WCES-2010

The web based simulation proposal to 8th grade primary school students’ difficulties in problem solving

Hasan Karala *, Ayça Çebič, Memnune Pekşen

*Department of Computer Education and Instructional Technology, Karadeniz Technical University, Trabzon 61040, Turkey
bDistance Education Center, Karadeniz Technical University, Trabzon 61040, Turkey

Received November 5, 2009; revised December 8, 2009; accepted January 20, 2010

Abstract

In this study; it was focused on 8th grade primary school students’ problem solving ways, the difficulties faced in this process and the reasons of them. To defeat students’ negative looks to problem solving and to develop their problem solving behaviors, it was aimed to arrange a web based simulation environment in which they was able to carry out the process, taking the ADDIE model as basis. For this purpose, a pilot study was applied on 10 students in a primary school in the city center of Trabzon province. In the pilot study 20 word problem were asked to students. As the data collection instrument it was benefited from the study adapted from Çalışkan and his friends’ “Physics problems solving evaluation form” which was developed in 2006 and from the interviews with the participants. Comparing the collected data with the data in the literature, the difficulties faced in problem solving process were defined and, as the studies regarding the defined learning difficulties were few, a web based simulation environment proposal was presented. It was concluded that the simulation environment which was arranged based on the results from the specialists’ thoughts and pilot study would help the students in the stage of giving meaning the problems.

Keywords: Problem solving skills; giving meaning to the problem; learning difficulties; simulation.

1. Introduction

Providing individuals multiple thinking ability, Maths which has an important role in science helps individuals to interpret the problems from different aspects. For this unique importance of it, maths teaching is involved in every phase of education. To increase the quality of Maths teaching is depended on some criteria, too. Having mathematical concepts, developing solving abilities, having self confidence in Maths and having positive attitudes about Maths are some of these criteria (Baydar & Bulut, 2002).

As the problem solving is in the center of Maths curriculums, Maths educators have given a great importance to this issue. Because, understanding the knowledge and make associations between this knowledge take place in the problem solving process (Karataş & Güven, 2004).
As the importance of problem solving ability is so emphasized, the analysis of problem solving process and bringing solutions by introducing the breakdowns in this process is necessary. Because, increasing the quality of education has a direct proportion with overcoming the breakdowns.

It is defined that in studies in Maths teaching, problem solving abilities are not in the desired degree in Turkey and in the world (Baykul, 1987; Chiappelli, 1987; Peker, 2003; Karataş & Güven, 2004; Soylu & Soylu, 2006) and it is stated that there have usually been difficulties of teaching it. Difficulty of Maths results from prejudice and fear as well as its structure (Umay, 1996; Albayrak, 2000). Teachers’ negative attitudes, used methods, student’s own anxiety and handicaps are noted among the seen prejudice and anxiety (Başar, Ünal & Yalçın, 2001). When the other studies in the field are analyzed, it is defined that students’ motivation defiency and concepts used in maths are abstract cause difficulties in maths teaching, too (Durmuş, 2004).

In the carried studies it is defined that in addition to difficulties in maths teaching students are not able to have enough achievement in problem solving skills, too (Silver & Marshall, 1990; Tall & Razali, 1993; Vicente, Ersoy & Erbaş, 2005; Orrantia & Verschaffel, 2007; Tatar & Dikici, 2008). In studies, it is found that students are not able to solve word problems or have difficulties in it (Tall & Razali, 1993), inadequate to formulate mathematically and thinking practically (Başar, Ünal & Yalçın, 2001).

It was seen that they are in adequate in drawing a figure for the solution, taking the problem to pieces, benefiting from similar simple problems and controlling the solution when they saw an unusual problem. It was defined that they had the tendency of coming to result, after having a look at it; apply the necessary operations quickly to the given numbers when they saw a problem (Altun & Arslan, 2006).

Being aware of students’ difficulties in any issue is the first step in the studies that are carried on learning (Tatar & Dikici, 2008). The pilot study before moving to the environment design is going to be a resource for a good teaching environment. Also, these data, because of necessity and responsibility of selecting and applying the teaching approaches that supply a maximum learning, will be the substructure to define and improve the most proper education approach.

With the technology based teaching approaches, more efficient and functional learning environments can be adapted. Education technology instruments have a great role in formalizing the concepts according to the levels of the students and in presentation of the concepts almost real, in meaningful learning and in observation of the events again in a repeated way (Akpinar, Aktamış & Ergin, 2005). A lot of surveys are available that with the implementation of technology, knowledge can be more permanent (Wainwright, 1989; Dursun & Peker, 2003; Tsai, 2004; Kwon, 2004).

With computer based teaching, using simulations which formalize the abstract concepts and make the students active in the process will help students to explain the concepts which are difficult to understanding easier (Tatar & Dikici, 2008; Çakıroğlu, Çebi, Bezir & Akkan, 2009).

At the end of the applied analysis, it was seen that the amount of the studies try to remove the learning difficulties were fewer considering the studies try to define the difficulties (Tatar & Dikici, 2008). This study has an importance as to give a proposal to remove students’ problem solving difficulties.

2. Method

In this study; it was focused on 8th grade primary school students’ problem solving ways, the difficulties faced in this process and the reasons of them. To defeat students’ negative looks to problem solving and to develop their problem solving behaviors, it was aimed to arrange a web based simulation environment in which they can carry out the process. For this purpose, first, to define students’ existing learning difficulties in problem solving and reasons of them, a 10 students sampling group was defined in a primary school in Trabzon. In the light of literature, 20 word problems were asked to the students in the pilot study. As the data collection instrument, Çalışkan and his friends’ “Physics problems solving evaluation form” which was developed in 1996 was used while adapted to the study. Data of the study gathered through the semi structured interviews. Comparing the results gathered from the interview with the data in the literature it was tried to define the students’ difficulties in the problem solving process.

Opinions of field specialists were taken on how to remove the identified difficulties and the design of the simulation environment was started. Simulation environment was prepared taking the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model as basis. Opinions of 2 content experts, 1 teaching technologist and 5 maths teachers were referred to in order to evaluate the designed system. Design process of web based simulation environment developed for the difficulties encountered in problem solving process can be summarized as follows.
2.1. Web Based Simulation Environment

Special care was given for the system design to have sensitivity that will address to the students in primary school level and to reflect the real life results of identified parameters one-to-one. Students are allowed to compose the problem entering the necessary data in word problem and to read the associated word problems and make sense of them using the interface in simulation environment. Students are able to see the changes between the beginning and ending points of the problem step by step at the solution stage, they are able to make associations between these changes, they are able analyze the path that goes to the result and they are able to control the correctness of the result.

In the system that is prepared according to ADDIE model; difficulties of the target group in problem solving skills identified by the pilot study, they were compared with the difficulties in literature and teaching efficiency of the system that address to teaching the topics that occur markedly to the students was arranged. An interface that addresses to removal of the problems such as not being able to read the question identified, not being able to identify the question type and not being able analyze the given and demanded in the pilot study in the process of making sense of the problem. The interface was developed in accordance with the teaching design principles and the characteristics of the target group. Special care was given for the use of simple drawings and a colourful and lively interface in order make students feel more comfortable to the problems which they consider as nightmares.

The system where students can analyze the word problem and do applications, and make exercises forming new problems as of the next problem solving skill, appropriate for the student level, was designed and was developed in the macromedia flash programme. Opinions of the experts about the system developed were referred to and the system was evaluated.

The system designed contains 3 main processes in problem solving process. These are; giving meaning to the problem, solution and evaluation processes. In Figure 2 problem solving steps that must be applied in web based simulation environment were summarized.
2.1.1. Giving Meaning Process

In this system, student has to read the question to solve. First the question type is determined. In second step, the system gets ready after verbal and numerical data and demands are defined and then relations among them are entered to system.

2.1.2 Solving Process

In this stage, working of simulation environment according to the entered parameters are observed by the students, the changes in the process can be observable and relations between reason and result become clear step by step.

2.1.3 Evaluation

If the given answer is wrong, it is easy to analyze the changes in the simulation and so the reason of the error can be defined and observe easily. Also, while giving proper feedbacks to every true and every false, an awareness in learning environment is developed. At the ends, given feedbacks are presented in verbal and visual format and result evaluation is made.
3. Results (Findings)

In the light of the findings gathered from pilot studies it was identified that the past failures of the students, being afraid of the problems, considering problems as a difficult subject in general in maths teaching affect problem solving behaviors of the students negatively. It was also seen that students had difficulties such as not being able to identify the type of the problem, not being able to analyze the given and requested in word problem in the process of making sense of the problem. As a result of the field writing review and pilot studied carried out with students it was identified that students were biased about problems subject and they were not able to use their problem solving strategies in the stage of making sense of the problem due to their bias.

Maths teachers who evaluated the environment stated that students had biases about the problems and they always find the solutions of the problems difficult and they thought that students would get rid of their biases in these kinds of settings. It was pointed out that these kinds of environments will make the comprehension of these subjects easier for the students with its affect of making difficult problems more concrete for the students, and with the changing curriculum students will be able to structure their own knowledge. It was also stated that due to the environment designed students will be able to gain the necessary skills to understand and read the problems carefully. Along with these positive aspects the environment was developed for the solution of simple level problems and it will be more helpful if used at the beginning of problem solving process.

According to the teaching technologist, the environment has the necessary qualities that the target group can easily understand and apply. It was said that the colors and the items are in harmony in the environment and the environment was developed taking the teaching design principles into account. But it was also mentioned that the environment had no audio support and that is a drawback of the environment.

Content experts stated that the content of the web based simulation environment has the necessary qualities in order to be applied and to make the participation higher, and it gave feedback to the students, and made these feedbacks effective by creating contrasts among the cases, motivated students and it kept this situation alive within the process. It was also underlined that the content is in harmony with the characteristics of the students that are at beginner level in problem solving skills gaining. It was also evaluated whether it could help the process of reading and making sense of the problems. It is also thought that the possible situations could be observed by changing the parameters and that could help students in an analytical inference of the origin of their mistakes.

4. Conclusion and Recommendation

From the expert opinions and the results obtained from the pilot study it was concluded that the simulation environment that is created will help students at the stage of making sense of the problem. A structure that will explain the word problem with visual representations in the simulation environment was created, thus abstract situations were made concrete. It was observed that the students reached correct results with the help of interactive environment simulation provided and the feedback given by the environment. Findings of the researcher in the pilot study correspond to the opinions of the field experts that evaluated the simulation environment developed.

Students display the behavior of leaving the problem before they read it when they encounter word problems. This situation occurs as a general drawback. The aim of the design of the environment is to create the supportive force to analyze the problems by making them read the problems. By making them gain this habit at basic level they are expected to make generalizations when they encounter different questions. Similar environments that will be prepared in accordance with student level and curriculum will affect problem solving skills of the students in positive and change the negative considerations about maths. By overcoming these prejudices, and reducing anxiety and worry motivation will be provided by a development in positive way. These results obtained correspond to the findings of Mathew and Dohery-Poirier (2000) and Poindexter and Heck (1999).

From the interviews with the experts, it was stated that designation of the environment taking the ADDIE model as basis and identification of the needs of target group provided the creation of an appropriate environment from the point of teaching. Maths teachers stated that students being able to interfere situations, play with parameters and what kind of an effect will be created with the change of each parameter being simulated in the environment was positive and with the help of this feature it will be possible to make students participate actively. At the end of the interview with experts it is thought that the colours and shapes used in environment design will catch the attention of the target group.
While designing similar environments, first the target group must be analyzed after that the data gathered after this analysis and the similar and different points being identified in the literature, environments must be designed in accordance with the opinions of the field experts about what can be the studies that could be suggested as a solution. This environment was prepared in order to help students in making sense of the problems at beginner level. Similar environments can also be designed for the solution of more complex problems in future studies.

References


