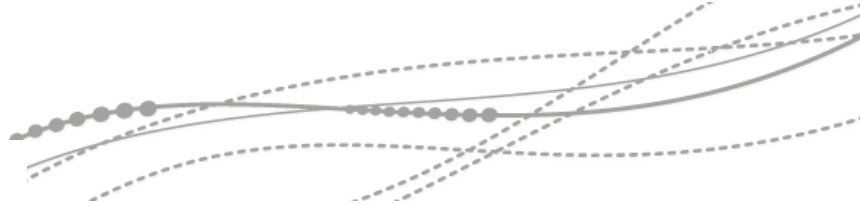


need to improve higher education teachers' expertise in the teaching, learning, and assessment knowledge domains; and c) there is empirical evidence showing that it is possible to improve higher education teachers' curricular practices (e.g. Bryan & Clegg, 2006; Falchicov, 2005; Menges & Austin, 2001). Indeed, in a literature synthesis of 30 empirical studies developed in a ten-year time span (2000-2009) Fernandes & Fialho (2012) concluded that new and innovative ways to assess students' learning have necessarily to be related with profound changes in the organisation and development of teaching. They also inferred that innovative assessment, namely formative assessment or assessment for learning, could only make sense if, for instances, students are provided with quality feedback, are engaged in finding solutions to a variety of tasks, interact on a regular basis with their colleagues and their teachers, use self-assessments and different forms of "interactive assessments" (e.g. peer assessment, small-group assessment) to regulate their learning, and participate in the processes of curriculum decision-making at the classroom level.

These are all pedagogical issues at the classroom level, particularly curriculum development ones, that need to be understood and that are still under-researched because there still is a need to elaborate in-depth descriptions, analyses, and interpretations about higher education teachers' curricular practices. This meaning that there is a need to look for patterns in those practices across different teachers, different courses and different specific contexts. Hopefully, as it has been referred to in the literature, these patterns might elicit the construction of a framework that could be a heuristic means to develop in-depth discussions and reflections on theoretical and practical curriculum matters (e.g. Menges & Austin, 2001). These authors, in their seminal paper, provided an in-depth discussion on a research framework for teaching in higher education that takes into account five interrelated elements: context, content, learner, teacher and teaching and learning environment. Besides, they discussed a set of recommendations for future research in areas such as Faculty Learning and Development; Interactions among Teacher, Learner, and Method Variables; Influence of the Discipline; and Context-Specific Research.



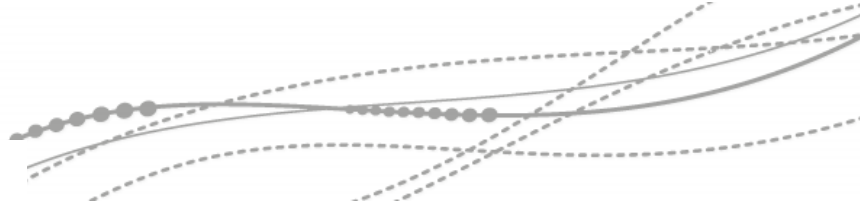
Obviously, pedagogical and curriculum issues are closely associated and one needs to take that into account when it comes to interpret and to reflect on what happens within classroom contexts. Barnett (2009) provides a discussion where pedagogy plays a significant role in developing those dispositions and qualities that, according to this author, students need in order to acquire knowledge. Thus, Barnett distinguishes the “immediate” relationship between teachers and what and how they teach from the “mediate” relationship between students and the curriculum they experienced. As it has been pointed out by other curriculum researchers (e.g. Goodlad, 1979; Goodson, 1997), Barnett also stresses the difference between the proposed curriculum and the curriculum experienced by the students. Ultimately, he mentions, it is the pedagogical relationship that could provide students with the dispositions and qualities that enable them to appropriate the curriculum in a meaningful way. Although Barnett considers that a curriculum in higher education should be built on the grounds of a “project of knowledge”, he clearly refers that knowledge and the skills that enable one to deal with the world are not enough. In fact, he argues that the idea of “being” is a third significant element that might enable people to deal with this world’s high complexity and, in his view, must have curriculum implications. Young (2008) also underlines the relevance of knowledge in the curriculum and brings up the idea of “social realism”, recognizing the social basis of knowledge but underlining its context-independent nature and the differences between knowledge and common sense. Young states that the “curriculum of the past”, advocated by the so-called neo-conservatives, ignores the surrounding social context where the curriculum “lives”. On the other hand, he mentions, the “curriculum of the future” which the so-called instrumentalists advocate, fails to acknowledge that cognitive interests determine the extent to which any curriculum enables one to acquire knowledge. According to Young, discussing what the students should learn has been a neglected issue both by public policies and by educational researchers. Thus, on the grounds of his social realist approach he provides a set of guidelines and foundation principles that should orient curriculum policies (e.g. knowledge needs to be conceived as a “non-reducible element in the changing resources that people need access to in



order to make sense of the world (p.90)”; if a curriculum was based on everyday experiences then it would only be recycling those experiences; the relevance of a curriculum based on research and pedagogy; the curriculum content and forms should be seen as dynamic and ever evolving issues). In the process of rethinking curriculum theory Young (2008, p. 92) remarks that “(...) we cannot go back to tradition or God in deciding what to teach: we have only reason, knowledge, and history”.

For the purposes of this investigation data were collected through teachers’ in-depth interviews, focus-group interviews with students and classroom observations (about 20 h per teacher). For each one of the above-mentioned knowledge domains two volunteer teachers, teaching two different undergraduate courses of a given programme, were deliberately selected to participate in the study. A research framework defined the main research objects (e.g. teaching, assessment) and, for each one of the objects, a set of relevant dimensions (e.g. classroom dynamics; teaching planning and organization; nature, frequency, and distribution of feedback; nature of assessment). Based upon this framework both interview and observation protocols were conceived and developed through a collaborative and peer-review process. These protocols provided the necessary basis to guide data collection processes and to reach acceptable levels of consistency.

Data organization and systematization, in a first phase, was developed by building up narratives on teaching and assessment practices have been produced: one as a result of the observations and the other two as a result of teachers’ and students’ interviews. In a second phase these three narratives were synthesized into one providing an integrated description of both teaching and assessment practices of each teacher. Therefore, at this stage, for each one of the above-mentioned knowledge domains, there were eight narratives – one for each teacher/course. Finally, the narratives for each knowledge domain were integrated into one and, as a result, a total of four narratives were obtained. Each one of these four narratives is an account of both the observed and perceived teachers’ curricular practices.



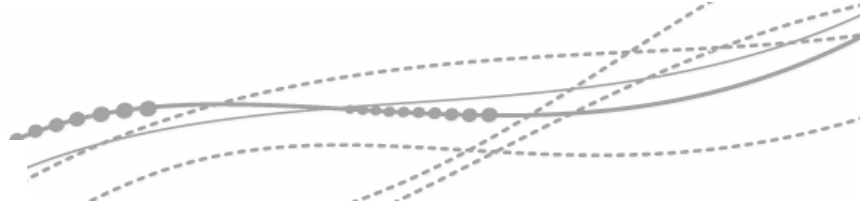
The aggregation and transformation of qualitative data followed the recommendations of Wolcott (1994) and took into close account both the research framework and the instrumentation produced. In order to study student's and teacher's perceptions, a 45-item questionnaire on teaching, learning, and assessment issues was administered. Quantitative data generated by the questionnaires were analyzed by means of a variety of inferential statistic procedures (e.g. Kirk, 1984).

Results have shown that although different professors shared quite similar pedagogical perspectives, they made use of different teaching and assessment practices. The study also showed that structured classes with clear and well defined purposes; diversified teaching and assessment dynamics; utilization of carefully selected tasks; student active participation in the learning and assessment processes; distribution of high quality feedback; utilization of formative assessment; and utilization of self and combined modes of assessment, are closely related to better student learning, according to both professors' and students' accounts. Questionnaire results illustrate that teachers and students share the same perceptions concerning many assessment, learning, and teaching issues. However, one could also notice that there are some critical issues on assessment and teaching that clearly divide their perceptions. Besides, this research enabled one to come up with some reflections on task nature, student participation, feedback, and quality of learning.

Keywords: Pedagogical Practices; Curricular Practices; Teaching Practices; Assessment Practices; Formative Assessment; Higher Education.

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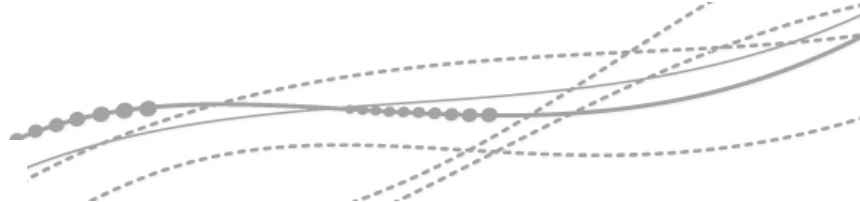
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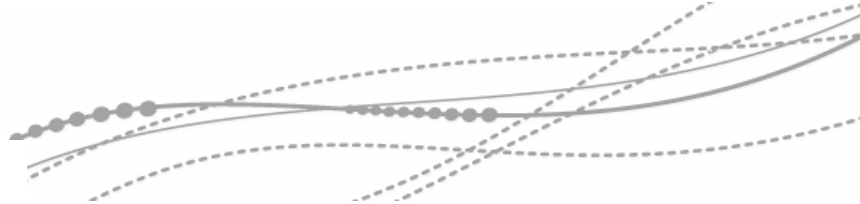
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Promoting university students' inquiry-based learning through use of questioning: Review of previous research and description of new research in Japan

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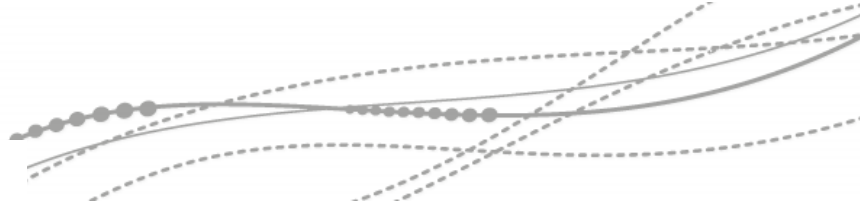
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ABSTRACT

This presentation provides a brief review of previous questioning research in Japan and then describes research conducted by the authors.

Study 1 examined student variables related to question generation. The findings indicate that perceived cognitive cost of questioning, and not knowing how to generate appropriate questions, were variables related to the number of questions that students generated. In Study 2, the long-term effects of question generation training were examined. Students were provided with “question stems” to support their question generation, and how the number of questions they generated changed in the long-term (during baseline, training, and post-training phases) was analyzed. The results showed that the number of questions generated was largest during training. However, during post-training, the number of questions returned to the baseline phase level. In Study 3, the objective was to find a viable way to promote students' long-term question generation. Two classes, a Control class and an Experimental class, were formed. In the Control class, students' question generation performance did not count toward their course grade. In contrast, in the Experimental class, the instructor announced to the students that their question generation performance would count toward their course grade. The results showed that the number of questions generated were consistently larger in the Experimental class. Thus, the effect of evaluating students' questioning performance was confirmed as effective in promoting students' question generation in the long-term. In summary, these studies show that students have difficulty verbalizing questions (study 1). However, providing question stems to facilitate their verbalization of questions has only a temporary effect and is not enough to promote long-term question generation (study 2). Study 3 found that one way to promote students' long-term question generation is to include question generation performance in their evaluation and course grade.



EXTENDED SUMMARY

Promoting university students' inquiry-based learning through use of questioning: Review of previous research and description of new research in Japan

Yoshinori OYAMA (Chiba University) & Emmanuel MANALO (Kyoto University)

Higher education provision in Japan needs to adopt alternative ways of teaching, such as reciprocal learning and 'flipped classroom' approaches, to promote the development of crucial 21st century skills in students. The majority of university classes, however, still relies on of the lecture method, and students are generally passive in their learning. The aim of the research described here was to assist in the development of students' question generation skills and promote university students' inquiry-based learning.

Study 1

The objective of Study 1 was to examine variables that could relate to question generation. Previous studies have suggested that variables such as meta-cognition and cognitive cost could possibly influence learners' question generation. However, the extent of that influence and what teachers should target in classroom interventions remained unclear.

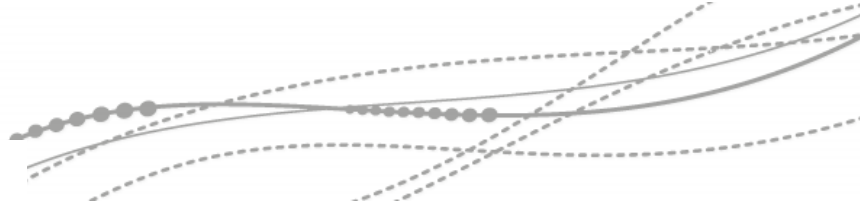
1.1 Method

1.1.1 Participants and Procedure

The participants were 96 undergraduate students taking a psychology class. The questionnaire booklet containing the research items was distributed at the end of one lecture session.

1.1.2 Materials

Assessment of Meta-Cognitive Skills



The participants' meta-cognitive skills were measured using the Japanese version of Schraw & Dennison's (1994) Metacognitive Awareness Inventory (Abe & Ida, 2010).

Question Generation Task

The Participants' were randomly assigned to read a Japanese version of a short passage describing either "Clouds" or "Dissolved Oxygen", based on Costa's (1997) study (cited in Otero & Graesser, 2001). Half of the participants read the "Clouds" passage and the other half read the "Dissolved Oxygen" one. After reading the passage, they were asked to write questions that occurred to them while reading. After writing the questions, the participants were given four short questions to check their passage comprehension.

Beliefs about the Use of Questions

The participants' belief about the use of questions were measures by using four items: "cognitive cost of question generation", "recognition of the effect of generating questions", "easiness of questions verbalization", and "not knowing how to generate an appropriate question". They were asked to respond using a six-point Likert-type scale (1: strongly disagree to 6: strongly agree).

1.2 Results

1.2.1 *Relation to the total number of questions participants' generated*

Based on King's (1995) study, the questions generated by the participants were categorized by two raters as either "factual" (e.g., What is a schema?) or "thought-provoking" question (e.g., How is a schema different from a script?). The inter-rater agreement was considered satisfactory (Cohen's kappa coefficient = .94). Examples of the participants' questions are shown in Table 1.1.

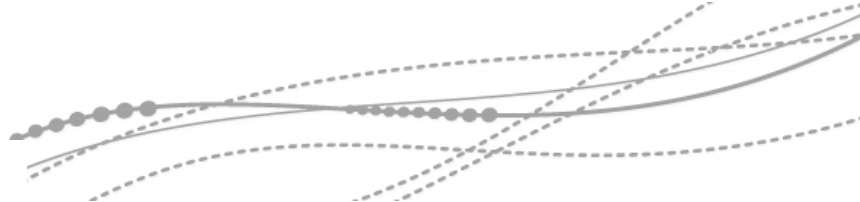


Table 1.1 Examples of questions participants generated

| Questions |
|--|
| Cloud: |
| Factual Questions |
| What is the distant between clouds and the ground? |
| What are the effect of friction and current in the air? |
| |
| Thought-Provoking Question |
| Why do clouds looks white? |
| Why do droplets in the clouds scatter lights? |
| What is the difference between water vapor and the droplets in the clouds? |
| |
| Dissolved Oxygen: |
| Factual Questions |
| What are the oxygen atom and the hydrogen atom s? |
| What are oxygen, nitorgen and carbon dioxide? |
| |
| Thought-Provoking Question |
| What will happen if water becom e polluted? |
| Why do the oxygen atom and the hydrogen atom s have strong bonds? |
| Why can oxygen, nitorgen and carbon dioxide be soluble in liquid? |

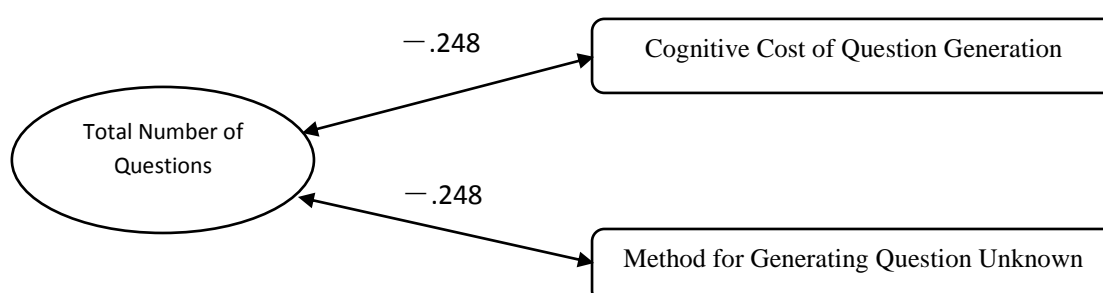


Figure 1.1 Correlations between Total Number of Questions, Cognitive Cost of Question Generation, and Lack of Knowledge About Question Generation

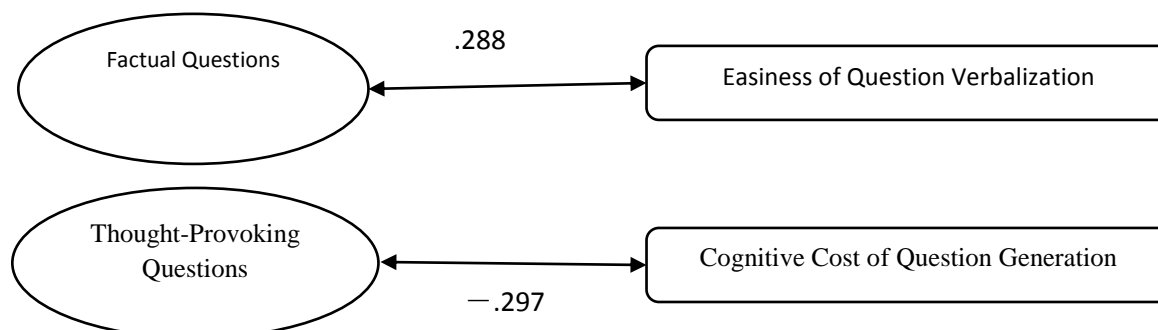
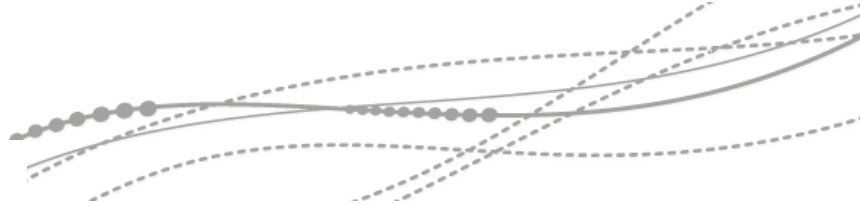


Figure 1.2 Correlations between Factual Questions and Easiness of Question Verbalization, and Between Thought-Provoking Questions and Cognitive Cost of Question Generation.



1.5 Discussion

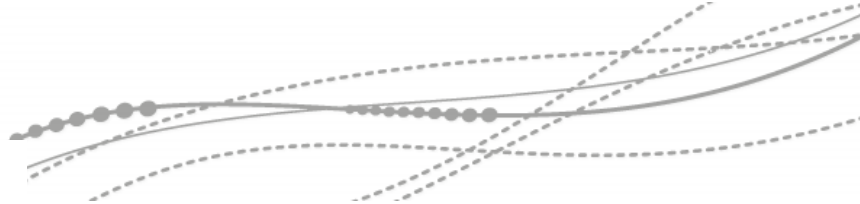
The result revealed that generation of factual questions is related to easiness of questions verbalization. Hence, teachers' support, for instance in providing question stems to help verbalization of questions, could possibly assist in the generation of factual questions. Therefore, in the next study, the effect of an intervention to promote learners spontaneous question generation by providing questioning stem to lighten their "cognitive cost of question generation" and ease "question verbalization" was examined.

Study 2

Previous studies (e.g., King, 1995) have reported positive effects of providing question stems in promoting learners' questions generation. However, those studies did not examine the longer-term effects of the intervention and whether learners spontaneously generate questions after the training period is not clear. Therefore, this study compared three learning phases (baseline, training, and post-training phases) to examine the longer-term effects.

2.1 Method

The participants were 61 undergraduate students taking an introductory psychology class. The class schedule was divided into three phases: baseline, training, and post-training. Each phase had six lectures in three weeks and, combined, lasted nine weeks in total. During the baseline phase, the participants received no training in generating questions, and a sheet to gather their feedback and spontaneous questions on the lecture topics was distributed at the beginning of every lecture. In the training phase, at the beginning of each lecture, the participants were given a "question matrix" (Fig. 2.1). The matrix had six blank spaces, and each had six question stems (i.e., why, relation / influence, advantage/disadvantage, similarity/difference, what if ..., and ... in the first place) that were aimed at assisting in the generation of "thought provoking questions" (King, 1995). In the post-training phase, the "question matrix" was not distributed to the participants and the instructor did not ask or verbally encourage the participants to generate questions: only a comment



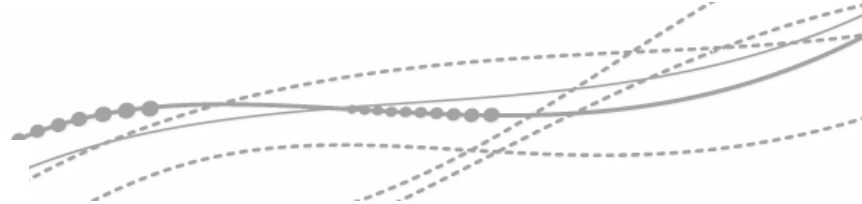
sheet, in the same format as the one handed out during the baseline phase, was given to the students. The generated questions were grouped into two categories by two raters using King's (1995) "thought provoking questions" and "factual questions" categories.

| Why | Relation Influence | / Advantage/ Disadvantage |
|---|--|--|
| e.g. "Why are people demotivated?" | e.g. "How is Freud's idea related to Jung's?" | e.g. "What's the main advantage of the client centered therapy?" |
| Similarity Difference | / What if | In the first place |
| e.g. "What are the similarities and differences of the classical and operant conditioning?" | e.g. "What if a child has no parents, would he/she fail to form attachment to others?" | e.g. "Do intelligence scales measure intelligence in the first place?" |

Fig. 2.1 Question Matrix

2.2. Results

A total of 225 questions were collected across the three phases from the 61 participants. Inter-rater agreement was considered satisfactory (Cohen's kappa coefficient = .92). First, the numbers of "thought provoking questions" across the three phases were examined (Fig 2.2). The result revealed a significant effect of phase on number of questions generated ($\chi^2 (2) = 29.2, p < .01$). A post-hoc test using Scheffe's pairwise comparison test showed statistically significant differences between baseline and training phases ($p < .01$), and between training and post-training phases ($p < .01$). Second, the numbers of "factual questions" across the three phases were examined. The result revealed a significant effect of phase on number of questions generated ($\chi^2 (2) = 12.3, p < .01$). A post-hoc test, again using Scheffe's pairwise comparison, showed



statistically significant differences between baseline and training phases ($p < .01$), and between training and post-training phases ($p < .05$).

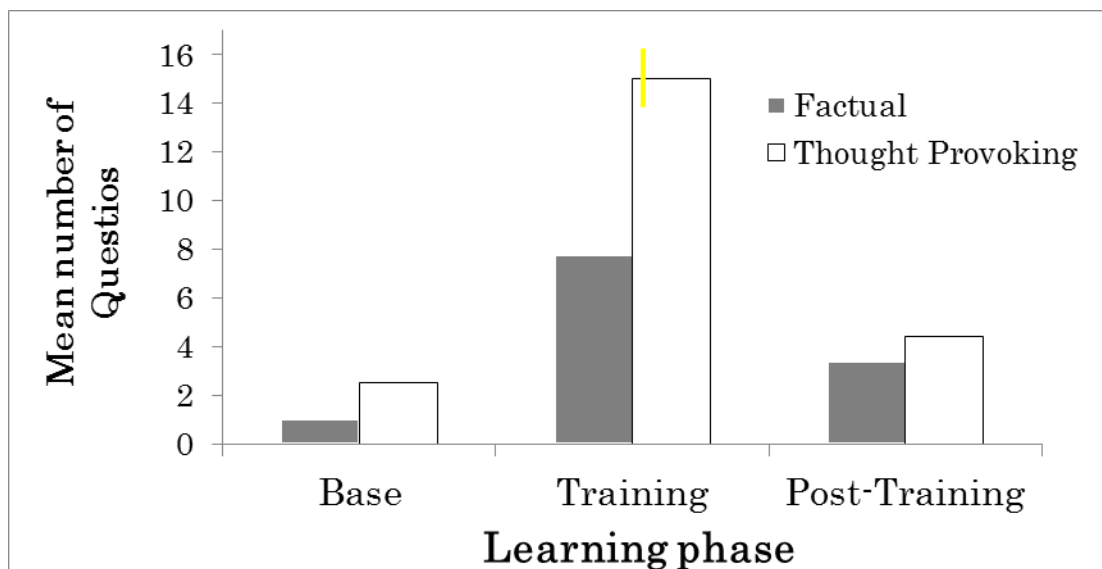


Figure 2.2 Changes of Number of Questions in Each Phase

2.3 Discussion

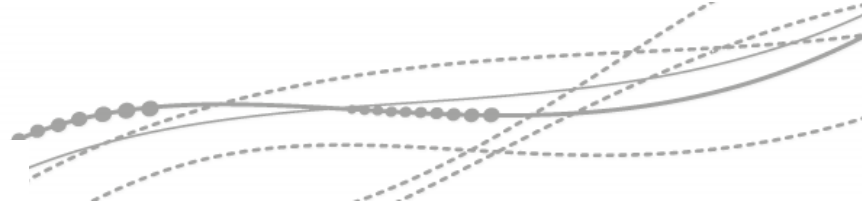
This study is distinctive in its examination of the long-term effects of providing question stems in training. However, the results of this study suggest that an intervention that only implements a novel strategy for learners to modify their learning behavior does not have long-term effects. The training must have elements that promotes the longer term use of the questioning in learning.

Study 3

The results of Study 2 revealed that after the training sessions end, the learners did not spontaneously generate questions. Study 3 further analyzed this phenomena in a classroom setting and explored how teachers could promote learners' spontaneous question generation.

3.1 Evaluation promotes question generation

Murayama (2003) reported that evaluation is a powerful tool that changes learners' learning strategy use. In Murayama's (2003) study, students in "fill in the blank" format test group relied on rote-memorization strategy, but students in the "writing short essay" format test group used deeper and more elaborative



learning strategies. Based on this finding, Study 3 tested the hypothesis that if question generation is made a part of the course grade and term papers are on the questions students generate, the number of questions would increase and students' questioning behavior would continue in the long term.

3.2 Method

Participants were sophomore students in educational psychology courses during the 2013 and 2014 academic years.

3.2.1 Control class

Students in the 2013 class were asked to generate questions concerning the materials covered in the course. Also, they had two quizzes (4th and 8th class sessions) during the semester.

3.2.2 Experiment class

Students in the 2014 class were asked to generate questions concerning the materials covered in the course and were told that their question generation was part of the course grade (5% of total) and they were required to turn in two reports based on questions they generated in the class (same period as the Control class, 4th and 8th class sessions).

3.3. Results

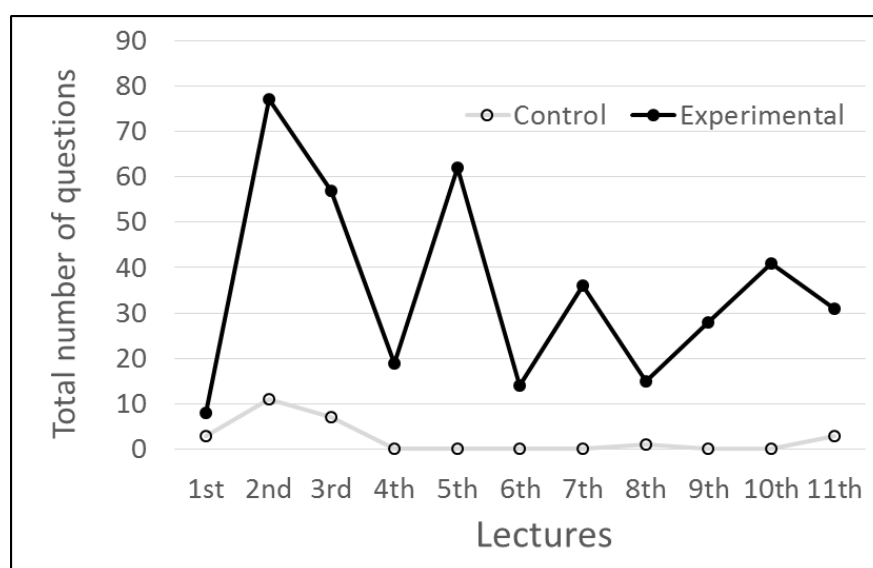
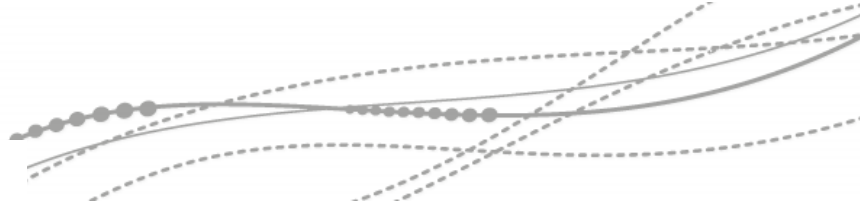


Fig.3.1 Total number of questions students generated



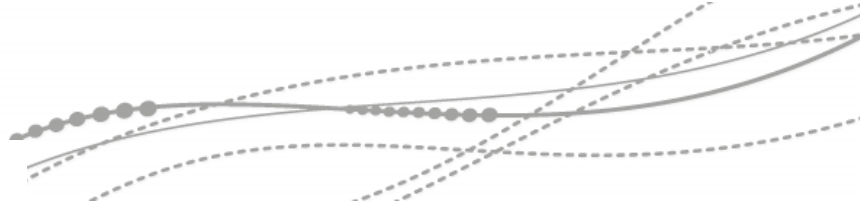
The total numbers of the questions per lecture are shown in Figure 3.1. Two-way ANOVA was conducted to analyze the effect of the two types of evaluation (quizzes or reports) on the questioning. The result showed a main effect of the lectures ($F(10, 1310) = 32.21, p = .00, \eta^2 = .197$) and the group ($F(1, 131) = 449.39, p < .001, \eta^2 = .77$), and the interaction between lectures and group ($F(10, 1310) = 25.49, p = .00, \eta^2 = .16$) was significant. Differences in the mean number of questions in control and experimental groups were assessed with Bonferroni multiple comparison procedure. The result showed that difference in number of questions generated for the control and experimental group was statistical significant for all lectures except the first session, during which only course introduction was provided, and no instruction in terms of evaluation of questions was provided.

3.4 Discussion

The results of Study 3 revealed that teacher's evaluation promotes student's long-term question generation. However, it is not truly spontaneous. Future investigations need to set up authentic spontaneous situations in which question generation is not a part of the grade. In addition, it is possible that students' belief toward question generation differs between the control and experimental group. The results of Study 3 also suggest that in terms of promoting university students' inquiry-based learning, teachers' role is not just to assist students' question generation, but also to evaluate the quality of questions students generate. It is possible that giving teacher or peer feedback on how to improve questions generated would help students' generate higher quality questions. Future studies need to examine these points.

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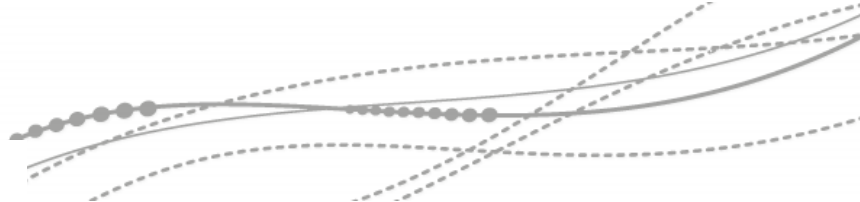


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Challenging Physics Lessons through questioning and collaborative work: research developed in Portuguese Higher Education Institutions

Nilza Costa

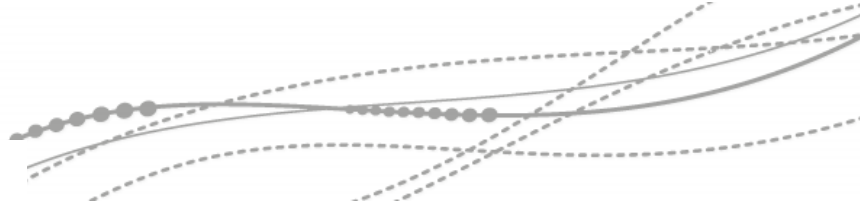
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ABSTRACT

Several studies show that Introductory Physics for non-physicist students, like engineering students, is a difficult subject being responsible for high level of academic failure. Students do not see the relevance of Physics for their curriculum, find it difficult to understand and do not see its relevance for everyday life. These have as a consequence the need to design the teaching and learning process in a way to overcome such obstacles. Since the late 90's of the 20th century that an American researcher, Eric Mazur, developed an instructional model which cornerstone is the concept question. Based on such model the author of this paper in collaboration with other researchers, working under her supervision, have been developing projects in several different educational settings aiming to use conceptual questioning in Introductory Physics disciplines for engineering students in order to promote academic success. In the first years of the development of these projects the researchers had a double role, assuming also the function of teachers. Then, in a second stage, and taking in consideration the importance of getting more teachers involved in the research and practice in the classrooms, the research team had decided to pursue with another aim- to study how to develop a collaborative way of work with other physic teachers in the same topic. This paper will then discuss the process and results of the research developed by the research team in the two stages mentioned above.

The potentialities of the methods used but also some constrains are putted forward as well as the challenges the research team is facing today.

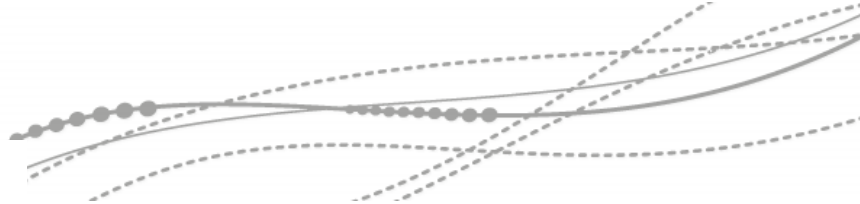


EXTENDED SUMMARY

In an expanding global technology society there is an ever increasing need for well qualified professionals, like engineers, being this one of the reasons why Higher Education Institutions have been criticized by several sectors due to the high levels of engineering student's failures, drop outs and graduation rates. Despite the complexity of this phenomenon, Physics courses in students' curriculum path have been pointed out as a barrier for engineering student's success (Jiang, & Freeman, 2011). Students have conceptual difficulties in understanding physics concepts and do not see its relevance for their degree and future profession (Booth and Ingerman, 2002; Smaill, 2012; Costa et al. 2012), which decreases their engagement in the teaching & learning process (T&L). These have as a consequence the need to (re)design the T&L process of Physics in Engineering Courses in order to overcome such obstacles and to promote academic success.

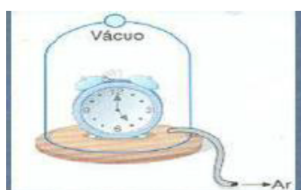
The author of this paper, in collaboration with other researchers working under her supervision (Oliveira, P. 2009; Oliveira, C. 2011; Chivangulula, 2014) have been developing projects in different educational settings focused on challenging the traditional lecture format which characterized the T&L process in order to promote engineering students learning in introductory physics classes. The conceptual framework underlying the didactical approach used was based on the instructional model developed since the late 90's of the 20th century by the American researcher, Eric Mazur, in which cornerstone is the conceptual question. Mazur's model, also known as *peer instruction method*, included a didactic sequence in a lecture with the main following steps (adapted from Litzinger et al., 2011):

- the lecture is divided into a set of short presentations by the teacher (around 15 min), each focused on a central physics concept/theory;
- after each short presentation, students are given a conceptual question in order to test their understanding of the physics concept/theory presented (see an example in Fig.1);



- students are given a few minutes to answer individually and then they are asked to explain their answer to the other students sitting around them. The teacher encourages students to provide the reasoning behind their answers;
- the students give their answers to the class;
- according to the students' answers the teacher decides what to do next (for example, moves to the next topic if the majority of the answers are correct)

ALARM CLOCK



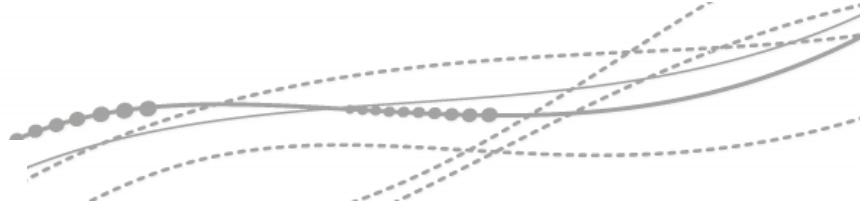
What happens to a bright and sonorous alarm clock when we put it in a bell vacuum?

- A) it rings, but doesn't flash
- B) it flashes, but doesn't ring
- C) it doesn't rings and doesn't flash
- E) it flashes and rings normally

Fig. 1: Example of a conceptual question in a physic class (adapted from Oliveira et. al., 2009, p. 99)

In the conceptual framework underlying the didactical approach used by our research team we have also included the principles and guidelines of *active learning* developed for several years, namely in the field of engineering education (Prince, 2014). Despite the considerable research which has been developed in this domain, and the contributions it brings to practice, we consider that Mazur's *peer instruction method* is aligned with it, as it can be seen by the following quotation: "On the simplest level, active learning is introducing student activity into the traditional lecture" (Prince, 2014, p. 225).

Empirical studies, mainly with a qualitative design, were developed by our research team using the didactic approach summarized above in two Portuguese Higher Education Institutions (Instituto Superior de Engenharia do Porto and the Universidade de Aveiro) and data was collected through questionnaires and interviews administered to students (Oliveira & Oliveira, 2013). The results show that "... the conceptual questions are a way to promote



motivation, increase the interactions in class and promote learning” (Oliveira & Oliveira, 2013, p. 422).

In the first years of the development of these empirical studies the researchers had a double role, assuming also the function of physics teachers. Then, in a second stage, and taking in consideration the importance of getting more teachers involved in the research and in the innovative practices, the research team decided to pursue with another aim, that is to study how to develop a collaborative way of work with other physic teachers in the same topic. Then, and in the line of other researchers (for example, Watts and Pedrosa, 2006), the team started to investigate how collaborative work between researchers of Didactics of Physics and Physics teachers, these being lectures of Introductory Physics courses to engineering students, may improve both their students’ learning and their professional development (Oliveira, 2011). In her work, Oliveira (2011) worked during one semester with a physic teacher at the University of Aveiro (Portugal) according to the general plan presented in fig.2.

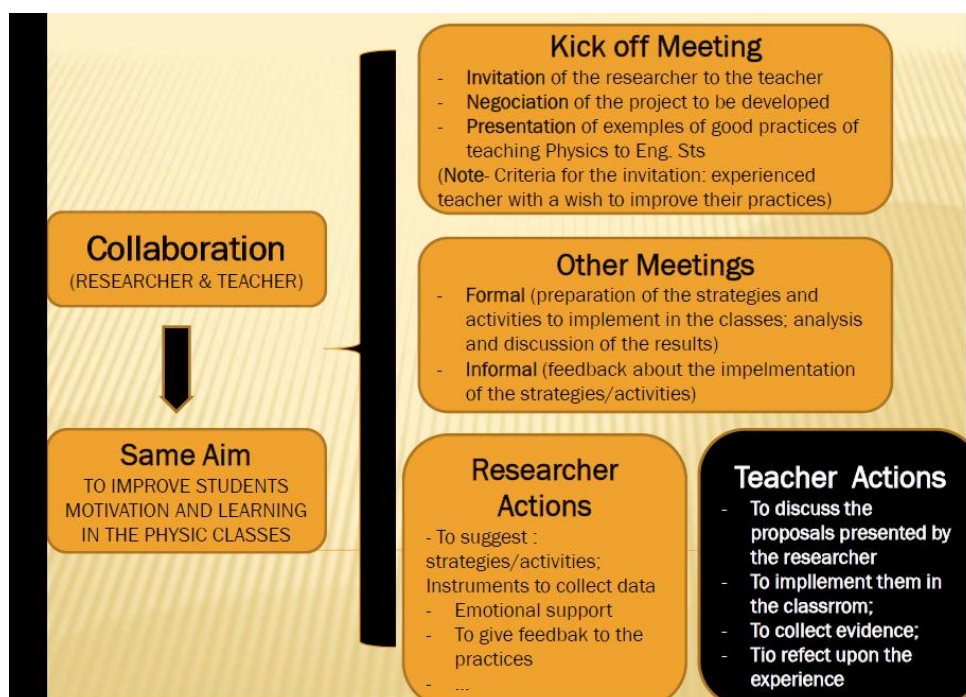
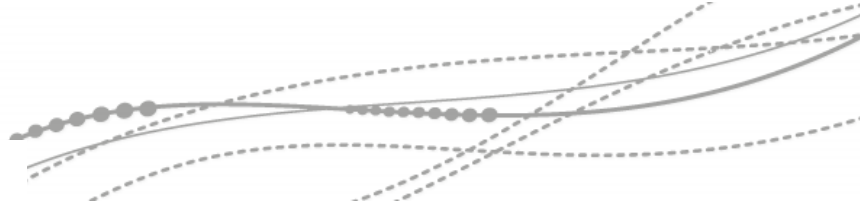


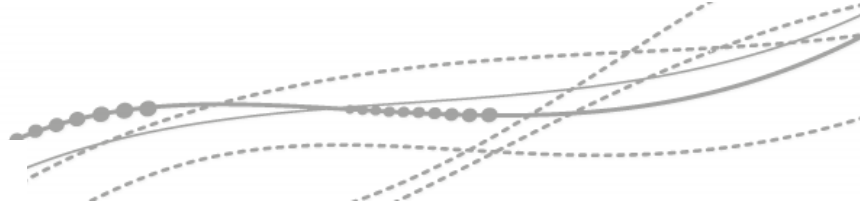
Fig.2: General description of the work developed by Oliveira (2011)



In her study, Oliveira (2011) gathered data through questionnaires and interviews to the students and interview to the teacher. The results of the study also show that the strategies used contributed to improve the motivation and students learning in physics. The teacher considered that the collaborative work with the researcher has contributed to her professional development, referring the following four main characteristics of the profile of the researcher to this effectiveness: the physics background of the researcher; the didactic of physics background of the researcher, namely in the domain of T&L physics for engineering students; the researcher availability and her relationship competences. In fact, the support of the researcher in helping the teacher to select conceptual questions for the different physic topics and to analyse students responses collected during the classes were very important as these are very time consuming tasks.

More recently the researcher team developed an exploratory study in Republic of Angola (Chivangulula, 2014) although only at the diagnosis level. Interesting is to notice that similar results have been found in terms of engineering students difficulties in physics and a good receptivity from the teachers involved towards the alternative T&L strategies, namely with respect to conceptual questions. However, and as the context of this study was different from all the others carried on by the research team (Geology Engineering in a different country) the researcher felt a lack of concrete material (for example conceptual questions) relevant for his context.

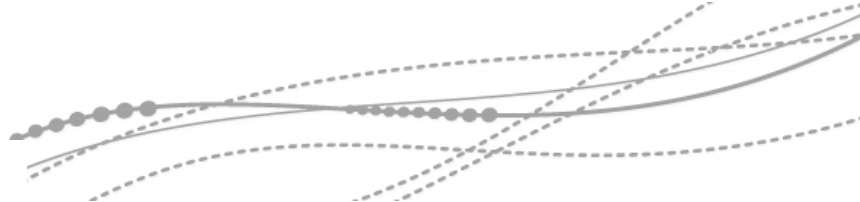
Although one cannot generalize for all the population from our studies about the positive impact of the strategies used, given the methodological approached used, there are evidence from other studies (see for example Freeman et al., 2014) that active learning increases students' performance in engineering and should then challenge traditional lecturing. However, our work in the field, as shown for example in Oliveira (2011) and Chivangulula (2014), suggest that teachers need to have support to innovate their practices. Therefore, one of the challenges the team is facing nowadays is to transform the knowledge so far developed by research in materials which can be used by teachers in their practices. Certainly these material will not have the desired impact if it will not



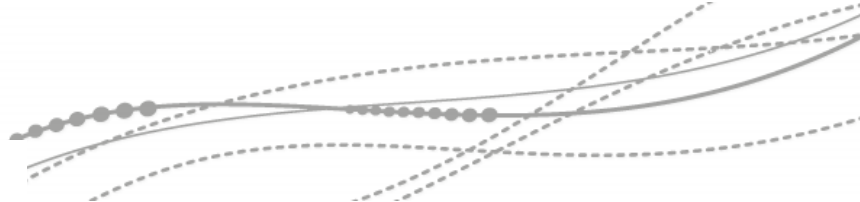
be incorporated in a new approach of T&L physics in engineering courses. Therefore another challenge is how to disseminate these materials so that institutions and teachers will “look” at them as a part of a different didactic approach.

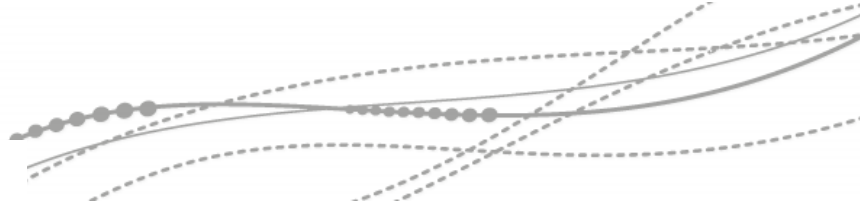
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Critical inquiry, question asking and the structure of conscious ignorance

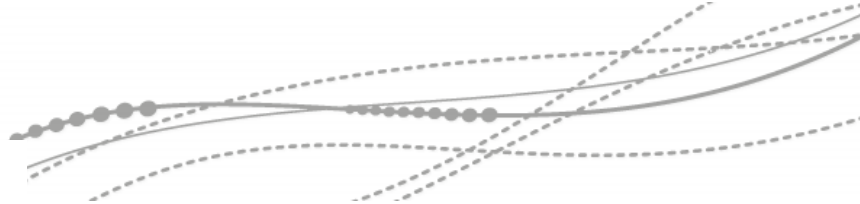
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ABSTRACT

Critical inquiry in science and critical thinking in general, involves, as an important component, the ability to ask relevant questions (Pedrosa-de-Jesus, Moreira, Lopes, & Watts, 2014). Question asking by science students has been extensively studied from several points of view (Chin & Osborne, 2008), but one of the relatively less studied components of questioning is the initial question generation stage. The detection of anomalies, including the awareness of unknowns or of incomprehension, leads to questioning as a regulation procedure aimed at clearing the anomaly up. In this paper we review some studies that examine the mechanisms that lead to questioning on objects or processes and the resulting structure of conscious ignorance (Otero and Ishiwa, 2014). This structure is examined in the particular cases of students explicitly generating unknowns on objects usually studied in science courses, and in processing expository texts that describe natural phenomena. The analysis of the structure of what students consciously ignore about an object or what they do not understand about a simple natural phenomenon described in a text allows us to examine the effect of several variables on the components of this structure. This contributes to an understanding of the mechanisms leading to better and more relevant questioning in educational settings and consequently to enhanced critical inquiry.

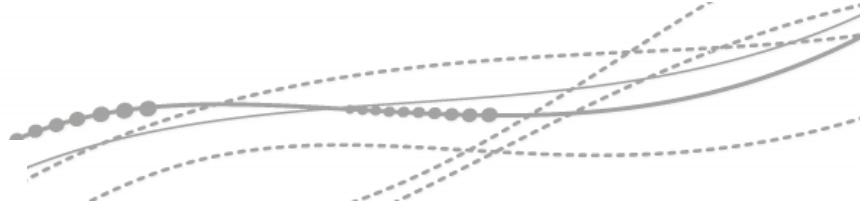


EXTENDED SUMMARY

Critical inquiry in science and critical thinking in general, involves, as an important component, the ability to ask relevant questions (Pedrosa-de-Jesus, Moreira, Lopes, & Watts, 2014) and to raise significant problems: “A well cultivated critical thinker... raises vital questions and problems, formulating them clearly and precisely (Paul & Elder, 2006, p. 4)”. This essentially involves being aware of one’s own lack of knowledge and one’s own incomprehension or, in short, being aware of one’s own ignorance. Also, this awareness is a fundamental competence both in self-regulated learning models (Schunk y Zimmerman, 2003), where students proceed by monitoring their performance in relation to a learning goal, and in problem-based and inquiry learning approaches frequently used in science education (Loyens & Remy, 2011; Savery, 2006).

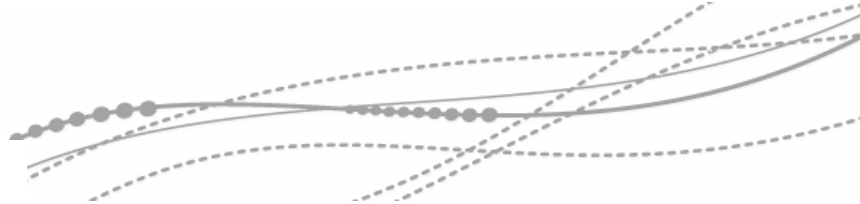
Students’ obstacles in knowing and understanding have been thoroughly analyzed by education researchers interested in conceptual change, text comprehension, metacognition and several other areas. However, relatively less attention has been paid to students’ own judgments about the comprehension obstacles that they find, i.e., how students build their own conscious ignorance expressed as questions and problems for inquiry. Understanding this process involves an appropriate characterization of students’ ignorance: Should it be understood as a void reflecting simple lack of knowledge or understanding, or does it have some kind of structure? A widely held assumption of sociological and philosophical studies about the nature of conscious ignorance is its constructive nature: conscious unknowns are produced by knowers based on what they already know (Gross, 2007; Otero & Ishiwa, 2013; Stocking & Hollstein, 1993). Therefore, we attempt a conceptualization of what may be unknown about an object, or what may not be understood about a natural phenomenon described in a text, in terms of what may be known about this object or understood about this text.

First, we consider students’ conscious ignorance about objects in a simple knowing task: What do secondary school students know that they do not know about a sample of objects included in their science curriculum? Vaz,



Fernandes, Morgado, Monteiro & Otero (2015) followed an approach based on lexical semantics in a study aimed at identifying the unknowns about objects that a sample of 7th grade and 12th grade students were aware of. The superordinate category of these objects could be unknown ('Is this a mineral?'), their parts or composition ('What is it made of?'), their attributes ('What size is it?'), or their functions ('What is it for?'). These are elements of knowledge directly associated with intrinsic features of objects and therefore they were termed *Intrinsic* unknowns. However, there may be additional knowledge about coordinate or subordinate entities associated with an object through temporal, spatial, causal or other relations. The unknowns associated with this kind of knowledge ('What is the white stuff that leaks from a battery when it is old?') were termed *Extrinsic* unknowns. The identification of these components allowed us, in its turn, to examine the effect that some variables, such as domain knowledge, have on the students' awareness of their own lack of knowledge

Secondly, there may be awareness of ignorance in more complex tasks, when more entities are involved. For instance, what do students know that they do not understand about a natural phenomenon described in a text? Paralleling the approach taken to characterize objects' unknowns, what a reader may not understand about a phenomenon described in a text may be characterized based on what is involved in understanding this text. Several text comprehension models assume that comprehension of a text amounts to building an appropriate internal representation of the information provided, i.e., an appropriate mental model or "situation model" (Van Dijk & Kintsch, 1983). Building this representation involves elements taken from a reader's knowledge base. Conscious incomprehension may result when a reader is aware of difficulties to integrate some of these knowledge elements, i.e. inferences, into the attempted representation. Trabasso and Magliano (1996) identified three broad classes of inferences in the case of narrative understanding that are also relevant when reading scientific texts (Van den Broek, Lorch, Linderholm, & Gustafson, 2001): associations, explanations, and predictions. Associations provide information about the features, properties, relations and, in general,

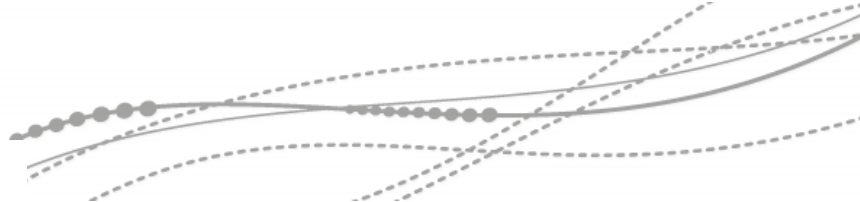


descriptive detail of the entities mentioned in a text. They are typically concurrent with the entities described in the text. Explanations provide reasons as to why something occurs. These reasons may be given in terms of efficient causes, as when explaining a physical event in terms of necessary and sufficient antecedents, or in terms of final causes, as when explaining a character's actions in terms of a goal. Lastly, predictions are forward oriented. They include consequences of actions or events, and they anticipate occurrences.

According to the previous scheme, the conscious incomprehension of readers who try to understand a scientific phenomenon described in a text may be related to difficulties in generating these three types of inferences. Association, explanation, and prediction obstacles are the potential difficulties in building an appropriate mental model of a text and therefore they are the elements composing the conscious lack of understanding of this text. Again, once these elements have been characterized, examining the effect of individual, text or task variables on the conscious incomprehension of a text becomes possible. We illustrate these effects in a study of different text processing tasks and the conscious incomprehension associated with each of them.

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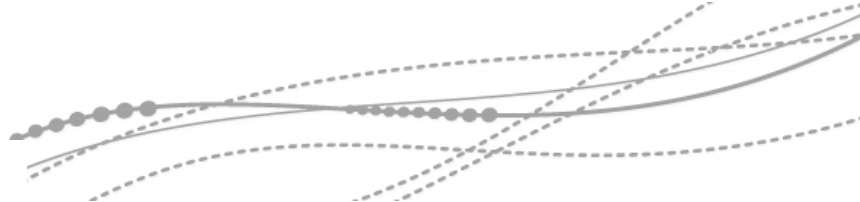
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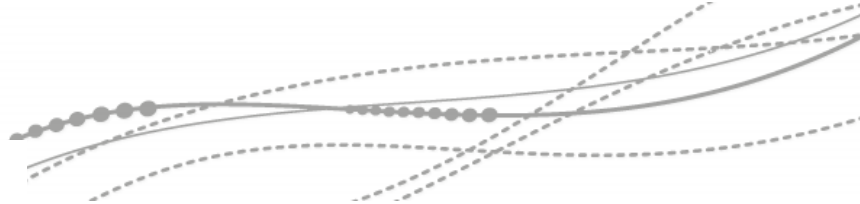
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Academic growth and scholarship of teaching and learning: the impact of research

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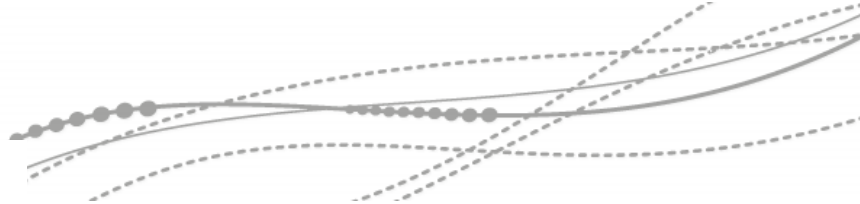
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EXTENDED SUMMARY

Rationale

The research-funded project we describe here has been conducted over the extensive period 2001–15. The research problem relates to the institutional and professional changes required to promote and encourage greater teacher and student engagement in learning across undergraduate studies. The emphasis in this paper is upon impact. Research can be seen as systematic inquiry for the creation and development of knowledge, and the process of measuring and describing the impact of academic research is becoming increasingly important in Europe and around the world. To measure impact requires some measure of both the generation of knowledge and the value of the knowledge generated. Knowledge itself is immeasurable, at best it is observed through *expressions* of knowledge such as publications, papers, patents, and students' and, in this case, teachers' perceptions.

Among the known tensions in higher education lie those between greater individualisation and personalisation on the one hand, and greater educative efficiencies on the other. Understandable difficulties arise from institutional, departmental and personal contexts in pursuing student-focused teaching. The solutions here entail curriculum design, dialogic teaching, alternative means of assessment, enhanced forms of feedback to students and e-based resources to encourage student autonomy. The goals of the research have been to (i) work collaboratively in designing and adopting novel practices to meet new demands on teachers' time and teaching methods; (ii) share innovative teaching and



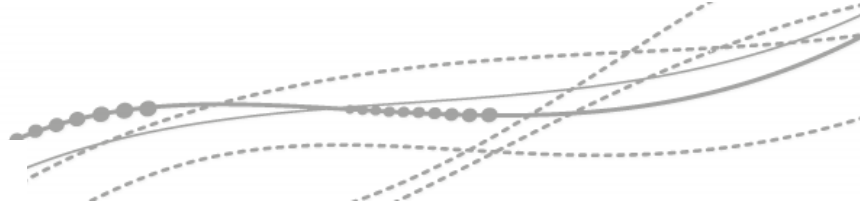
learning approaches and (iii) promote enquiry-led learning. Results and experience from this work over the last decade have provided greater understanding of the complexities of classroom interactions, of the dynamics of student-generated questioning and learning, of the diversity of approaches to, and styles of, teaching and learning, of the framing of alternative means of assessment, of the intricacies of student feedback, as well as of the design and use of e-learning support systems. The research entailed almost daily contact with teachers and researchers as they have made observations and recorded lectures, held frequent constructive discussions and negotiations with the research team.

Context

Impact

The Bologna Process has been a non-binding inter-governmental initiative between a voluntary collection of signatory countries with the goal of developing a European Higher Education Area (EHEA), initially to be achieved by the year 2010. Student-centred and enquiry-based learning was taken fully into this process during the Leuven/ Louvain-la-Neuve ministerial conference in 2009, and now constitutes an important reassertion of the teaching mission of higher education, which has become central to the creation of the EHEA. The capacity for organisations of higher education to change to meet these challenges to customary 'transmissive' approaches to teaching and learning are variable, and this research explores ways of impacting upon departments, groups and individual university teachers, administrators and students to resolve some of the impediments to greater learner engagement.

Research impact measures are often described using quantitative methods such as citation counts, journal impact factors and using researcher specific metrics such as the h-index, terms commonly collected under the umbrella 'bibliometrics'. However, research are much more than mere numbers. Statistics play just a small part of the reality of educational impact, provide an incomplete picture of the research product, and any meaningful demonstration of research value must go beyond simple quantification. The principal direction of our

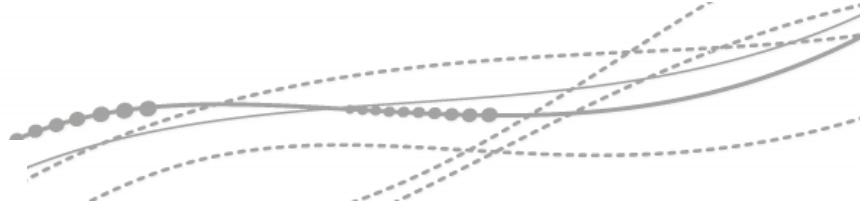


research has been qualitative methods focussing on naturalistic contexts, using surveys, interviews, observations and case studies to explore, illustrate and illuminate good classroom practice in terms of teaching, learning, assessment and student feedback. This has involved university departments of Chemistry, Biology, Microbiology, Education and Social Sciences. Some descriptive statistics have been used to explore the progress and achievement of relatively large groups of students, and these have been detailed in, for example, Pedrosa-de-Jesus & da Silva Lopes (2011, 2012), Pedrosa-de-Jesus *et al.* (2013, 2014). At the core of this work has lain the very nature of scientific and humanistic enquiry, the formulation of discipline-based questioning by both students and teachers, leading to the implementation of enquiry-led learning and question-based teaching. The research has focused on the cognitive, affective and conative implications and applications of this form of learning, on the classroom contexts and interpersonal conditions that enable this approach to university teaching.

Academic growth

The rationales for engaging in activities that lead to academic growth and a concern for the scholarship of teaching and learning (SoTL) vary. They can, however, be defined broadly by two categories: (i) augmentation of curriculum provision, and (ii) enrichment of educative practice. Augmenting the curriculum focuses predominantly on improving students' understanding of the content of their studies, whereas enrichment of teaching and learning activities focuses on a broader range of outcomes, such as changing students' appreciation, attitudes and awareness of the processes of higher education. These two distinct rationales are important because the successful definition of 'impact' may vary depending on what is being researched.

Given this, the impact of a research programme involves identifying the variety of expressions of knowledge produced, as well as the changes that these expressions have on a multitude of different potential research targets (students, teachers, curriculum, technology, systems, departmental organisation and institutional structures, etc.). Although some impacts may be tangible (new



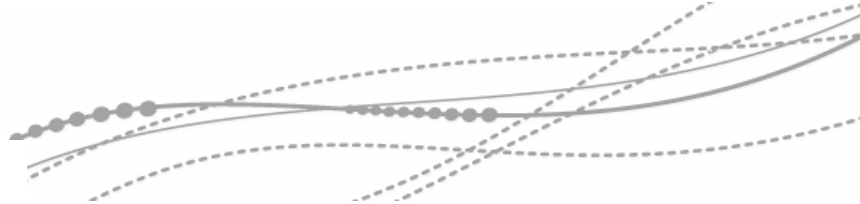
instruments developed, new research ideas stimulated, multiple students trained in new disciplines), many may be intangible (e.g. an increase in a student's confidence, growth of a teacher's repertoire of skills), and difficult to identify, much less quantify. The long-term impact of the research we discuss here can be shown to have (i) enriched classroom ethos to increase students' motivation and participation; (ii) improved teaching strategies that impact on students' learning and engagement; (iii) improved learning theory, providing a model of factors involved in the learning and teaching processes at this level. Here we use the words of just one teacher (of several) to illustrate impact in terms of just one innovation (of many) and his perceptions of its successful impact.

Outcomes and Findings: The Microtalk strategy

This innovative strategy was first attempted by our 'case' teacher in 2010/2011, and aimed at stimulating students' knowledge about research in Microbiology (i.e. the topic of bacteria with antibiotics' resistance). Each Micro-Talk consisted of a twelve-minute classroom presentation by different researchers from the Department of Biology, and five minutes for discussion with students. The teacher valued collaboration with research colleagues in further developing this strategy:

A positive impact was that we began to record these MicroTalks. We would not have done this without this collaboration. The fact that all teachers have to talk to an outsider [educational researcher] who asks them questions is a very significant aspect for reflection about what we are doing.

In this instance there is recognition of the power of multidisciplinary collaboration, what Weston and McAlpine (2001, p61) suggest is 'engaging in disciplinary and multidisciplinary teaching associations'. The following academic year the Microtalks were filmed using EDUcast service and made available on Moodle so students could review and submit questions and/or queries both directly to the researchers and to the teacher. He identified three teaching strengths and saw this as curriculum augmentation, an opportunity for students



to understand several microbiology topics, relating it to the curricular unit contents:

First, is to bring authentic research to the classrooms, which is related to my own research group... Second, is to show some diversity of topics in microbiology in a concrete way. Third, it shows that research is an activity that people can do. Can be a profession, does it not? Because students have the opportunity to see real researchers and could question them, could discuss.

But it was also enrichment:

I noticed that in smaller groups of students there was an interest, because they asked several questions about whether they [Microtalks] could happen more often ... which shows that there was interest and motivation ... they [students] felt that there was an area of work that was more interesting for them.

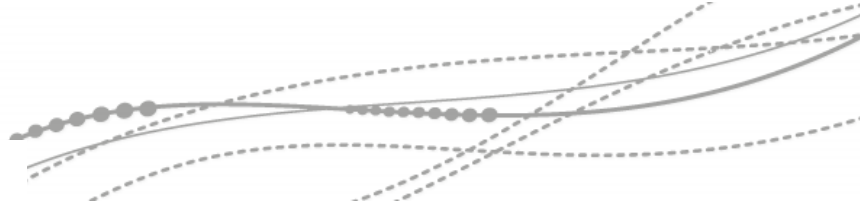
Moreover, it was enjoyable for him as the teacher:

As a teacher, these strategies are extremely pleasant since I'm going to the lectures always taking in something new. I'm not going just to transmit knowledge for students to memorise and then they go to the exam ... no ... this is a deliberate strategy having a specific purpose, where all the intermediate steps are planned in order to maximise the final result [the students learning outcomes]. Therefore, this is what I most value in these strategies being develop during this curricular unit as a result of this collaboration.

So, while he noted it was motivating, allowed students to expand their knowledge about microbiological research as well as content, he reserved judgement on whether this approach actually did translated into impact on students' assessment and grades:

I do not know if this had an impact on assessment ... it may have had an impact in medium terms rather than on longer-term assessment.

Conclusions



This is one instance of one teacher in one university. However, the comments provided here serve to illustrate (i) the forms that new approaches to teaching (in this case, short enquiry-led presentations) can take and be developed through professional collaboration between the members of the department and the research group, (ii) ways in which these can both augment the curriculum and enrich the teaching and learning process, (ii) means through which research output could be disseminated, and (iv) some capture of the enormous cognitive, affective and educative complexities in attempting to 'measure' impact. As noted earlier, this rich form of impact defies numbers

In the meanwhile, this particular research, over a 14-year period, concerning numerous university departments, teaching groups, individual university teachers, post-doc researchers, PhD students, Masters students with some some 1000 undergraduates being intimately involved. The work has generated two previous international invited seminars, 16 presentations at international conferences, 34 high-level journal articles, five book chapters and one book pending.

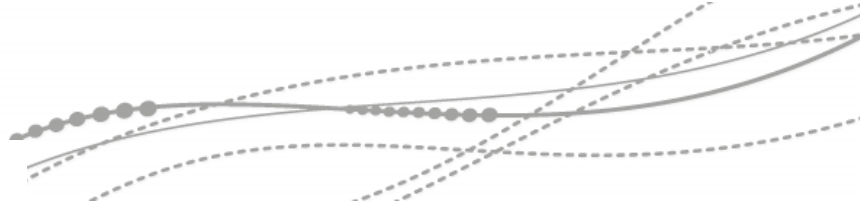
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