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# Using LAMS to facilitate an effective synchronous virtual classroom in the teaching of algorithms to undergraduate students

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Modern theories of learning suggest that there is a social dimension to the learning process. However, the majority of traditional students do not participate actively in the actual classroom environment. Transition from f2f learning to blended learning means greater demand for support via synchronous Tutoring Tele-Meetings (TTM). In conventional Higher Education in Greece students have physical presence by attending lectures but they do not really have the opportunity to actually involve themselves in the learning process. Virtual classroom is one of the tools that can reduce the sense of isolation by offering more engagement opportunities for both online and traditional students. Keeping everyone engaged in a virtual classroom is a challenge because, unlike a physical classroom, students' body language cannot be read. It is important to provide students with learning activities before, during and after the TTM in order to achieve much more than just listening and passive attendance. In this paper we propose a LAMS sequence template which we expect to lead us to a pedagogical planner for implementing effective synchronous virtual classroom, and we share the lessons learnt about using LAMS to facilitate open education in our university. Organizing synchronous e-learning opportunities for our students is an effective way to increase self-learning with less guidance and support. By using LAMS we can properly prepare and monitor our students to enhance their participation in effective TTM with which we complement teaching of algorithms to undergraduate students.

Keywords: synchronous virtual classroom, higher education, learning activities, teaching algorithms, LAMS

## Introduction

The exploitation of e-learning is continually increasing in Higher Education (HE). The term "blended learning" and the combination of instructional methods and media are used with increased frequency in academic circles (Bonk et al., 2005). Research findings (Catley, 2005) indicate that e-learning can provide an important supplement to traditional teaching approaches. Greek HE institutes follow this tendency as well, but in a smaller degree. In Greece, the traditional face-to-face (f2f) learning environment has been around for many years as a professor-directed environment. On the other hand, distributed learning environments have begun to grow and expand as e-learning technologies. Thus, they have expanded the possibilities for interaction and collaboration.

In this framework, our research effort focuses on how computer-mediated environments can bring a level of authenticity and interactivity to the traditional formal classroom level in HE. According to Dalziel (2003), a key dimension of education is learning which arises from interacting with instructors and peers

(rather than simply interacting with content). In this case study, we try to blend the lecturer-controlled teaching approaches in which the lecturer transmits accumulated information to students, with constructivist approaches to university teaching and learning which demands students to be active, hands-on and supported by peers and tutors based on a "just-in-time" basis. According to Gerbic (2006), factors affecting students' participation in online discussions are related to access to technology at home, lack of familiarity with computers or software, technical problems, too much information and easier expression of thoughts in text rather than speech. According to modern theories of learning organizing synchronous virtual classroom implementation in HE enhances the social dimension and interactivity in the learning process.

The University of Macedonia is a Public University located at Thessaloniki, Greece. The most common way of teaching is still focused on transmissive rather than interactive strategies to support learning. The "Algorithms with C" is a compulsory first year course in Applied Informatics Department, aims to a) introduce students in the algorithmic thought and the relative basic significances of calculating a problem and its solution and b) familiarize students with the structured planning, repetitive and retrospective.

In this course, students face up learning difficulties on the implementation of an Algorithm in an arithmetic example and the step-by-step description of a given algorithm pseudocode. Blended learning is the new trend in integrating ICT in HE teaching. Convenient communication provided by ICT allows students to share and exchange ideas with tutors and other peers and stimulate their interests using multimedia educational material. Since 2005, web-based learning activities have been integrated into our teaching approaches. We supported students during the whole semester with s*ynchronous virtual classrooms*, Tutoring Tele-meetings (TTMs) implementation, complementary to traditional lectures (Papadakis et al., 2006a). Students participated voluntarily in asynchronous and synchronous activities. Our findings from previous research on TTM implementation indicated that this is a suitable tool for complementing a conventional course (Papadakis et al., 2006a, 2006b). During TTM students have the opportunity to construct their own knowledge and develop skills about the subject via studying alternative resources and posting questions on the course forum (Rossiou et al., 2008). Although TTMs had positive results in students' learning, we found them time consuming for both students and tutors, they would be more effective if there was better preparation from students' side. This may be achieved if students work out on interactive activities before TTM's implementation.

This paper will examine evidence of using a learning design tool in order to plan a sequence of learning activities aiming to prepare students for their participation in synchronous virtual classroom. The Learning Activities Management System (LAMS) was the tool chosen for it.

Our main research question is: *Which can be the phases of a template (according to the expected pedagogical planner) of a sequence of learning activities in order to support students to participate in an effective synchronous virtual classroom?*

The TTMs improvement is setting in the context of moving towards the greater utilisation of e-learning to facilitate student learning. Our research focuses on the impact of the Learning Activity Management System (LAMS) on educators as it concerns the better planning and organising of more effective TTM based on a sequence of learning activities. We propose *Resume Algorithms Sequence (RAS)* of learning activities for TTM's facilitation as appropriate preconditions for students to be well-prepared for their active and affective participation.

This paper is organized as follows: firstly, it is presented a description of Tutoring Tele-Meetings in order to support students to resume and reflect on algorithms and teaching units during the whole semester. Secondly, the design of TTM is drawn and a template (Revision Algorithms Sequence - RAS) of a sequence of learning activities in LAMS for TTM facilitation is suggested. To conclude, the lessons learnt about using LAMS are discussed and some conclusions and recommendations are proposed.

## What is Tutoring Tele-Meeting?

The most current teaching practice in HE is focused on transmissive rather than interactive strategies and nearly all instructors use lecture as the major teaching technique. Blended learning systems combine face-to-face (f2f) instruction with computer-mediated instruction (Bonk et al., 2005). Given emphasis on

computer utilization, it is clear that we need to ensure that we make full and effective use of the opportunities that it offers us. However, we need to ensure that we bear in mind two things: a) 'traditional' teaching methods are valuable and still have a place; and b) the use of ICT must be driven by teaching and learning considerations and not by a requirement to include more IT.

Blended learning engages students to experience a range of media and activities during the study process. The turn to computer mediated learning and later on to the web-based learning environments expanded in exponential ways. It becomes clear from the literature that the combination of traditional f2f learning and e-learning are widely used in HE and it is not enough to simply mix these two different areas of learning (Graham et al., 2003). An increased and continuing effort should be made to effectively design the combination of f2f teaching approach and e-learning experiences for both instructors and students. The face-to-face teaching with e-learning supplements is situated closer to pure traditional f2f teaching yet (Figure 1). Thus, this influences design of blended learning implementation since it is related to both students' expectations and attitudes and educators' mentality.

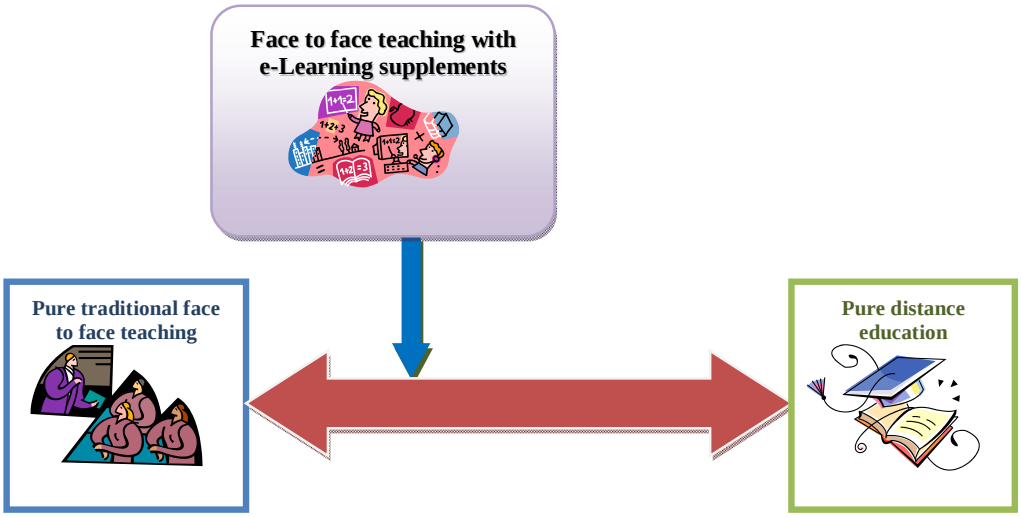


**Figure1: Range of Blended Learning suitability**

*Virtual Classroom* or Synchronous eLearning, as Keegan et al. (2005) define, is a group of students being together online at a particular time for certain duration. Students are in different places and are taught electronically by a teacher using a web browser with integrated voice and video as the main delivery medium. As the sessions are recorded, the learning module can be both synchronous and asynchronous. It can be replayed for clarification and reinforcement (Keegan et al. 2005).

The term, *effective virtual classroom,* is defined in terms of a) the virtual classroom's acceptability to students; b) the enhancement of the learning experience and outcomes; c) opportunities provided for tutors to reflect on d) the possibility of queries expression e) accomplish educational objectives and knowledge acquisition in depth.

*Tutoring Tele-Meeting* (TTM) constitutes an educational networked tool based on features of adult education and offers the possibility of self-supportive, cooperative and experiential learning (Hatzilacos et al., 2007). Students search and find support when they need it according to their personal learning difficulties. The queries' expression, the common attempt to solve problems and the exchange of suggested solutions promote their self-confidence and their active learning through experiment. In addition, it provides feedback to students about their process and generally allows them a degree of independency as it concerns "when" and "where" they study. Also, it promotes interaction with other students and instructor as well.

The proposed lesson plan of TTM, the synchronous virtual classroom teaching, is based on Bloom's Taxonomy (Bloom, 1956). The TTM is a 4-phased educational process: the first phase is implemented in the main room of virtual classroom. Students remember, understand and apply the taught concepts

(Rossiou et al., 2008). The second phase is the main phase during the particular TTM. Students form small groups (2-4 students), may "move" in another networked environment and work together to a particular assessment. The next phase is implemented mainly in separated rooms where groups of 4-6 students analyse and try to understand the concepts in depth. Finally, during the last phase groups present their work and both evaluate and are evaluated in the context of knowledge, skills and attitudes goals of TTM (Voyiatzaki et al., 2008). Our experience of implementing TTM illustrated the need of complementary e-tools in this innovative supplementary educational approach (Figure 1). A TTM needs help *before*, *during* and *after* its implementation. Before TTM, students download educational material, ask from alternative material, need a way to communicate with tutors and peers to support themselves when they study or/and solve technical difficulties that they face. Also, they prefer interactive activities before, during and after TTM. So, we used an LMS, *Compus*. The available asynchronous e-tool during the whole semester was the forum of the course, where students could pose their queries and difficulties but there was not high participation in them. As Rossiou and Sifalera (2008) refer, the majority of the students explained that the main reasons for their abstention were the lack of study during the semester or/and their preference to keep anonymity and therefore they did not feel comfortable in using it. Thus, we became aware of investigating a better way that can effectively facilitate TTMs. Furthermore, the necessity of a learning design tool to support effective practice in designing and implementing our approach was raised. We chose LAMS because of its ability to orchestrate learning activities instead of creating learning opportunities based on content as the older LMS did.

Our motivations to implement TTMs with LAMS and choose blended learning over other learning options were identified to be: (1) pedagogical enrichment of the course, (2) access to disseminate knowledge, (3) social interaction (between students and students-tutors), (4) personal activity and decrease of passive attendance, (5) cost effectiveness (due to the lack of teaching rooms and available time from both teachers and tutors for f2f tutorials), and (6) ease of resuming and recapitulation of the taught concepts.

The expected educational benefits from TTMs are:

- for students: a) create active participation during the semester b) develop their knowledge in algorithms and lead to better and deeper understanding c) increase examination pass rate
- for educators/instructors/tutors: a) create reusable material which they can continually develop b) communicate easily and know students' learning needs better than in traditional lecturing c) plan their lessons according to important concepts, following their students' needs and decrease time consuming tasks and costs.

## Designing the blended learning approach

During the blended learning approach students go through *four phases*:

- Phase 1 / core lesson: *Face to Face* is implemented by a traditional lecture with person to person interaction in a live physical environment (amphitheatre) and it usually focuses on knowledge transmission.
- Phase 2 / preparation : *online self-paced learning* to review or/and to acquire any prerequisite background knowledge that will lead easily into the new knowledge.
- Phase 3 / access – flexibility: *Synchronous online learning* and support to review and reveal again the most important points of the core lesson.
- Phase 4 / evaluation – reflection*: Asynchronous online learning* and self-assessments in order to prepare students in facing up their final examinations with success.

The tools that we have used for the above 4-phased approach are: a) an asynchronous LMS, b) a learning activity design tool, c) an online learning environment with synchronous virtual classroom interaction (Table 1).

**Table 1: Phases of blended learning approach**

| PHASES | *Aim of phase* | *Way of implementation* | *place* |
|---|---|---|---|
| *Phase 1*<br>*Core lesson* | Acquisition of new knowledge | face to face | amphitheatre-university |
| *Phase 2* | Resuming or/and acquirement | Synchronous and | e-tools: |

| | | | |
|---|---|---|---|
| *Preparation* | of any prerequisite background knowledge | asynchronous online learning, self paced and cooperative learning | • LMS - Compus<br>• LMS-LAMS<br>• WEB |
| *Phase 3 Access - flexibility* | Support for resuming of the most important points of the core lesson, queries solution and knowledge acquisition in depth. | Synchronous online learning | CENTRA |
| *Phase 4 Evaluation reflection* | Development of self-assessments in order to be prepared for final examinations. | Asynchronous online learning | LAMS - COMPUS |

We planned one sequence of learning activities for each TTM during the whole semester 2008-2009. Apart from the first sequence, the three of them corresponded to TTMs which followed from a series of f2f lessons. The first one was aimed to students' familiarization with the e-learning environments that they would use later on. The media available placed constraints on the nature of instructional methods that could be used in each environment. Thus, we promoted students' expression of queries and their activation which could not happen in the conventional teaching.

TTMs used Hellenic Open University *CENTRA Symposium and LAMS 2.1* servers and the Course Management System of University of Macedonia, CoMPUs. Centra is an online learning environment with virtual classroom interaction; it is a virtual classroom software i.e. it is networked synchronous class. Centra is a set of features for interactive, effective group learning, bringing together voice, video, data and graphics in a structured online learning environment (www.centra.com). Collaboration, synchronous audio and video, file sharing, whiteboard, surveys, break out room, text chat, "web-safari" are some of Centra virtual classroom privileges. Also, the "qualifications" of expressing feelings (agreement or not, applaud, laugh), annotating with text and graphics, playing asynchronous playback support participants of virtual classroom with interactive actions (Marthur, 2005). CoMPUs constitutes a completed system of Asynchronous tele-education of University Macedonia Economic and Social Sciences, Thessaloniki, Greece (http://compus.uom.gr).

## Resume Algorithms Sequence: a proposed LAMS sequence

Our aim was to develop a LAMS sequence template to support TTMs for the algorithms course. This necessity was a finding of our latest years' research. We had noticed that many students hesitated to participate in TTMs because they were absent from f2f lectures or/and they had not time to study and resume properly the taught concepts or/and they felt that they were not able to participate actively. So, we tried to find a way to solve the above problem. We had prepared four (4) LAMS sequences, complementary lessons to f2f lectures and suitable for students' preparation for their participation in TTM. We wonder about the reliability because we are not able to ensure that we could apply quite a large number of f2f lessons and TTMs as well. We would expect to form a LAMS sequence template which would be: a) appropriate for students' active participation in TTM, b) reusable material for tutors, not depending on their attitude and editable so that it could be continually improved, c) proper to give the opportunity for easy communication with students and offer an account of students' learning needs better than in the traditional lecturing, and d) suitable for tutors to plan their resuming lessons according to important concepts, following their students' needs and reducing time consuming and cost.

### "Walking" to *Resume Algorithms Sequence*

Ten steps were followed for each one of the four blended learning weeks in order to finalise the TTM's template. After the implementation and many attempts, changes and critical thinking on created sequences we resulted in *Resume Algorithms Sequence (RAS)* which can be used as a complementary educational process in a blended learning course. The steps were:

1. *Preparation of e-lesson plan* for a week (*WL*-week lesson). It contains the educational material for a chapter or a unit. With WL, students will resume the particular chapter/unit which has been already taught traditionally (f2f).
2. *Preparation of LAMS sequence* accordingly to the lesson plan (*WLL* - week lesson with LAMS)
3. Announcement and continual *communication* with students via Compus (for informing students via announcements, answering to students' queries, giving hints for important concepts for resuming, delivering alternative educational material, keeping warm the learning environment)
4. *Preparation of TTM lesson plan.* It contains all the necessary educational material for the 1 ½ hour TTM duration and it is designed accordingly to students' needs with a particular teaching approach (Rossiou et al., 2008).
5. *Implementation of WLL*: students follow learning activities and tutors monitor their work.
6. *Preparation* of LAMS sequence for *evaluation* of TTM.
7. *Implementation of TTM*
8. *Students' Evaluation* of TTM via a LAMS sequence.
9. *Tutors' Analysis* of students' portfolios and students' participation from TTM playback
10. *Tutors' Evaluation* of TTM and WLL

After running the above steps for 4 weeks, we led to the template for the Resume Algorithms Sequence (RAS) which can be used accordingly to f2f lectures and prepare students' active participation in an effective synchronous virtual class, TTM. The template is a way of presentation and communication which is coded and can be shared and reused. We tried to develop a sequence which presents our learning design properly for the undergraduate course in Computer Science. Also, we wanted to investigate advantages and disadvantages for teachers/tutors and students. The LAMS environment can represent the whole educational process from f2f up to TTM event.

### RAS description

Each RAS sequence is implemented after the series of f2f lectures for a chapter of Algorithms and before the TTM which aims to emphasize a particular unit of a chapter and/or solve students' queries and/or just help students' study of the chapter (Figure 2).


**Figure 2: Timeline position of RAS sequence**

RAS sequence is a five stage sequence of learning activities in LAMS which aims to help students to prepare themselves for their TTM participation (Figure 3). Students' knowledge is enriched, concepts are presented with alternative ways, co-operation urges students to exchange opinions and discuss for a common topic or/and suggest their topic and learning is helped. Each phase in RAS has a particular aim and each activity leads students to accomplish particular objectives by doing individual or co-operative assessments (Table 2).

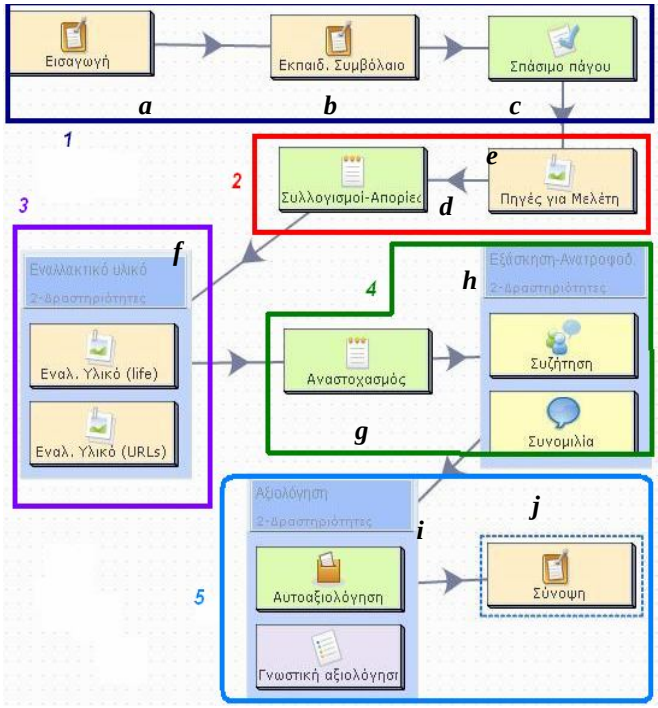


**Figure 3: RAS is a five stage sequence**

During the *first phase* (Figure 3:1), students are *introduced* (Figure 3:a) to the sequence with information about it and agree or shape the *educational contract* co-operatively (Figure 3:b). The *ice breaking* starts warming the learning environment and the preconditions for knowledge acquisition start being established (Figure 3:c). Educational material and resources for study and the possibility of posing questions, queries and/or answer to others students' reflections are executed *after the introductory* phase. The *third phase* ((Figure 3:3) contains alternative educational material and resource from various educational websites and/or the connection between real life and scientific knowledge. The next phase is the interactive phase with other students. Knowledge reflection is developed by asynchronous (forum) or/and synchronous (chat) discussions given by the tutors or/and suggested by students. RAS five stage sequence is integrated with self evaluation and cognitive skills acquisition assessments.

**Table 2: LAMS activities of RAS**

| *RAS stages* | *Activity* | *Aim of the phase* |
|---|---|---|
| 1. *"Starting" to walk* | Introduction | Develop warm learning environment |
| | Educational contract | |
| | Ice breaking | |
| 2. *" Connecting" with f2f lectures* | Resources for study | Study educational material |
| | Thoughts and queries | Pose Questions-difficulties-queries |
| 3. *"Looking further"* | Alternative educational material (Real life examples - Special URLs) | Study alternative material and compare |
| 4. *"Going far" with co-operative activities* | Critical Reflection / Chat-Forum | |
| 5. *"Evaluating" the walk and "relaxing"* | Evaluation (Self-evaluation and cognitive)<br>Synopsis | evaluate the educational process and show the knowledge results |

## Discussion

In this paper, an attempt was made to explore the nature and the causes and possible solutions of the instructional design problems that higher-education educators experience as a result of the use of Virtual Classroom as supplementary tool to enhance teaching in undergraduate students.

This case study compared a pilot experimental condition with examples to the conventional training condition with emphasis to knowledge transmission. In comparison with the traditional academic lectures approach, TTM provides a solution to the problem that students in higher-education are mainly passive learners and they have not the opportunities to interact with peers and educators.

Early findings from pilot implementation of synchronous virtual classroom facilitated by a sequence of learning activities in LAMS, i.e. TTM with RAS can prepare students for active participation in TTM. Students' portfolios help tutors to monitor their students better than in traditional teaching. Finally, tutors are able to straightforwardly plan their lessons according to important concepts, following their students' needs and reducing time consuming and cost.

But it is not easy for traditional educators to organize and implement a Synchronous Virtual Classroom. They should be well qualified in ICT skills and be able to implement pedagogical activities in their e-lessons. Furthermore, the *law-framework* sets limits in applying innovative teaching approaches changes in higher education courses. This means that it is necessary to keep f2f lessons per week and introduce any innovation voluntarily. Obviously, this leads to small participation from tutors and students as well.

## Conclusion and future work

During the last decade, teaching and learning in the field of higher education have been in a state of transition. The shift from lecture based teaching to blended learning using mainly web-based resources and services forces instructors to change their way of thinking and lessons design. The instructor's most important role has changed from transmitter of knowledge to facilitate student's learning process.
The traditional university, as an institution offering on-site courses, needs to recognize the opportunities (and risks) being offered by new technologies in order to maintain its prominent position.

In general, students seem to be supported and facilitated by the sequence of learning activities to prepare themselves for their participation in Synchronous Virtual Classroom and resume each chapter of algorithms. We identified the characteristics of LAMS from the perspective of process support in order to facilitate an effective synchronous virtual classroom which is using in teaching of Algorithms to undergraduate students. LAMS is capable to support our educational blended learning approach but entail an increased workload for instructors and tutors. Fortunately, with time consuming and undertaken experience this load could be expected to diminish. LAMS appears to have compromised learning outcomes in comparison with the previous learning environment in increasing learners' motivation and in encouraging participation. Some students recorded that they like the linearity of LAMS sequences in combining with the direct feedback on their progress within synchronous virtual classrooms. By using LAMS we can properly prepare and monitor our students to enhance their participation in effective TTM.

The importance of a blended approach pointing out in how the same activity may differ qualitatively when conducted in deferent media. For example a synchronous online face-to-face discussion may promote richer exchanges between students and instructors, while a chat activity during the week before the TTM allows students to review and hence reflect on what has been said at the face to face lecture.

Follow-up research in the effectiveness of TTMs is needed to assess the long-term effects of the synchronous distance training as supplementary process to the existing one. For a Virtual Classroom to be effective we expect duration of at least of five time of at least one academic year. In practice we have seen that a short, training period implementing virtual classroom is convenient for most of teachers.

Future plans include: a) RAS evaluation of the algorithms course during the whole semester and for all units b) implementation of TTM with other synchronous learning management systems (e.g. dimdim http://www.dimdim.com/)

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