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Blended university teaching using virtual learning environments: conceptions and approaches

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Abstract

This paper reports findings from a phenomenographic investigation into blended university teaching using virtual learning environments (VLEs). Interviews with twenty-five Computer Science teachers in Greek universities illuminated a spectrum of teachers' conceptions and approaches from 'teacher-focused and content-oriented', through 'student-focused and content-oriented', to 'student-focused and process-oriented'. Using VLEs was described as a means of supporting: A - information transfer; B - application and clarification of concepts; C - exchange and development of ideas, and resource exploration and sharing; D - collaborative knowledge-creation, and development of process awareness and skills. The study suggests that pedagogical beliefs and circumstances underpinning face-to-face teaching are more influential in shaping approaches to blended VLE use than VLE system features. The authors propose that the

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findings could be used to inform educational enhancement initiatives and that there is a need for further discipline-focused research on blended teaching.

Keywords: university teaching; virtual learning environments; blended learning; blended teaching; phenomenography; Computer Science

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Abstract

This paper reports findings from a phenomenographic investigation into blended university teaching using virtual learning environments (VLEs). Interviews with twenty-five Computer Science teachers in Greek universities illuminated a spectrum of teachers' conceptions and approaches from 'teacher-focused and content-oriented', through 'student-focused and content-oriented', to 'student-focused and process-oriented'. Using VLEs was described as a means of supporting: A - information transfer; B - application and clarification of concepts; C - exchange and development of ideas, and resource exploration and sharing; D - collaborative knowledge-creation, and development of process awareness and skills. The study suggests that pedagogical beliefs and circumstances underpinning face-to-face teaching are more influential in shaping approaches to blended VLE use than VLE system features. The authors propose that the findings could be used to inform educational enhancement initiatives and that there is a need for further discipline-focused research on blended teaching.

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Introduction

A substantial body of research evidence exists on the subject of university teachers' conceptions of and approaches to teaching. In a large number of studies phenomenography has been used as the research methodology. These studies have illuminated a continuum of teaching conceptions and approaches that appears remarkably consistent in broad terms across many different educational contexts. The continuum ranges from strongly teacher-focused and content-oriented conceptions and approaches on the one hand, to strongly student-focused and learning-oriented on the other. A related, extensive body of work on student learning has shown the significant impact of teachers' educational conceptions and practices on the quality of student learning: when teachers adopt student-focused and learning-oriented approaches they are more likely to encourage students to adopt approaches to learning that lead to deep conceptual understanding and change (Prosser and Trigwell 1999).

In a recent review of research into teaching and learning in higher education, Entwistle (2008, 13-14) identifies as one of the most important conclusions that 'all elements within a whole teaching-learning environment act together in affecting the quality of learning.' Digital technology is a pervasive element in this environment in universities across much of the world but, as he notes, there remains 'a lack of research that brings together technological advances with the findings about learning and teaching in a coherent way' (Entwistle 2008, 25). For example, as yet, only a very limited number of phenomenographic studies have explored the use of technology as part of university teaching despite the fast-changing landscape of the university teaching landscape and the need to explore the use of technology in new contexts. Exceptions

include five studies that have examined aspects of the adoption of e-learning technologies in a variety of contexts of on-campus and distance teaching. In a detailed discussion of the findings of these studies and of the small-scale pilot to the study we report in the present paper (REF REMOVED), it is noted that a pattern appears to be emerging that is broadly consistent with the wider body of phenomenographic evidence on university teaching (Gonzalez 2010). At one end of a continuum of conceptions and approaches, the focus is on using technologies in teacher-focused and content-oriented mode ‘as a medium to provide information’ and at the other in student-focused and learning-oriented mode ‘as a medium for engaging in communication–collaboration–knowledge building.’ These studies also point to factors that may contribute to shaping teachers’ e-learning conceptions and practices in specific contexts, including cultural aspects (McConnell and Zhao 2006) and recency effects in technology-adoption (Ellis, Steed, and Applebee 2006).

The study we report in this article contributes to this emerging strand of research on university teaching. We conducted a detailed phenomenographic investigation into university teachers’ conceptions of and approaches to teaching using digital technology in blended settings; that is, in on-campus teaching in which technology is used in conjunction with face-to-face teaching. Whereas other phenomenographic studies have explored e-learning more broadly defined, we chose to focus specifically on the use of virtual learning environments (VLEs, sometimes called course or learning management systems). Over the last decade, these have become ubiquitous in university education in many disciplines across much of the world. A VLE often is implemented at institutional level, with encouragement - sometimes, a requirement - to utilize it in all teaching. The software typically offers a platform for a range of different digital

tools combining access to multimedia content, online communications media and other facilities such as e-portfolios. Recent trends in VLE functionality, both of commercial and open source products, include the addition of Web 2.0 style applications that are intended to support user-led and collaborative content creation. VLEs can be used to provide access to the five types of learning technology that, according to Laurillard's (2002) classification, support key processes in productive learning: *narrative* media for attending and apprehending (e.g. digital text, video, audio); *interactive* media, for investigating and exploring (e.g. digital library, weblinks); *communicative* media for discussing and debating (e.g. discussion board, online chat); *adaptive* media for experimenting and practicing (e.g. online simulation, virtual laboratory, quiz providing feedback); and, *productive* media for expressing and presenting (e.g. blogs, wikis, digital objects). However, studies have shown that VLEs are used predominantly in narrative and interactive modes to offer students access to digital content. It has been argued that some widely-used VLE systems are more oriented in terms of their technical design and functionality towards teacher- than learner-centred approaches to teaching, and that they therefore carry in-built constraints on the development of effective technology-enhanced pedagogies (Vogel and Oliver 2006).

We chose to focus our study on teaching in one discipline, Computer Science. According to Biglan's (1973) widely-used classification, this is a 'hard applied' discipline. However, it has been suggested that while many computer scientists may see it as most strongly associated with the applied disciplines of engineering, for others it is more properly identified as 'hard pure' along with Mathematics and/or the sciences (Clark 2003). Moreover, Computer Science is a broad discipline with boundaries that are not clear. More socially-oriented subjects that feature in

many teaching curricula may colloquially be described as ‘soft’, as in the case of some respondents in the study we report here.

In the teaching of Computer Science emphasis is placed on application of theoretical concepts to practical exercises, formation and testing of hypotheses, modelling and the development of practical design competencies, and the development of professional knowledge and skills. A wide range of approaches including problem- and inquiry-based methods as well as practical laboratory exercises and lectures are used (Abenerthy, Gabbert, and Treu 1998). Learning technologies have long been used in Computer Science education, including web pages, simulations, microworlds and other multimedia tools and, more recently, Web 2.0 social software as well as VLEs (Kordaki and Komis 2000).

The research participants in our study were all university teachers of Computer Science in Greece. According to commentators, teaching in Greek higher education traditionally has been instructivist and teacher-centred in nature, favouring a focus on theory over practice and non-interactive methods based largely on oral presentation of the teacher’s knowledge by means of lectures, and requiring memorization by students (Siakas and Georgiadou 2003). However, recent trends in Greek university teaching include increasingly widespread adoption of new technologies, including for Computer Science teaching and learning.

Against this background, the over-arching research question for our study was: what are the qualitatively different ways in which teachers of Computer Science in Greek universities experience teaching using VLEs? Here we take ‘experience’ to encompass the closely linked

phenomena of understanding of, and approach to, teaching. In the following section we outline the phenomenographic research methodology and then move on to present and discuss the findings.

Methodology

Phenomenography aims to discover the range of variation by which a given phenomenon, such as teaching, is experienced (Marton 1986). Through analysis, categories of description are derived from the pooled interview data. Between them, the categories provide an holistic view of the various ways in which the phenomenon can be conceived of or experienced. The analysis will also reveal the way in which the categories are logically related to each other. This relationship may take the form of an inclusive hierarchy, describing less to more complete ways of experiencing the phenomenon. The 'outcome space' of a phenomenographic study illustrates the relation between categories and their structural and referential features - that is, the 'how' and the 'what' of their make-up. In the case of this study, the phenomenon under investigation was Computer Science teachers' experiences of teaching using VLEs.

Consistent with recommendations regarding sample size in phenomenographic studies that are based on interviews (e.g. Trigwell 2000), twenty-five Computer Science teachers from six higher education institutions participated in the study. This includes five who participated in the pilot study and whose interviews then were incorporated into the final dataset. The overall sample was established to allow for variation in terms of level of students taught using VLEs (fourteen participants taught undergraduates, six postgraduates and five both) and subject-matter

taught using VLEs (twelve participants taught 'hard' subjects, thirteen 'soft', and two both (e.g software engineering and professional issues). Eighteen used VLE-A (a well-known commercial system) and seven VLE-B (a well-known open source system). All participants had used a VLE for more than one year, and all were using the VLE for campus-based (as distinct from distance) teaching that had face-to-face components as well as online.

One one-to-one interview lasting around fifty to sixty minutes was carried out with each participant. Since the aim was to capture how teaching using a VLE appeared to and was described by participants (Bruce 1997) interviews were flexible and responsive as is usual in phenomenographic research, with open-ended questions used to allow participants to express their own understandings and experiences of the themes under investigation and to 'choose the dimensions of the questions they want to answer' (Marton 1986: 42). In line with the project's overall focus on teachers' approaches to, and understandings of, teaching using VLEs, key lines of questioning stemmed from two over-arching questions: 'How do you use the VLE in your teaching?', 'What do you see as the value of the VLE?' Follow-up probes and prompts were used to explore views in depth and clarify explanations, on themes that emerged as salient to interviewees. Through this process, probes relating to approaches to VLE use included 'Which VLE tools do you use?', 'What are students doing when they're using the VLE on this course?' and 'Can you say more about how this relates to the face-to-face teaching sessions on the course?'. Probes on the value of the VLE included 'What are you trying to achieve as a teacher when using the VLE in this way?' or 'How do you help your students to learn with the VLE?'. Prompts to stimulate and pursue the respondents' own line of reflection that were used frequently included 'Can you explain that further/give me some examples?' 'Why is that important?'

Stimulated recall was used in some cases when teachers logged on to their computer and showed the interviewer how they used the VLE on a particular course.

The interviews were conducted in English with the exception of times when some interviewees chose to reply in Greek in order to better express their views. These responses were translated into English by the (bilingual) interviewer. The interviews were tape-recorded and transcribed verbatim and qualitative data analysis software (Atlas-ti) was used to support the analysis, which was undertaken following guidelines from the literature (Akerlind 2005; Marton and Booth 2007). The data produced by the lines of questioning described above were analysed inductively in order to identify categories of description and dimensions of variation. Analysis was an iterative process involving repeated reading of the transcripts treated as a whole dataset, initially in two parts. To begin with, around half of the transcripts were read several times, followed by production of a preliminary list of categories (and sub-categories) of description with explanatory summaries and illustrative quotations. The aim was to avoid imposing a predetermined set of categories, and to focus on identifying the range and nature of variations in ways of describing experiences within individual interviews and across them all, as well as the logical relations between variations. There was also a focus on identifying what was in the foreground and what in the background of teachers' awareness in different categories of description. The remaining transcripts were then analysed in the same way, in relation to the preliminary categories of description. The full dataset then was reviewed several times as a whole, with categories and relations between them tested and retested (Marton 1986). It is recommended that phenomenographic analysis ideally should be carried out collaboratively, in order to mitigate the potential for idiosyncratic interpretations (Marton and Booth 1997). In the case of this study, it was conducted principally

by one researcher in extensive discussion with others in the team with reference to the primary data. At the final stage, a detailed collaborative review of the analysis was led by another team-member, resulting in some further refinements including elimination of over-lapping sub-categories, and the analysis was stabilised.

Results

In this section, we present four categories of description and differentiation between them along five key dimensions of variation, as these emerged from our data.

Four qualitatively different categories of description were identified in the data elicited from the lines of questioning pursued in interviews, and can be seen as representing a series of progressively more extensive and complex orientations to the use of VLEs in blended teaching in Computer Science. Using VLEs was described as a means of supporting:

- (A) information transfer;
- (B) application and clarification of concepts;
- (C) exchange and development of ideas, and resource exploration and sharing;
- (D) collaborative knowledge-creation, and development of process awareness and skills.

Table 1 presents illustrative quotations for each of these four categories and the sections that follow discuss each of them in turn.

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INSERT TABLE 1 HERE

Table 1: Experiences of teaching using VLEs

Category A Information transfer

In this category the emphasis is on using the VLE to provide students with ‘any time, any place’ access to administrative and subject-related information, using web pages and downloads, weblinks, and bulletin board and email announcements (a mix of narrative, interactive and communicative media). Transfer of curriculum knowledge from teacher to student is at the forefront of teachers’ awareness. Structurally, this category can be seen as reflecting a strongly teacher-centred (or ‘instructivist’) view of the role of the VLE in teaching that is also strongly content-oriented in being concerned solely with students’ learning of subject-matter as distinct from learning about processes relating to learning. Teachers see the VLE primarily as an efficient, one-stop repository for items such as course and assessment descriptions, background material, lecture slides and notes they have produced, and secondarily for providing pointers to further subject resources that, in a fast-moving field, offer access to more up-to-date information than might be provided in textbooks. The VLE’s communication media are used to disseminate administrative information and announcements. The VLE is seen to offer further efficiency benefits in being a platform for submission of work for assessment, and in supporting teachers’ organisation and storage of content for review and reuse in successive course iterations.

Category B Application and clarification of concepts

In this category the VLE is seen as a medium through which to engage students in tasks involving analysis and practical application of theoretical models, and feedback on understanding and performance. VLE technologies used include those in Category A, with the addition of one or more digital simulations, animations, tests, quizzes or exercises (a mix of narrative, interactive, communicative and adaptive media). Correcting students' misconceptions is at the forefront of teachers' awareness. In this case, a less strongly teacher-focused view of the role of the VLE in teaching is reflected in that there is a new emphasis on dialogical interaction between student and teacher, although the emphasis remains on the teacher's (or their digital proxy's) role in communicating conceptual understanding through feedback and on curriculum content as distinct from issues relating to the learning process. Two modes of online feedback are used. Extrinsic feedback is communicated through teachers' responses to student queries, typically via discussion board. This is seen as an efficient platform for question-and-answer, since students can read teachers' answers to questions posed by peers and teachers do not need to repeat answers multiple times. Teachers want to enhance student engagement by providing access to feedback on an 'any time any place' basis and the asynchronous mode of interaction is seen as beneficial in providing time for students to reflect on feedback. Although there may be occasional online communication between students, the pedagogical focus is on one-to-one or one-to-many interactions between teacher and student(s). Intrinsic feedback is communicated through self-assessment or application exercises accessed via the VLE, such as automated multiple-choice quizzes or scenario-based simulations, which enable both students and teachers to test students' understanding.

Category A, with its primary focus on using the VLE as an information repository, is the least developed of the four. Category B includes, modifies and extends its features. For example, in Category B the VLE is still valued as a repository for content and in addition to lecture notes and other background resources access may be provided to examples showing how concepts apply to practice. However, with the pedagogical focus on supporting application and clarification of concepts with the VLE rather than solely on information transfer and recall, the VLE is used to support a more complex range of learning and teaching processes. Whereas communicative media are used only for informational purposes in Category A, in Category B they are used to support student-to-teacher question-and-answer.

Category C Exchange of ideas, and resource investigation and sharing

In this category the emphasis is on using the VLE to help students negotiate, further develop and change their understandings through engagement with tasks that encourage open-ended interaction between peers as well as with the teacher. The range of technologies used may be extended to add blogs, microworlds, games and synchronous chat (a mix of narrative, interactive, communicative, adaptive and productive media). Providing opportunities for students to explore and express their own perspectives, alongside engaging with and debating those of others, is at the forefront of teachers' awareness. Structurally, this category shifts from a teacher-focused to a student-focused view of teaching with VLEs, oriented towards helping students to construct their own knowledge. There is still a primary focus on students' engagement with subject-matter (content) rather than process issues. Asynchronous

communication is seen as having benefits including allowing students to express their views without the time constraints of in-class discussion, promoting reflection alongside discussion, providing a record of the development of ideas, and helping to improve students' skills in written expression. Digital resource investigation and sharing is an integral, secondary distinguishing characteristic of this category. The VLE is used as a medium for actively encouraging students to identify resources that provide supporting evidence for their arguments and to share these resources with each other in preparation for discussion that might take place online or face-to-face.

Category C includes, modifies and extends the features of Categories B (and A). As in Category B the VLE may be used in part to mediate students' application of concepts to practical contexts, and to provide teacher or system feedback. However, a strong focus on facilitating exchange of views, and information exploration and sharing, is to the fore. The VLE's communication media are used to foster interactions between students as well as with the teacher and in this context teacher feedback is seen less as a matter of correcting students' misconceptions and more as a matter of offering an alternative perspective. The VLE is seen as providing access to an information repository as in B (and A) but there is an additional strong interest in encouraging students to proactively seek further information resources beyond the VLE via weblinks to library resources or the wider web and to share these with others.

Category D Collaborative knowledge creation and development of process awareness and skills

In this category the emphasis is on using the VLE to mediate student engagement with tasks – such as case scenarios and role-plays - that encourage small group or team collaboration and building of a learning community across the larger cohort. As in Category C the full range of media types may be used. Provision of opportunities for students to engage with common goals and work together to produce shared outcomes is at the forefront of teachers' awareness. The VLE is seen as offering a supportive framework for this including the potential to promote collaborative interaction across disciplinary boundaries, for example between computer science students and sociologists or business studies students within or across institutions. The VLE also may be used to extend the boundaries of community through providing students with online access to external professionals and experts. Issues and problems addressed are seen as complex with parameters that may be defined by students themselves, offering scope for them to participate in determining the direction of their learning in relation to their personal or professional interests. This category can be seen as the most strongly student-focused of the four, and there is a shift towards an explicit and strong pedagogical focus on supporting students' engagement with process issues relating to collaborative learning, shared responsibility and reciprocal support. This is an integral, secondary feature of the category. For example, guidance and support may be provided on expected online behaviours such as how to give constructive peer feedback and students may be encouraged to negotiate mutual expectations in groups and engage in reflection and self- and peer-assessment on issues of participation and contribution to collaborative tasks.

Category D includes, modifies and extends the referential features of Categories C, B and A. As in Category C, supporting exchange, development and debate of ideas is an important

concern but there is an additional strong focus on engaging students in collaboration and community participation, both for the purposes of academic learning and as preparation for professional lives and future learning. Proactive online information-seeking and sharing in this case is oriented towards collaborative projects. Teacher feedback features in the category but the additional and strong emphasis is on exchange of peer feedback in relation to both the products and processes of collaborative activity.

Dimensions of variation

In this section we highlight differentiation between categories of description along five key dimensions of variation, as these emerged within the interview data. The dimensions of variation represent five parts of the totality of the concept: ‘experiencing teaching with VLEs’. Table 2 provides an overview and Table 3 shows illustrative quotations.

Table 2: Dimensions of variation (summary)

INSERT TABLE 2 HERE

Table 3: Dimensions of variation (quotations)

INSERT TABLE 3 HERE

In the sub-sections that follow, we discuss each dimension in turn.

Role of the teacher online

Along this dimension the conception of the teacher's role in using the VLE extends from provider of information, through designer of tasks, provider of feedback, facilitator of debate, to facilitator of collaboration and process skills development. Category A strongly reflects a view of the teaching-learning process as knowledge-transfer, with the teacher using the VLE with the aim of making subject (and administrative) information easily accessible. Category B reflects a similar view of the learning-teaching process but the teacher plays a more developed and active part by designing online assessment or practice-oriented tasks that provide feedback on understanding and performance and by adopting the role of online interlocutor with students, posing and responding to questions.

In contrast, Categories C and D are characterized by knowledge-construction views of learning and teaching, with knowledge seen as internal to, and produced by, students. In Category C, the teachers' role in online task design and online interventions is to facilitate negotiation of meaning amongst students and students' own construction of knowledge. The teacher may for example pose open questions with a view to stimulating student participation and critical reflection, and to modeling forms of questioning that students can emulate in their interactions with each other. The teacher also creates tasks and resources that stimulate digital resource-investigation and sharing. Category D reflects a more strongly social or collective conception of the process of knowledge-construction, with the teacher responsible for designing tasks and an environment that will encourage collaboration, community and reflexivity in learning, and for providing guidance and mediation on these processes.

Role of the student online

Along this dimension the conception of the student's role in using the VLE extends from receiver of information, through 'doer' of set tasks, seeker of feedback and further information, developer of ideas, creator of knowledge, to contributor to the learning of others and developer of personal awareness and skills. The students' role shifts from responsive to increasingly more active forms of engagement with personal and collective learning. In category A the student consults online materials as a 'receiver of knowledge' (T12). The student is not expected to define or modify what is provided and there may be an emphasis on memorizing content prepared by the teacher and delivered via the VLE. In category B the student's role in relation to the VLE is more active, engaging in online exercises selected or designed by teachers and seeking online feedback. In Category C students are seen as responsible for constructing meaning, exploring information and contributing to each others' learning by engaging in debates and sharing resources. In Category D students are seen as collaborators and participants in online community; undertaking joint projects with peers, they are expected to give and receive constructive online peer feedback and take their own decisions about how to carry out projects and, in some cases, about how their work should be assessed. They are perceived as sharing responsibility with teachers for their own and each others' learning experience, or as taking the lead: 'the student replaces the teacher' (T9).

Epistemic status of subject-matter

Along this dimension the view of the role of the VLE in teaching differs according to the teacher's understanding of the epistemic status of the academic subject-matter. Categories A and

B are associated strongly with the teaching of subjects in areas of the curriculum where the knowledge-base is treated by the teacher as certain; that is, where only one correct way of understanding something is identified or, as one respondent put it, where the philosophical stance of the teacher is 'realist' rather than 'social' (T14). When subject knowledge being taught is treated as certain by the teacher, the VLE is used to provide information access and feedback to students on their understanding and application of concepts. Both Categories C and D are associated with the teaching of subjects in areas characterized by open-endedness and the potential for different or competing responses to problems. These usually, but not uniquely, are socially-focused applied subjects and sometimes described as 'soft'. When subject-matter is seen as open-ended, or uncertain, the VLE is used to support negotiation of ideas, resource-investigation and sharing, collaboration, and explicit, reflexive engagement with process.

Students' level of study

Along this dimension, teachers' views and practices differ according to students' level of study. While for teaching at less advanced levels of study the VLE is used in less student-focused ways, for teaching at more advanced levels it is considered appropriate and possible to adopt more strongly student-focused and process-oriented approaches to VLE use. Individual teachers may report taking a 'purely instructive' approach in the first undergraduate year but a 'collaborative group-work approach' at postgraduate level (T23). Category A is associated strongly with entry-level undergraduate study. Some teachers express the view that undergraduate students at this level expect to learn in information transmission mode and that this constrains other possibilities. Category B is associated with all levels of undergraduate study

although it may be perceived that more advanced undergraduates generally are more willing to proactively seek online feedback from teachers. In Category C, more advanced undergraduates and taught postgraduates are seen as especially suited to the pedagogical approach and as more likely to recognize its value and to be willing to participate. Category D is associated solely with taught postgraduate teaching, with students at this level perceived to be more appreciative of, and skilled in, this mode of learning.

Relation between online and face-to-face

This dimension reflects different views of the relation between online and face-to-face teaching using a VLE, extending from a view in which it plays only a secondary role, through a more integrated view, to a view of the VLE as the main site for learning and teaching. In Category A the face-to-face environment is seen as the principal site for teaching and the VLE is seen as playing a supporting role. Use of the VLE may be described as a way of ‘making the most’ of face-to-face sessions (T11). Uploaded resources are intended to help students familiarise themselves with content prior to face-to-face sessions and memorise it afterwards. The VLE is seen as a tool that can enhance the quality of students’ attention in the face-to-face environment because the reduced need for students to take extensive notes. Use of the VLE as a repository is seen as a means of freeing up more time for teaching and learning activity of various kinds during face-to-face classes and of providing access to additional content. In Category B the face-to-face environment is again seen as the principal site for teaching with the VLE seen as a supportive extension of it in offering opportunities for further practise with application of theory and model building, and for additional and different modes of feedback.

The VLE is used variously as a platform for providing access to material used as a stimulus for face-to-face activity, identifying misconceptions that can be followed up in face-to-face sessions, or clarifying teachers' explanations given face-to-face.

In Category C the face-to-face and VLE environments are seen as mutually supportive. Face-to-face teaching is seen to support VLE-based teaching as well as *vice versa*, for example when a topic is introduced face-to-face with a view to continuation and development of the discussion on-line. The rationale often is that VLE-based discussion is a means of enhancing the expression of diverse ideas because views may be exchanged more freely in the less formal and more decentralised online setting. In Category D the VLE is identified as the principal and well-suited site for collaborative learning. Face-to-face interaction is the setting in which preparation for 'the actual work' (T20) takes place, for example in the form of face-to-face organization of small groups or provision of guidelines for online group discussions.

Discussion

This study identified four qualitatively different conceptions of and approaches to the use of VLEs for Computer Science teaching in Greek universities. Table 4 (the 'outcome space' of the phenomenographic analysis) summarises their referential and structural characteristics, and the inclusive and hierarchical relation between them.

INSERT TABLE 4 HERE

Table 4: Referential and structural aspects of conceptions of blended teaching using VLEs

Over-arching features of the findings of this study are consistent with those of the few other phenomenographic studies that have examined university teaching using e-learning technologies. They also correlate with the descriptive categories identified in qualitative studies of approaches to higher education teaching more generally, with a continuum from teacher-focused approaches to learner-focused approaches (Samuelowitz and Bain 2001).

However, while the findings confirm the general picture, the study also identifies some distinctive aspects in the conceptions and approaches of the computer scientists who participated. In particular, Category B - 'the VLE as a means of supporting application and clarification of concepts' with its core emphasis on teacher- and system-feedback - reveals an orientation to blended teaching not clearly represented in these other studies that may be explained by the discipline-specific focus of our study. The use of adaptive digital media such as simulations appeared to be strongly embedded in the VLE-based practice of computer scientists. The emphasis in Category D on using the VLE to mediate development of students' process awareness and skills also is not strongly identified in other phenomenographic studies.

Differences exist between the categories identified by our study and broadly equivalent categories in other studies on some further points. The use of synchronous as well as asynchronous communication media was associated with the aim to stimulate debate and dialogue, in contrast with the 'group analysis, decision making and dialogue' category identified by Roberts (2003) in a part-phenomenographic study of teachers' conceptions of university teaching using the Web. Utilization of online communication tools solely for unidirectional provision of information from teacher to students was associated with the least complex pedagogical conception and approach (Category A) rather than with a more complex one as reported by Gonzalez (2010) in a study of 'what university teacher think elearning is good for',

which identified 'elearning as a medium to provide information to students' as the least complex category and 'elearning as a medium for occasional online communication' as a more complex category. Again in contrast with this study, the full range of media according to Laurillard's (2002) classification - narrative, interactive, communicative, adaptive and, to a lesser extent, productive - were represented in teaching. The features of a category identified by Ellis, Steed, and Applebee (2006) - 'blended teaching as replacing part of the responsibility of being a teacher' - were not found in our study and nor was the strongly technology-dominated (as opposed to pedagogically-dominated) orientation they found in some teachers' conceptions, perhaps because of computer scientists' familiarity with digital technology and its increasingly embedded and routine status in pedagogical practice in universities.

Our study draws attention to different perspectives on the relation between on-line and face-to-face modes in blended teaching using VLEs. The VLE was seen and used as a secondary environment for more teacher-centred teaching whether in information provision or more dialogical mode (Categories A and B). It was seen and used as an equally important, or in some cases primary, environment for more student-centred teaching where the emphasis was on negotiated meaning and collaborative knowledge-creation (Categories C and D). While it may be argued that Category A in particular reflects under-utilisation of the potential of a VLE to support richer forms of blended pedagogy, the face-to-face environment was regarded by some teachers as more appropriate for person-to-person interaction and use of the VLE as an information repository often was described as being combined with more interactive teaching face-to-face.

The study identified three main structural orientations to teaching with VLEs: a 'teacher-focused, content-oriented' orientation (Categories A and B), a 'student-focused, content-

oriented' orientation (Category C) and a 'student-focused, process-oriented' orientation (Category D). This continuum differs in an important respect from the one more usually identified in phenomenographic research, in establishing a distinction between content/process rather than content/learning. In Categories A and B the focus of VLE use is on knowledge-transfer and the role of the teacher (or proxy, in the form of system feedback) in communicating concepts. In Category C the focus shifts toward mediation of students' active (co)construction of knowledge of subject-matter (Categories C and D) and development of process awareness and skills (Category D). Categories A and B seem to reflect the epistemological belief that knowledge is external to the student and can be mediated via a VLE through on-line documents, examples, exercises and provision of feedback. Categories C and D seem to reflect the belief that knowledge is constructed, or co-constructed, by the student and that this process can be facilitated via the VLE principally through dialogue and collaboration. Category D in particular suggests a social-constructivist or socio-cultural understanding compatible with the tenets of networked learning, defined as, 'learning in which information and communication technology (CI&T) is used to promote *connections*: between one learner and other learners; between learners and tutors; between a learning community and its learning resources' (Jones and Steeples 2002, 2). Arguably, the epistemological beliefs reflected in Categories A and B on the one hand, and C and D on the other, are philosophically incommensurate. However, our findings suggest that the epistemological beliefs of individual teachers may not be stable across different contexts of practice, or may be over-ridden by other considerations. The study highlights the interaction of a number of the factors that may impact on teachers' pedagogical approach to using VLEs in any given context.

Technological considerations appeared to play some part here. Some research participants expressed the view that VLEs are not neutral in their pedagogical affordances and that the nature of their VLE's technical functionality influenced their practice. VLE-A was described by some as more suited to the presentation of content and orchestration of structured tasks while VLE-B was seen as especially suited to collaborative and student-led activity. In more social subjects some teachers reported that the features of VLE-A prevented them from adopting student-focused online pedagogies and that consequently they used it for providing subject information only. On the other hand, some teachers reported using VLE-B solely for the purposes of information provision for introductory courses in 'hard' subject areas (Category A).

Overall, technological considerations did not appear to have as great an influence as issues relating to subject-matter and students' level of study, and indeed several participants in the study reported their perception that the opportunity to use a VLE had not changed the way they viewed or approached teaching in any fundamental sense. Two factors - teachers' perceptions of the pedagogical implications of the epistemic status accorded to the subject knowledge being taught, and of students' level of study - appeared to be especially significant in shaping computer scientists' teaching using VLEs and also in explaining why individual teachers altered their approaches to using VLEs in different contexts. These factors also have been identified as significant in phenomenographic studies of teaching *per se*. For example, although studies have revealed variation in the educational conceptions and approaches of teachers working within the same discipline, some have indicated that in general terms student-focused and learning-oriented conceptions and approaches tend to be much more common in the 'soft' humanities than in the 'hard' sciences (e.g. Prosser et al. 2005). Other studies have shown these

to be more common amongst teachers of more advanced level students (e.g. Cliff 1998; Samuelowicz and Bain 1992). In the light of these patterns, our findings suggest that in Computer Science and quite possibly other disciplines, the characteristics of individual teachers' VLE use for blended learning may be explained primarily by the pedagogical assumptions and circumstances that underpin their face-to-face teaching rather than by VLE system features *per se*. Our study did not reveal any strongly distinctive cultural factors influencing Greek Computer Scientists' conceptions of, and approaches to, using VLEs in teaching.

Conclusion

As digital technologies become ever more pervasive in the learning and research environments of all academic disciplines, blended teaching is becoming a major focus of interest in universities' educational development initiatives. We suggest that the findings of this study could be used to inform these initiatives, whether they are focused specifically on Computer Science teaching or more broadly oriented towards teaching across the disciplines. In recognition of the importance of disciplinary epistemologies in shaping pedagogical understandings and practices, there is a growing interest in discipline-focused educational development activity in universities (e.g. Healey and Jenkins 2003). However, an equally important role is identified for cross-disciplinary approaches that encourage academic staff to engage reflexively and critically with the cultural concerns, beliefs and practices of their own disciplines (e.g. Skelton 2005). This study has highlighted pedagogical beliefs and practices in one discipline that appear to play a key role in shaping its practitioners' approaches to blended teaching. The findings may be interpreted as pointing to elements of an 'inner logic of the subject and its pedagogy' linking 'the nature of

knowledge in the discipline to the specific set of methods most likely to work well in helping students to learn' (Entwistle 2008, 21). At the same time, in highlighting different approaches to blended teaching in 'hard' and 'soft' subjects in Computer Science curricula, and at different levels of study, the findings also raise important questions about student-centredness and congruence in blended learning environments across different subject areas and levels within disciplines.

In conclusion, we return to the observation that as yet relatively little research has explored teachers' pedagogical beliefs and practices, as related to blended teaching, at the level of individual disciplines. Our study offers a small-scale, preliminary exploration of this theme; based on its findings, we suggest that there will be value in further research of this kind and especially in studies that explore in detail the relation between conceptions of and approaches to face-to-face teaching, and technology-use.

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Table 1: Experiences of teaching using VLEs

Category	Description	Representative Quotations
A	<i>VLE as a means of supporting information transfer and recall</i>	The purpose is the retention of knowledge after the end of the course so [students] can have a medium for retaining knowledge acquired during the course (T12). In the uploaded slides I am highlighting issues that I think are important and these can be used during face-to-face teaching so students can focus on certain points for attending more easily to the lecture (T14). I use it as a tool with which the student will not be taught by my teaching practice but from the content she or he can pull out of it... so it can be viewed as a repository for the course (T15).
B	<i>VLE as a means of supporting application and clarification of concepts</i>	Although programming is a practical course there are some theoretical issues that need to be understood. So what I am trying to do is to explain them in-class and then to encourage students to solve some relevant examples that I have uploaded on the VLE for practicing these particular theoretical issues (T8). All questions are gathered in one place so it can form a big repository of all the questions and answers related to the course for students to clarify issues and points (T15). There is an extra help for clarifying some points by the on-line self-assessment, they can make a revision of things they have learned and also see their learning level (T16).
C	<i>VLE as a means of supporting development and exchange of ideas, and resource exploration and sharing</i>	Students can add new ideas and opinions and they can actually see how these ideas have developed and evolved over a period (T9). Students are engaged in activities, they exchange their opinions, usually I ask them to build on their own, usually there is an announcement of the activity like you are going to study this and you will do that and then I am encouraging them to discuss what they have done and make explicit their views (T11). I ask them to search the net and find sites that are relevant and through this search to support their argument during the online discussion (T25).
D	<i>VLE as a means of supporting collaborative knowledge-creation and development of process awareness and skills</i>	I am suggesting that 'maybe we could include in our online collaboration a separate discussion forum to process the online learning experience, not the discussion of the assignment or something that has to do with the project, but how we are experiencing the online version of the course' (T1). Creating an environment that will allow students to share their objectives and their goals in terms of the learning process but also an environment that takes discussion, collaboration and dialogue as the fundamental way of generating knowledge - if the teacher can design such an environment then possibly an online learning community can be created (T2). I think that when using a VLE the focus should be on dialogue and collaboration. When students form groups then you see them argue, negotiate with each other, this creates a feeling of working together, supporting each other for a common goal (T22).

Table 2: Dimensions of variation (summary)

	A	B	C	D
Role of teacher	Organizing and disseminating information	Designing tasks for feedback and providing feedback	Designing tasks for, and facilitating, debate and resource-exploration/sharing	Designing tasks for, and facilitating, collaboration and students' focus on process
Role of student	Accessing, attending to, memorizing information	Asking questions, practicing/applying, receiving feedback	Sharing ideas, seeking and sharing resources	Collaborating, reflecting, exchanging peer feedback
Relation between modes	VLE supports face-to-face	VLE supports and extends face-to-face	VLE and face-to-face mutually supporting	Face-to-face supports VLE
Epistemic status of subject-matter	Certain ('hard')	Certain ('hard')	Uncertain ('soft')	Uncertain ('soft')
Study level	Entry-level undergraduate	Undergraduate	Advanced undergraduate, postgraduate	Postgraduate

Table 3: Dimensions of variation

Dimension	Representative Quotations
Role of teacher	A: My role is to transmit knowledge in a systematic way through the VLE (T24). B: The teacher cannot only just transmit information but providing knowledge through examples and online exercises, discussing with the students, giving comments, propose different ways of thinking (T1). C: I am posting questions just to trigger them... they are constructing knowledge, I am just helping them (T13). D: I did not do anything, knowledge was created through the online community, the members of the groups were trying to define the subject of their project and their tasks and how they are going to be evaluated(T4).
Role of student	A: [The student] works as a receiver of knowledge, to find the material I prepared and memorize it (T12). B: When they see me to post questions, sending feedback, asking them to reply on my comments then they are becoming participative without being aware of it(T3). C: I saw huge interest [among students] to share resources, to discuss with others, to be involved, that was really positive in terms of how they reacted with the use of the VLE (T13). D: Students should help me [promote collaborative work] they have to collaborate, there is no other way (T1).
Relation between modes	A: The time in class is important for discussing students' questions and queries and to take decisions for certain things while [the VLE] is for making available learning content (T14). B: The VLE is used for organizing and conducting the course and for accessing materials and a little more dynamic things like online tests, all these support my face-to-face teaching (T24). C: I create some [online] tasks that enhance what we do in class... like the discussion forum where we are discussing things online and then we are commenting on mistakes later in class (T25). D: We do kind of the preliminary work in class and then we are going on-line for the actual work (T20).
Epistemic status of subject matter	A: Since this course is... a programming course my role is to transfer information with or without the VLE (T12). B: In my [programming] class I am trying to use the VLE specifically for giving feedback... I think the VLE is the ideal medium for giving further explanations and comments (T14). C: If you find an interesting topic, if it is really interesting for them, they will take part... for example, e-government... issues about e-health... how secure is information, personal identity things... I think there will be discussions for issues like that (T13). D: Collaborative learning activities via the VLE occur in relation to our information management course... the nature of the course allows us to be more flexible and open to collaborating online (T23).
Level of study	A: In the first year I am above their heads, showing them what to do, giving them what to read via [the VLE], things are purely instructive (T23). B: In my most advanced undergraduate course... they are asking for feedback when they are studying at home, the course is more open, there is more room for discussion, so we use the forum for the purpose of giving and receiving feedback (T19). C: Postgraduates are more conscious with their learning, they ask, they share... they have a good relationship with the use of [the VLE] so it is easier to engage them in such activities (T2). D: [With early-level students] I am the instructor, I am telling how things should be learned, I am making conversations but I am saying at the end what is correct... gradually this is being reduced and we are going to the postgraduate [level] where I am trying to work as a facilitator (T25).

Table 4: Outcome space: referential and structural aspects of teaching using VLEs

		Structural ('how' of the conceptions)		
Referential ('what' of the conceptions)		Teacher-focused/ Content-oriented	Student-focused/ Content-oriented	Student-focused/ Process-oriented
A	Supporting information transfer	A		
B	As in (A) <i>and</i> supporting application and clarification of concepts	B		
C	As in (B) <i>and</i> supporting exchange and development of ideas, and resource exploration and sharing		C	
D	As in (C) <i>and</i> supporting collaborative knowledge-creation and development of process awareness/skills			D