Evaluating computer assisted problem based learning environment for endocrine system in human beings in view of professionals

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Abstract
In current study, Computer Assisted Problem Based Learning (CAPBL) environment for human endocrine system was designed considering 3C3R model (Hung, 2006) in high school biology by one of researchers. The aim of the study was to introduce a Computer Assisted Problem Based Learning (CAPBL) environment designed to 3C3R model and examine its instructional relevance in terms of professionals' perceptions. For this purpose, CAPBL Relevance Questionnaire developed based on literature review by one of researchers were implemented to 14 professionals (including four high school biology teachers, two computer and educational instruction technology teachers and eight faculty members studying computer and educational instruction technology and biology education). In the study, problem scenarios in CAPBL environment were sufficient from the point of content acquisition as well as instructional eligibility. Professionals suggested that some revisions were required in navigation buttons of CAPBL environment to enhance its usefulness.

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1. Introduction

Biology occupies a unique place in the school curriculum. Biology is essential many science related courses such as medicine, pharmacy, agriculture, biochemistry and so on. It is obvious that no student intending to study these disciplines can do without biology (Yusuf and Afolabi, 2010). These factors, among others, have attracted attention of researchers towards biology as a subject in the school curriculum (Kareem, 2003). In spite of the importance and popularity of, performance at secondary school level had been poor. Most study showed that biology has been among the science lessons in which most learning problems are encountered (Çimer, 2004; Adalı, 2005; Salman, 2006). It has been observed that poor performance in the sciences is caused by the poor quality of science teachers, overcrowded classrooms, and lack of suitable and adequate science equipment, among others (ekle tez önerisinden Kareem, 2003).
In recent years, computer assisted instruction has been popular to overcome learning problems which result in the lack of suitable and adequate science equipment. Computer, as one of the technological devices, enable students to gain experience in the real world context and facilitate the understanding of abstract subjects occupy in science particularly biology. That is because various means are used in these environments, such as images, simulations and animations which transfer abstract knowledge to real situations and videos, graphics, sounds and texts which can reflect real situations, problems or sample cases (Jonassen, 2002).

Development in education technologies has directed researchers towards studies which support the learning theories, methods and models with computers. For instance, it has been some studies that support problem based learning with technology because there is a complementary relationship between technology and problem based learning. Both function for the sake of the other. While problem based learning claims that learning takes place on the part of the learner by structuring the knowledge acquired previously and at the moment in a particular context, technology provides learners with the environment to form that rich context (Gürsul, 2008). The related literature showed that the number of sample implementation for computer-assisted problem based learning is rather few, particularly in our country, and also at secondary biology classroom even though there are findings about the contribution of supporting problem based learning with computers (Tekedere, 2009; Şendağ, 2008; Ak, 2008). For this reason, it is necessary to design and conduct research these design’ effect on student learning outcomes.

Some computer assisted instructions has been criticized because they do not meet expectations in terms of education. This is because it can be lack of preliminary study which conducted with professionals during the process of design (Özdener and Erdoğan, 2001). In this content, aim of the current study was to determine the adequacy of the format, the content and education of the design CAPBL environment in the subject of ‘Endocrine System in Human Beings’ by getting the opinions of the professionals on biology and computer and instructional technology education.

2. Method

In this study, the aim was to evaluate the adequacy of the computer assisted problem based learning (CAPBL) environment designed for the subject ‘Endocrine System in Human Beings’ in terms of content, education and form. The study was designed in "Survey Model". This model is research approaches which aim at describing a past or present situation in the form it exists. Individuals or objects which are the subject of the study are tried to be described under their own conditions. The main reason why the ‘Survey Model’ was chosen in the study was the fact that enough evaluation had not been carried out in Turkey about educational software particularly intended for computer assisted teaching and insufficiency of field literature about explanatory, generalizing and institutional research intended for web assisted teaching (Karasar, 1999, p.77).

2.1 Computer Assisted Problem Based Learning (CAPBL) Environment

CAPBL environment, which was developed in the scope of ‘Endocrine System in Human Beings’, was designed for students in the problem based learning method on the basis of the constructivist approach. This environment which requires that students use their high level skills such as researching, questioning, deep thinking, reflecting and problem solving was developed in accordance with the 3C3R design model (developed Hung, 2006).

3C3R model consists of two main components, core components and processing components. Core components include content, context and connection dimensions and used to support content/concept learning. Processing components include researching, reasoning and reflection dimensions, and they are interested in learners’ cognitive learning process and their problem-solving skill. In the CAPBL environment, students have to follow the under mentioned steps basically in the process of solving a problem scenario:

1. Examining the problem situation (watching/reading)
2. Examining the task section
3. Making explanations with Socratic questions
4. Examining the research menu (links about observation, laboratory test results, physical findings)
5. Collecting the data (evidence) and writing them in the ‘Take notes’ section
6. Making explanations with Socratic questions (scaffolding)
7. Repeating the above-mentioned steps if necessary

![Figure 1: A screenshot of researching sub menu of CAPBL environment]

2.2 Participants

In order to evaluate the CAPBL environment, opinions were taken from professionals on biology and computer and instructional technology education. Some information about the professionals who participated in the study is summarized in the table below.

| Professionals on biology education | n | Professionals on computer and instructional technology education | n |
|-----------------------------------|---|-----------------------------------------------------------------|---|
| Assistant professor              | 4 | Doctorate student                                              | 2 |
| Professor                        | 1 | Master student                                                 | 1 |
| Biology teachers                 | 4 | Computer and instructional learning teacher                    | 2 |
| Total                            | 9 |                                                                 | 5 |

Opinions were taken from four biology teachers, five faculty members in biology education, two doctorates and a master student in computer and instructional technology education to evaluate the CAPBL environment.

2.3 Data Collection Tool and Data Analyze

Professionals’ opinions were taken via the Computer Assisted Problem Based Learning Environment Adequacy Form designed by one of the researchers. This form consists of three dimensions; problem-content adequacy, educational adequacy and formal adequacy of the design. Professionals on biology and computer and instructional technology education were given briefings at different times to introduce the CAPBL environment. After that, experts were asked to examine the CAPBL environment by using it individually and write their opinions on the environment in the forms handed out during the briefings. Experts were asked to score the items in each dimension they were related to in a ranked manner as 5 "very adequacy"; 1 "not adequacy at all". In the form, there was an ‘Explanation’ section in which they could write down their opinions on each dimension. At this stage, the arithmetic mean of the points, which the experts scored for items related to each dimension in the form, were calculated and points obtained were presented in a table. Also their quotes which wrote in ‘Explanation’ section related to each dimension were directly presented to support data.
3. Findings and Discussion

3.1. Professional Opinions on Problem-Content Adequacy of CAPBL Environment

In order to determine problem-content adequacy, only opinions of professionals on biology education were evaluated.

| Problem            | Content/Domain Knowledge                                      | Average Point (N=9) |
|--------------------|---------------------------------------------------------------|---------------------|
| Is Shrek real?     | Anatomy of pituitary gland                                   | 4.6                 |
|                    | Physiologic effect of pituitary gland                         | 4.8                 |
|                    | Physiologic effect of hormones secreted by pituitary gland    | 4.8                 |
| Incredible suspicious | Anatomy of thyroid                                           | 4.4                 |
|                    | Physiologic effect of thyroid                                 | 4.8                 |
|                    | Physiologic effect of hormones secreted by thyroid            | 5.0                 |
|                    | Anatomy of parathyroid                                        | 4.4                 |
|                    | Physiologic effect of parathyroid                             | 4.4                 |
|                    | Physiologic effect of hormones secreted by parathyroid        | 4.6                 |
| She-man            | Anatomy of gonads                                             | 4.6                 |
|                    | Physiologic effect of gonads                                  | 4.6                 |
|                    | Physiologic effect of hormones secreted by gonads             | 5.0                 |

According to Table 2, the average points of the participants with regards to each problem scenario indicate that problem scenarios are quite suitable in terms of content. At the same time, some statements which participants wrote about problem-content adequacy dimension in the explanation section support this fact.

- As a biology teacher, I think these scenarios are very instructive (P1).
- It is good to use the illness in the scenario in a positive way (P7).
- Problems are quite suitable with subjects and they are expressed clearly and intelligibly. Their being interesting will make learning easy and enjoyable (P5).
- The content is suitable (P2).

Malopinsky, Kirkley, Stein, and Duffy (2000), PBL is designed to help students concurrently enhance problem-solving skills while constructing a domain knowledge base. Students gain the domain knowledge by going through the processes of solving problems that, in part, require them to engage in knowledge acquisition activities. For this reason, when designing PBL problems, the content component of PBL problems must be taken into consideration. Hung, (2006) claimed that the first step in designing PBL problems was to set goals and objectives in accordance with the curricular standards as well as ensuring proper scope of PBL problem. In this sense, the problem scenarios taking part in CAPBL environment were developed for the objectives and concepts of the subject of ‘Endocrine System in Human Beings’ which is included in the 12th grade biology curriculum. The professionals indicated that problem scenarios were quite adequacy in terms of content for the subject of ‘Endocrine System in Human Beings’ with regards to each problem scenario. This is because, task analyses on both learning objectives/concepts and the candidate PBL problem to reveal the degree of correspondence between the two was conducted and made adjustment on PBL problems considering this alignment.

3.2. Professional Opinions on the Educational Adequacy of the CAPBL Environment

In order to determine the educational adequacy of the CAPBL software, the opinions of professionals on biology and computer and instructional technology education were evaluated.

Table 3. Professionals Opinions on the Educational Adequacy of CAPBL Environment
As seen Table 3, the average points of the professionals with regards to the adequacy of CAPBL environment educational dimension indicate that this design is quite suitable in terms of educational aspect. According to opinions of professional, CAPBL environment is quite interesting and motivating for students to do research. Biggs (1989) argued that students would attempt to maximize their understanding of a topic when they were motivated intrinsically, such as when satisfying a curiosity or interest about a topic. Similarly, Hung (2006) highlighted that one of the most important points in PBL problem design was to form contexts that can motivate students towards doing research and learning. To provide this, many researchers think that problems that will be used in PBL should be as authentic as possible (Barrows, 1994; Duch, 2001; Hmelo & Ferrari, 1997). In the study, the problems in CAPBL environment were designed close to real life or they were directly taken from real life with the aim of developing situations which students find meaningful and worth researching. For example; the problems of “Is Shrek Real?” and “She Man” were taken from newspaper reports and used after some necessary adjustments. Opinions of professionals confirmed that problems in CAPBL environment are closely related with real life. Also they found that CAPBL environment is quite suitable with student level. Below, some quotes of them were presented to support their perception.

- Scenarios have been selected from subjects we may encounter in real life. So, they are interesting (P1)
- Using examples related to real life is motivating (P4)
- The scenarios in the environment are at a level that can attract students’ attention. In order to find answers to these questions, students will use the environment excitedly to carry out the tasks given to them. Questions asked in the environment will enable students to reason and in addition, they will have the chance to argue with each other in this process (P11).

### 3.3. Professional Opinions on the Formal Adequacy of the CAPBL Environment

In order to determine the formal adequacy of the CAPBL software, opinions taken from the professionals on biology and computer and instructional technology education were evaluated.

| Formative Adequacy                                                                 | Average Point (N=14) |
|----------------------------------------------------------------------------------|----------------------|
| Appearance                                                                       | 4.3                  |
| Screen and color harmony                                                         | 4.4                  |
| Animations                                                                       | 4.2                  |
| The usage of screen                                                             | 4.1                  |
| Screen density                                                                  | 4.3                  |
| Feedback features                                                               | 4.6                  |
| Screen legibility                                                               | 4.4                  |
| Clarity of guidelines                                                           | 4.1                  |
| Ease of usage                                                                   | 3.6                  |
According to Table 4, the average point, which were given by the professionals to the items related with the formal suitability of the computer assisted problem based learning environment, indicate that this design is at the suitable level in terms of form. Participants’ average points with regards to the ease of use of the computer assisted problem based learning environment indicate that the ease of usage of the design is at medium level. On the other hand, some experts stated in the explanation section of the form that the design needed to be developed for ease of use. In this section, there are detailed suggestions given by the professionals on computer and instructional technology education with regards to the improvement of this dimension of the design.

- I think that the guidelines for use are not quite sufficient. It is possible to say that the color harmony and the screen pitch are well adjusted (P14).
- The design and objects used etc. are quite successful. The screen readability and the language used are quite clear and understandable (P9).
- It is a positive quality that the design is generally simple and not distracting. The colors are also simple and in harmony. However, I think that there may be some problems related to the use. They are some small details but I want to tell them in case they are overlooked…(P11).
- It is a bit confusing that the buttons below the problems, which were inactive at the beginning, become active after students record their answers. These buttons can be removed from here and added after students record their answers or at least their function may appear when the cursor is on them. I think it will be more understandable in this way (P13).

4. Conclusion and Implications

In this study, the aim was to evaluate the adequacy of the computer assisted problem based learning (CAPBL) environment designed for the subject ‘Endocrine System in Human Beings’ in terms of content, education and form. According to the data obtained in this study, it is verified that the CAPBL environment is adequate in terms of problem-content adequacy, educational adequacy and formal adequacy of the design. However, professionals have indicated that the ease of usage of the design is at medium level. They also suggested some correction in terms of this component of CAPBL environment. To enhance its usability, navigation buttons and guidelines are considered to reorganize in view of opinions of professionals.

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