Q & A with Ed Tech Leaders

Interview with Stavros Demetriadis

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1. What are you currently researching?
Three topics attract my research efforts currently:
1. Adaptive systems for collaborative learning. This refers to building technologically flexible systems for offering personalized and pedagogically appropriate support to groups and individuals within learning groups.
2. Scripting collaboration in computer-supported collaborative learning (CSCL). I am interested in developing digital tools for scripting (guiding and structuring) the collaborative learning activity and exploring their impact at many levels (affective, cognitive, metacognitive).

Stavros Demetriadis is currently an Assistant Professor with the Department of Informatics, Aristotle University of Thessaloniki (AUTH) in Greece. He also earned his Bachelor's degree in Physics and a Master Diploma in Electronic Physics from AUTH. He became interested in information and communications technologies when he was a high school Informatics teacher, and returned to the Department of Informatics, AUTH to earn his PhD in Multimedia Technology in Education. Dr. Demetriadis's major research interests are related to adaptive systems for collaborative learning, technology systems for scripting in CSCL, and collaborative techniques for advancing young learners' computational thinking skills (e-mail: sdemetri@csd.auth.gr)

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3. Advancing students' computational thinking. Computational thinking involves skills that relate to students' ability to analyze and represent problems and their solutions in ways that are processable by a digital machine. The concept is not new (Papert introduced it in the 1990s) but there is a renewed interest linked also to the fact that educators now have many tools for introductory and "recreational" programming (for example, robotics, tangibles, Scratch, Alice, LookingGlass, GameMaker, and others), and engaging kids in such activities is easier than ever before. Our interest is on empowering teachers with appropriate intervention techniques (for example, collaboration scripts and prompts) to maximize students' computational thinking skills.

2. You have recently published material on group formation based on learning styles. What instrument did you use and what were the results?

In exploring group formation based on students' learning styles, we developed and used the PEGASUS system (PErson-centered Group Activity SUpport System). The system identifies students' learning styles using the Raudsepp Problem Solving Styles Inventory and then assigns students to heterogeneous groups (3, 4, or 5 members in group). Heterogeneity refers to having in the same group students of different learning styles. It is expected that this arrangement causes productive imbalance in the group, which may lead to students' greater satisfaction, as they can be assigned tasks within the group which are better fitted to their own styles.

In our work, two major conclusions were recorded: (a) the adoption of learning styles theories in practice can be greatly facilitated by systems for automated group formation—otherwise the daunting task of identifying styles and making necessary group arrangements may disappoint the interested teachers; and (b) group formation methods aided students by emphasizing complementarities and pluralism in ways of thinking, but only after the instructors' consistent support through regular group-facilitation meetings. Otherwise, using the learning styles-based grouping may result in a trivial approach of using styles to simply "label" students.

3. What do you mean by scripted collaboration, and how would it work?

"Scripted collaboration" refers to scripting (structuring and guiding) students' activity within learning groups. Scripting is important as it triggers peer interactions (for example, engage peers in argumentation, conflict resolution, reviewing each others' work, etc.), which otherwise would not have happened. Productive peer interaction, in turn, leads to improved learning outcomes (both domain-specific and domain-general). Practically, the idea of scripting boils down to three specific prescriptions for instructors:

1. Structure group work in distinct phases. In each phase it should be clear what the group work is and the kind of deliverables it leads to.
2. Assign roles to students in each phase. Provide adequate guidance on how to play each role. Playing a role offers an excellent opportunity to trigger peer interaction.
3. Define deliverables. Each work phase should lead to developing a deliverable, which should be the outcome of role playing and peer interaction.

In technology-enhanced learning (TEL), interest in the idea of scripting has led to the development of integrated environments and specific digital tools that support both teachers (as script designers and orchestrators of the collaborative activity) and students (as active learners engaging in interactions prescribed by the script).

4. What do you mean by peer review based scripted collaboration, and how would it work in real life?

"Peer review based scripted collaboration" refers to engaging students in collaboration based on a peer review scenario. Typically, a peer review learning activity implements an "assigned pair" protocol, which means that the teacher assigns student work (e.g., essays) for review by student pairs. However, this allows students to review only one of their peer works and accept review from only one of their peers. To improve the situation, we have proposed and explored the impact of a "Free-Selection" protocol (students are allowed to freely explore and select peer works for review). Our results indicate that students following the Free Selection protocol demonstrate (a) better domain learning outcomes, and (b) better reviewer skills, as compared to the Assigned Pair condition. You need some kind of technology to efficiently implement the technique, but it can be as simple as a Webpage, where peer works would be available for preview and downloading.

5. How do you define domain-specific and domain-general knowledge? And how does this relate to knowledge acquisition in computer science?

Knowledge and skills relevant to the domain of instruction are always "domain-specific." For example, understanding the basics of computer networking is conceptually domain-specific knowledge in the computer science area. "Transversal" knowledge/skills not directly relevant to the domain of instruction but used as a means for instruction can be described as "domain-general." For example, understanding argumentation and constructing good arguments about building an efficient computer network can be considered as a domain-general knowledge when learning about networks.

6. You recently reviewed the field in terms of "adaptive and intelligent systems for collaborative learning support." Could you summarize what you found?

Adaptive and intelligent systems are important because—at least in theory—they integrate teacher expertise and can guide students efficiently, providing appropriate support at the time it is needed. We reviewed 105 relevant articles, with 70 of them reporting concrete evaluation data on the learning impact of adaptive/intelligent systems for collaborative learning. The reviewed articles indicate that such systems increasingly introduce artificial intelligence and Semantic Web techniques to
support various phases of the collaborative activity; for example, guiding group formation and facilitating learning by triggering peer interaction.

Our findings suggest that systems can improve both learners’ domain knowledge and collaboration skills; however, these benefits are subject to the learning design and the capability of the system to adapt and intervene in an unobtrusive way, thus avoiding increasing learners’ cognitive load.

7. What is an “adaptation pattern”? What is adaptive collaborative learning activity?

Adaptation patterns are primitives of teachers’ adaptive behavior when guiding small-group work. In other words, adaptation patterns are prototypical ways of changing/adapting one’s initial design (course of action) when specific conditions are encountered. Think of a teacher who directs students to work in small groups following initially a specific didactic scenario. At a point he or she realizes that a more advanced/skillful student in a dyad has already completed the task while a partner struggles to follow. How does the teacher adapt the initial task design to keep the advanced student engaged and benefit also the less capable? We analyze what the teacher thinks as a good adaptation practice in this situation, and we classify this teacher’s intervention as an adaptation pattern in the context of collaborative learning. We have managed so far to identify several such patterns, formalize them, and integrate (some of them) in technological environments for collaborative learning. We consider this a promising path that may lead to advanced adaptive/intelligent tools for supporting collaboration.

8. What patterns of modeling have you found to have a practical influence when designing modules for learning?

Based on our analysis of adaptation patterns, I can argue that important learners’ profile aspects that need to be modeled include:

(a) students’ prior domain knowledge: this is typical modeling in many adaptive systems, helping to make the system aware of the “learning starting point” for any specific student;

(b) students’ experiences with collaborative learning activities and techniques: this would help adapt the scaffolding interventions of the system and the roles assigned to the students—for example, a more experienced student could be assigned the group moderator role; and

(c) group synthesis: modeling the group as a whole helps modeling the possible dynamics of peer interaction and thus adapt the level of guidance provided to the group and individuals; for example, it is different to have two domain novices working together (you need to provide consistent support) than having a dyed with a novice and an advanced student (the collaboration script can be adapted so that the advanced works on a more demanding version of the task, supporting also the novice during collaboration).

9. Many students have quite different learning styles—how can prompting and encouragement help?

We came across this issue in one of our studies exploring the impact of question prompts on student learning in relation to their learning styles. The students’ styles were modeled according to Kolb’s learning styles inventory (accommodator, assimilator, converger, and diverger) and the prompting technique helped students focus on important issues while working to analyze cases in the domain of software project management. Our results indicated that convergers considered the question prompts as more helpful and less tiresome than the other student styles, being also the group that provided the longest and, seemingly, more complete answers to the prompts during their study. It is possible, therefore, that although prompting can be generally helpful, factors such as the students’ learning styles are able to limit the cognitive benefit emerging from the prompting intervention. The suggestion for designers is to consider combining prompting with other scaffolding methods, in order to effectively support all students, independent of their learning styles.

Our current understanding, however, considering students’ learning styles, is that students’ self-awareness of possibilities and limitations regarding their own styles is of primary importance in learning situations, and it can be effectively supported through teacher–group face-to-face supportive sessions (group-facilitation meetings).

10. Could you describe further your use of PEGASUS and how this would help with supporting group activity??

The PEGASUS system can actually do three things:

(a) allow students to login to the system and answer a learning style psychometric test;

(b) process students’ answers and identify their learning style, providing also initial information on strong and weak points regarding student style; and

(c) allocate each student in a student group depending on the instructor’s group formation settings (for example, a teacher may ask for heterogeneous quadruplets and thus PEGASUS provides a possible four-member grouping, satisfying the heterogeneity criterion).

In essence, PEGASUS (as other similar technologies) is a learning style-based group formation system that automates the daunting task of group formation and makes it much easier to accomplish for the instructor. This step (group formation) is a first important step in applying learning style-based pedagogy. However, as I discussed earlier, the effectiveness of a learning-styles approach strongly depends on teacher–group face-to-face interaction, which should cultivate students’ self-awareness of their styles and boost group creativity.

11. What do you mean by an “ill-structured” domain, and how does the prompting mode affect learning?

Domains can be classified as more or less well- (or ill-) structured. In an ill-structured domain, the context of a situation when knowledge is applied has a strong influence on the problem-solving process and the possible solutions.
Thus, the domain cannot be studied through an abstraction approach that eliminates contextual factors and provides solutions in a "linear" fashion (i.e., that the same initial conditions imply the same solution). Instead the context has to be thoroughly analyzed and taken into consideration during the solution process. Such domains include applied medicine, law, and management (such as software project management and others), and instruction needs to employ methods sensitive to contextual factors, such as case-based learning.

In case-based learning, prompting techniques can serve many purposes—cognitive and metacognitive. While students are guided to study a number of relevant cases, prompts attract their attention to the varying roles and impacts of contextual factors, help them reflect on the intricacies of applying domain knowledge during problem solving, and facilitate metacognitive processes.

In our research, we have explored the effectiveness of two variants of a prompting strategy, when students learn in an ill-structured domain with the aid of a Web-based environment. Specifically we investigated the impact of the "writing mode" (students are asked to provide written answers to a set of prompts meant to engage them in deeper processing of the material) vs. the "thinking mode" (students are asked only to think of possible answers to the same question prompts). Results indicated that students in the "writing" condition group outperformed the "thinking" condition group in both domain knowledge acquisition and knowledge transfer post-test items. The conclusion is that prompting techniques may lead to improved outcomes, when combined with the requirement that students provide their answers in writing.

12. What should designers look at when deciding at what point in the learning to fade prompts? When does the prompting interfere with learning?

The answer to this (when to fade out scaffolding) is not straightforward. It depends on contextual factors, such as the complexity of the script to be internalized and students' prior knowledge/skills. However, what is important is that when fading out, the system should also engage students in practicing the skills to be learned. Simply fading out the support does not seem to provide any benefit.

13. How do you define "novice student learning" as opposed to "expert student learning," and how should we be studying this—qualitatively or quantitatively?

"Novice student learning" refers to the three lower levels of Bloom's learning taxonomy (that is, recalling basic domain information, understanding the introductory domain conceptual framework, and being able to supply basic domain problem-solving techniques). Respectively, "advanced" (or "expert") student learning" focuses on the three higher levels of the hierarchy, that is, to learn and be able to analyze complex problem situations, design or synthesize appropriate solutions based on the analysis of a complex situation, and evaluate various proposed solutions.

Both quantitative and qualitative methods can (and should) be used for studying novice and advanced level learning. However, as the latter is evidenced in complex learning activities (such as, for example, project-based learning), it is important that the researchers apply a battery of research techniques, which combined can document the emergence of student advanced mental models.

14. What are "e-lectures" in your mind, and how would you study their efficiency? Why are they important?

I call an "e-lecture" the very common practice, nowadays, to upload digitized versions of course lecturing material as supportive learning material for students. An e-lecture can be developed "in vivo" (the instructor is lecturing in front of a live audience) or "in-vitro" (the instructor is lecturing in studio conditions addressing a virtual audience). E-lecturing is obviously important because it helps to increase the flexibility of the learning experience. At the same time, however, it is important that the adoption of e-lectures to support flexible learning should be advanced in close relationship to models of course re-engineering that also foster instructional cohesiveness, by integrating the various learning events as interrelated nodes of a productive learning network. In other words, e-lecturing should be part of an integrated strategy that encourages and advances student engagement and efficient learning in parallel with increasing flexibility in educational settings.

15. Could you discuss the value of "writing to learn" and it's importance?

Several authors have emphasized the learning benefits emerging for students when practicing writing-to-learn activities, suggesting that the process of eliciting thoughts in written form enhances the thinking process and learning outcomes. Relevant research has shown that writing can be used effectively as a tool for constructive learning and for supporting students in developing critical thinking and increasing their analysis, inference, and evaluation skills.

In line with this perspective, we have investigated how student prompting techniques embedded in technology-enhanced learning environments can have an increased impact on learning in ill-structured domains. In particular, we developed a Web environment for case-based learning, where students were prompted to (a) focus on the role of key events in the case, (b) relate these events to what is already known from other similar situations, and (c) reach useful conclusions (reasoning process), based on the results of the two previous steps.

Our results indicated, as also mentioned earlier, that asking students simply to think of possible answers to the above prompts was not as engaging and effective as when asking for submitting written answers. We concluded that eliciting thoughts in written and properly phrased statements and arguments triggered additional cognitive activity that resulted in better learning outcomes. The implication for designers is that interactions for having students express in writing their thinking during the learning activity can be a more effective option in technology-learning environments compared to simple question-answering techniques.

16. In your country, are you "going blended" or
approaching learning from some other perspective?

As in many other countries, "going blended" in Greece is not exactly the mainstream course of action but the practice of more skilful and experienced educators and in specific situations. "Going blended" may refer to (a) combining onsite (face-to-face) and online (Web-based) learning activities, and you can see this happening in certain cases, for example, in inservice teacher training seminars, and (b) teachers integrating digital technologies in their everyday practice; tools like interactive boards, multimedia content repositories, Internet resources and also—more rarely through—social networking media.

17. Who has mentored or influenced you?

One of my first influences was Michael Jacobson (currently at the University of Sydney), whose work on hypertext and cognitive flexibility theory inspired my PhD work. I closely attend the work by colleagues in the CSCL and adaptive/intelligent systems community, including (in the US) Peter Brusilovsky (University of Pittsburgh), Carolyn Rose (Carnegie Mellon), and Dan Suthers (University of Hawaii at Manoa), and (in Europe) Pierre Trionfetti (University of Grenoble), Pierre Dillenbourg (EPFL), Frank Fischer (University of Munich), Armin Wienberger (Saarland University), and, of course, my dear friend Yannis Dimitriadis (University of Valladolid).

18. What is your educational background and your experience in the field of educational technology?

I entered the Aristotle University of Thessaloniki (AUTH) in 1978 to study Physics. At that time the term "educational technology" referred to using overhead projectors—perhaps also videotapes—in the classroom! The computers available were mainframe systems, where programming was done using punched cards and—if you were lucky enough—dummy terminals. I took my first courses on programming (Fortran and Pascal) during my basic studies and after getting my diploma I enrolled in a two-year postgraduate program in electronic physics, where I specialized in microprocessors and assembly programming.

Having a postgraduate degree, it was rather easy to get a job in education, so I joined secondary technical education as an electronics teacher (1989). In the meantime, the first personal computer laboratories were installed in Greek technical schools, and there was a need for computer-specialized teachers.

As a teacher, I grew up interested in using digital technology for educational purposes and in doing research in the field. The opportunity was provided a few years later (1994), when I joined the newly established (1992) Department of Informatics at AUTH as an adjunct researcher. The department had just installed a very well-equipped multimedia laboratory, where I could do research on the educational use of multimedia technology. Soon, I discovered a lot about learning theories, instructional design, and multimedia authoring tools of the time, like Authorware, Director, and Toolbook. My PhD work was decisively influenced by the work of Rand Spiro and Michael Jacobson in cognitive flexibility theory and hypermedia applications for learning in complex domains.

I developed a software application for case-based learning in the computer networking domain and demonstrated how novice learning by criss-crossing the domain could be significantly more flexible when compared to learning following the typical method of linearly covering the thematically organized domain. I published my first journal papers and did my first conference announcements on this issue and got my PhD in 2000. Later on (2002), I joined the department as a Lecturer (2002–2008) and Assistant Professor (2008–now). Early in my academic career I had the very constructive experience of leading the AUTH team participating in the "Kaleidoscope" European Network of Excellence.

19. Please describe the university with which you are affiliated.

The Aristotle University of Thessaloniki (AUTH) (http://www.auth.gr) was established in 1926 and is the largest university in Greece and the Balkans (more information on AUTH history can be found here: http://www.auth.gr/en/history). AUTH comprises seven faculties organized into 33 Schools, five single-school faculties, as well as four independent Schools. The University campus covers some 23 hectares close to the center of Thessaloniki, but some educational and administrative facilities are located off-campus for practical and operational reasons. A number of those are outside Thessaloniki or even in other cities. More than 95,000 undergraduate and postgraduate students study at AUTH (65,000 active students), 86,000 in undergraduate programs, and 9,000 in postgraduate programs. The faculty members (Teaching and Research Staff) number 2,316 people (648 professors, 620 associate professors, 502 assistant professors, and 546 lecturers).

The Department of Informatics (http://www.csd.auth.gr) was established in 1992 as a part of the Faculty of Sciences of AUTH. There are about 700 undergraduate students enrolled, 140 graduate students in two postgraduate courses, and 100 PhD students. The faculty members are currently 30 and there are five research laboratories in the Department: (1) Multimedia Laboratory, (2) Computer Architecture and Communications Laboratory, (3) Artificial Intelligence and Information Analysis Laboratory, (4) Data Engineering Laboratory, and (5) Programming Languages and Software Engineering Laboratory.

The activities of the Multimedia Laboratory focus mainly on the domain of educational technology (some other domains are also supported within the lab). Research and instruction are oriented to the design, development, and evaluation of technology-enhanced learning environments, with emphasis on computer-supported collaborative learning, instructional design, flexible learning, multimedia/ hypermedia learning applications, intelligent agents for learning, learning communities, and the didactics of informatics.

20. What is the current status of the educational technology field in Greece?

In Greece there is currently a relatively small but active educational technology community. The community is offi-
cially represented by "ETPE," which is the "Greek Scientific Association for ICT in Education," with 355 members currently (est. 2000: http://www.etpe.gr/index.php). Unfortunately, the site is temporarily available only in Greek.

Technology-enhanced learning (TEL) was advanced in Greece during the 1997–2001 years when major investments in infrastructure (through a panhellenic project under the code name "Odyssey") helped via installing computer laboratories at secondary education schools; made available to schools several successful software learning tools (most of them translated in Greek); and organized ICT-in-classroom training seminars for inservice teachers.

Today, although computer equipment can be found in many schools, there are two major drawbacks for TEL activities: (a) it is difficult for schools to update their software and hardware infrastructure, and (b) it is difficult for teachers to have the necessary technical support. However, as new teachers (familiar with the use of technology) enter the profession and technological tools mature (thus are more reliable to use) many more TEL activities are conducted in schools, employing current technologies that greatly attract the interest of students, such as Web 2.0 communication services for supporting school communities and programming tools for educational robotics. Most of these pioneering teachers are usually university masters or doctoral students, who implement in their classrooms innovative teaching methods and present their results in national and international fora.

Members of the Greek educational technology community are actively participating in the committees of many conferences worldwide (for example, the IEEE ICALT conference, CSCL, INCoS, Constructionism, etc.). The community issues the International refereed journal Themes in Science and Technology Education. Several conferences of interest (national and international) are organized in Greece each year. Some of these focus strongly on the work done by teachers at schools (such as the conference organized in Syros island each year, the conference on the Didactics of Informatics, and the conference of Computer Science teachers). And at least one international conference (the ICITE conference) is permanently organized in Greece, in picturesque locations, such as the Corfu, Rhodes, Crete, and Samos islands.

21. What have we neglected to ask?

People often ask (or wonder) if investments in educational technology actually pay back. I always answer that the impact of learning technology can be profound and can only be appropriately evaluated in the long run. Learning is a complex phenomenon, interweaving psychological, social, and cognitive factors. Technology opens new roads and possibilities and offers the opportunity to our students to engage in rich learning experiences, making them "richer" people cognitively, metacognitively, and socially. However, teachers should always keep in mind that for students the sense of belonging to a learning community and the face-to-face communication with the teacher (as an expert member of the community) are irreplaceable.