

Development of Learning Environments with Use of Logo programming language in teaching praxis

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Abstract. The thesis focuses on the development of learning environments with the use of Logo programming language in didactic praxis to promote exploratory and collaborative learning in primary and secondary education and teacher training. A framework is proposed for designing, developing and implementing scenarios and teaching activities by using microworlds developed in Logo-like environments as teaching-learning tools focusing on teaching Informatics and investigating their contribution to the teaching-learning process through authentic teaching examples. Activities and microworlds were designed and developed to support the teaching and learning process (i) promoting learning through exploration and collaboration and (ii) providing a scaffolding to those involved (teachers and learners) during the engagement with activities in classroom. Also online learning environments are proposed as alternatives online teaching suggestions in introducing Logo and Logo-like environments in modern Learning Management Systems / Course (LMS / LCMS) Moodle and LAMS. In particular, a) an online introductory Logo course on Moodle platform where the teaching-learning material for each level of education is grouped and b) sequences of learning activities on introduction to Logo into LAMS platform. Finally, the online learning environment of social networking “The Logo in education: A learning community of practice” is proposed, which is formed in the framework of development and operation of the homonymous educational online social network.

Keywords: Logo, Logo-like environments, Logo programming, microworlds, learning activities, microworlds, investigation, exploration, collaboration

1 Introduction

The introduction and exploitation of Information and Communication Technologies (ICTs) in classroom remains an open, composite and multifactorial issue. The creation of interesting and demanding environments encouraging the active and constructive participation of students is a great challenge for teachers. The planning of a

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learning environment includes extensive decision making for planning, which should be the result of conscious thought rather than an unconscious choice ([27], [4], [6]). Learning occurs through a process of continuous changes in the individual's cognitive structures and is directly linked to the effects of the sociocultural environment [28]. At the same time, the context in which learning takes place [24], as well as the tools' mediation [28] play a crucial part providing opportunities for active, exploratory and personally significant learning for the individual.

Logo is considered an important tool in the hands of teachers and students for the development of their exploration skills, creativity skills and problem solving skills and for the cultivation of logical-algorithmic reasoning ([24], [16], [2], [18], [17], [3], [26], [5]). The trainees become, at the same time, users and designers as they design and construct tools and objects for the solution of problems. This double role of the trainees leads directly to the notion of constructionism. Constructionism involves two interweaving types of construction: knowledge construction through construction of artifacts with personal meaning ([16], [18]).

Logo-like environments can be used to plan and develop microworlds that offer students the possibility to express and exploit their thoughts, ideas and instincts and support the process of building knowledge by creating learning environments rich in speculation and opportunities for experimentation ([17], [26]).

The microworld concept has been present for over four decades now and the exploitation of microworlds in education has triggered the interest and attention of many researchers and instructors, who plan, experiment with and explore alternative constructionist approaches in various thematic fields ([18], [5], [6], [19], [20], [21], [22], [23], [1], [2], [25]).

In this context, the research focuses on the development of technologically supported learning environments through the use of Logo as a programming language and philosophy of education, that supports exploratory and collaborative learning in primary and secondary education and teacher training.

Central research topic was the design, development, implementation and evaluation of teaching scenarios, activities and microworlds developed in Logo-like learning environments to promote exploratory and collaborative learning and exploring their contribution to the teaching-learning process. Also, an important research topic was the development of online learning environments as alternative online teaching suggestions in introducing Logo and Logo-like environments towards promoting communication,

interaction and collaboration among members of the educational community.

The remainder of this paper is organized as follows. In Section 2, a framework for designing, developing and implementing scenarios and teaching activities by using microworlds developed in Logo-like environments is presented. In Section 3, online learning environments are presented as alternatives online teaching suggestions in introducing Logo and Logo-like environments in modern Learning Management Systems / Course (LMS / LCMS) Moodle and LAMS. Following, in Section 4, the online learning environment of social networking “The Logo in education: A learning community of practice” is presented. Finally, conclusions are given in Section 5, with the main points of the research and its contribution in the specific research area.

2 A framework for designing, developing and implementing scenarios and teaching activities by using microworlds developed in Logo-like environments

A framework is proposed for designing, developing and implementing scenarios and teaching activities by using microworlds developed in Logo-like environments (for example MicroWorlds Pro, Xelonokosmos/E-Slate) as teaching-learning tools focusing on teaching Informatics and investigating the contribution of these in the teaching-learning process through authentic teaching examples.

Educational scenarios, activities and microworlds were designed and developed to support the teaching - learning process in primary and secondary education and teacher training (i) promoting learning through exploration and collaboration and (ii) providing a scaffolding to those involved (teachers and learners) during the engagement with activities in classroom ([8], [11], [12], [14], [15]).

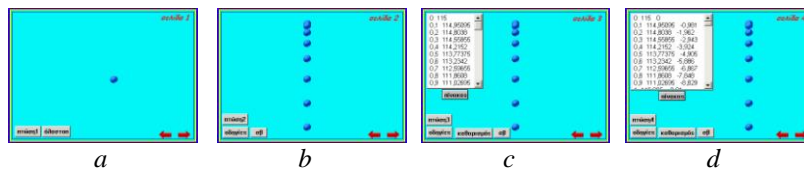


Fig. 1. Snapshots of the “Free fall simulation development” preconstructed microworld.

The basic axes for the design of educational scenarios and activities suggested are: a) structuring exploratory roles, b) supporting the process of active knowledge building, c) exploiting students' previous knowledge, experiences and intuitions, d) developing new student-teacher roles, e) creating collaborative learning environments, and f) using a cross-thematic approach.



Fig. 2. Snapshots of the “Free fall simulation development” students’ project work microworld.

The Investigation Course functions as a framework for the introduction and exploitation of microworlds in the classroom, focusing on alternative forms of exploration, knowledge structuring, expression, collaboration and communication for students and teachers [15]. The activities of the Investigation Course offer rich opportunities for experimentation, formulation and testing hypotheses, interpreting and shaping ideas by placing emphasis on the development of high level reasoning and problem solving skills.

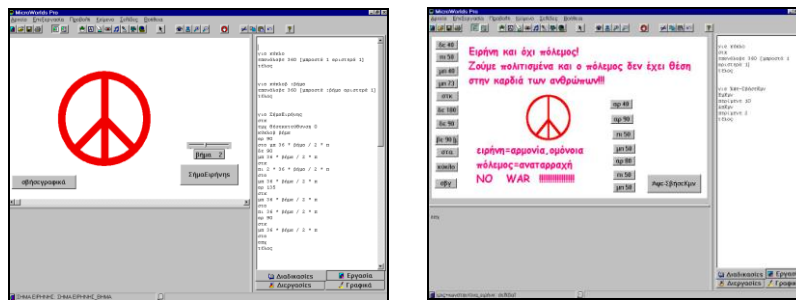


Fig. 3. Snapshots of “The Peace Symbol” students’ microworlds.

The following are stressed as particular focal points of the Investigation Course: a) emphasis is given to the process and not to the end product, b) students' intuition is cultivated and exploited, c) students' thoughts and ideas are visualized, d) students exploit their mistakes and are led to the depenalization of the mistake, e) new

problem solving strategies develop, such as the analysis of the problem in different parts, f) students make original artifacts of personal interest and meaning. Taking into consideration the particular students' previous knowledge and experience level, the starting point and the task's course are different each time, having as basic guiding axes the fact that we gradually move to the writing of an increasingly difficult code: a) to the familiarization with simple Logo commands, b) to using the simple and composite repetition command, c) to defining procedures, d) to defining superprocedures, e) to introducing the concept of variable and the definition of parametric procedures and f) to defining parametric Logo superprocedures.



Fig. 4. Snapshots of a microworld, while working out activity with a gradually increasing degree of complexity (Stages 2-3).

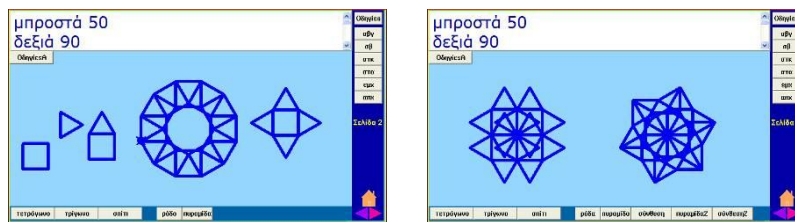


Fig. 5. Snapshots of a microworld, while working out activity with a gradually increasing degree of complexity (Stages 4-5).

It also proposes an alternative constructionist training approach for the introduction to Logo programming by using a structured series of activities and preconstructed reusable microworlds developed in the multimedia programming environment MicroWorlds Pro. The proposed approach and material aims to scaffold the gradual familiarization of the trainees with Logo –programming language and philosophy of education- and the programming environment by applying in action the constructionist reasoning ([9], [10], [13]). The training material is characterized by a gradual increase in complexity

and difficulty degree, and exploits the gradually acquired experience of the trainees by providing them with tools that they are in position to use.

The preconstructed microworlds functioned as “objects to think with”, a good starting point and a solid ground for explorations-modifications-extensions, as a vehicle for collaboration and led to various alternative constructions of personal and social meaningful artifacts. The use and re-use of preconstructed microworlds for the creation of new artifacts with a gradually increasing degree of complexity encourages the systematization of knowledge and bridges the gap between the simple and the more complex ([8], [9], [10], [13]).

3 Development of online learning environments

Online learning environments are proposed as alternatives online teaching suggestions in introducing Logo and Logo-like environments in modern Learning Management Systems / Course Management Systems (LMS / LCMS) Moodle and LAMS. In particular, a) an online introductory Logo course on Moodle web platform where is grouped the teaching-learning material for each level of education and b) sequences of learning activities on introduction to Logo into LAMS platform.

The special features of online learning environments create new conditions for learning and demonstrate a variety of new possibilities for alternative forms of communication, interaction and cooperation by supporting collaborative learning. Both online learning environments are emerging as convenient and friendly web development tools of learning environments that support active participation and promote communication, interaction and collaboration between stakeholders (teachers and learners). They are different platforms with specific features each and a total benchmarking is not feasible. The teacher emerges as the catalyst acting on the teaching strategy that will follow and support through the tool and in this way will add value to the pedagogical use of technology. Nevertheless it is considered that by using the Learning Management System / Courses Moodle more emphasis is given on content delivery, while by using the Learning Activity Management System LAMS more emphasis is placed on interaction and cooperation.

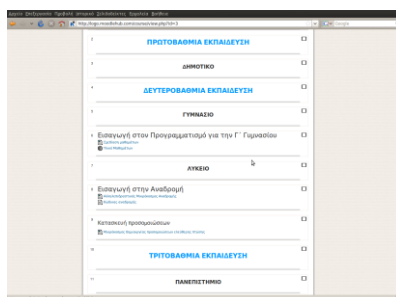


Fig. 6. Snapshot of an online introductory Logo course on Moodle platform.

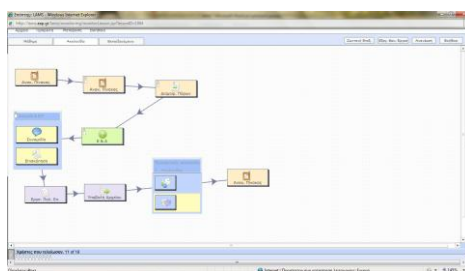


Fig. 7. Snapshot of a sequence of learning activities on introduction to Logo into LAMS platform.

4 Development of the online learning environment of social networking “Logo in education: A learning community of practice”

The online learning environment of social networking “Logo in education: A learning community of practice” (“LogoinEdu” as abbreviation) is proposed, which is formed in the framework of development and operation of the homonymous educational online social network (“EOSN” as abbreviation). This EOSN is functioning as a learning community of practice and as a step for dialogue and mutual support of the educational community in the effort to upgrade the teaching - learning process [7]. Its goal is the communication, cooperation and exchange of views, ideas and material between members of the educational community from different fields, age and background, who are fond of Logo programming language and philosophy in education.

The network primarily concerns teachers of Informatics and Computer Science and in parallel, teachers of various specialties, cognitive subjects and all educational levels who are interested in or/and experimenting with the usage of Logo programming language in the teaching praxis. As it is denoted in the “LogoinEdu” subtitle “Learn - Construct - Collaborate - Communicate” the ulterior objective of “LogoinEdu” is to function as a learning community of practice, as a forum for the dialogue and mutual support between members of the educational community focusing on the pedagogical exploitation of Logo and Logo-like environments attempting to improve the teaching-learning process. The network members are invited to interact in the spirit of Social Constructionism: “Let’s function as a community of practice and learning and exchange views, experiences, practices and tools, such as microworlds, websites, lesson plans, worksheets, codes and all kinds of resources necessary for our teaching practice, with the purpose to upgrade the teaching-learning process.” as it is characteristically mentioned in the network pages.



Fig. 8. Snapshot of home page of the “Logo in education: A learning community of practice” educational online social network.

5 Conclusions

The research presented contributes to the fields of didactics of informatics, and especially of didactics of Logo programming as well as of computer-supported collaborative learning. The main

contribution of the work lies in the provision of a framework and in the development of Logo-based learning environments that support the construction of knowledge and promote synchronous and asynchronous communication and collaboration.

It proposes a framework for designing, developing and implementing scenarios and teaching activities by using microworlds developed in Logo-like environments as teaching-learning tools focusing on teaching Informatics and investigating the contribution of these to the teaching-learning process through authentic teaching examples. Activities and microworlds were designed and developed to support the teaching and learning process (i) promoting learning through exploration and collaboration and (ii) providing a scaffolding to those involved (teachers and learners) during the engagement with activities in classroom.

Online learning environments are proposed as alternatives online teaching suggestions in introducing Logo and Logo-like environments in modern Learning Management Systems: a) an online introductory Logo course on Moodle platform where is grouped the teaching-learning material for each level of education and b) sequences of learning activities on introduction to Logo into LAMS platform. Finally, the online learning environment of social networking "The Logo in education: A learning community of practice is proposed. The network is functioning as a learning community of practice and as a step for dialogue and mutual support of the educational community in an effort to upgrade the teaching - learning process.

The studies conducted, revealed encouraging and positive results for the above mentioned environments in serving their underlying objectives and in supporting the learning process.

The structured teaching/training material exploited in gradual steps and according to the acquired experience of the students/trainees could be considered especially effective in introducing Logo programming and in gradual familiarization with the programming environment; it may be adapted/extended to individual needs and may be used in different learning contexts.

The preconstructed microworlds functioned as a good starting point, as a solid ground for explorations-modifications-extensions, as a vehicle for collaboration and led to various alternative constructions of personal and social meaningful artifacts. The use of preconstructed microworlds for the construction of new artifacts with a gradually increasing degree of complexity encourages the systematization of knowledge and bridges the gap between the simple and the more complex.

The proposed framework and corresponding learning environments support exploratory and collaborative learning and contribute to the active involvement of stakeholders (teachers and learners), the construction of knowledge in programming concepts and cultivation of programming, expression and collaboration skills.

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