

WORKSHEET-BASED MATERIAL DEVELOPMENT AND APPLICATION IN COMPUTER-ASSISTED CHEMISTRY EDUCATION

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ABSTRACT

This study aims to develop computer-assisted worksheet-based teaching materials on atoms and screening as challenging topics of chemistry for students and to determine the effects of these materials on students' achievement. A group of 40 were administered an achievement test of 10 questions related to the topic of the study. The misconceptions and comprehension difficulties were determined through the results of the test. A teaching material, which consists of worksheets that aim to overcome the misconceptions and comprehension difficulties of students, was developed in computer media. With the help of the worksheets, students were aimed to understand major tendencies regarding atom. Screening was chosen as the main concept of the topic and a strategy was determined over the effects of screening on major tendencies in atoms. The worksheets enabled the examination of the effects of screening characteristic on nucleus and outer electrons. The previously constructed misconceptions of students were tried to be overcome. The screening characteristic, which is a quite abstract concept, was presented with drawings and visual presentations in the worksheets in order to facilitate students' comprehension by creating a sample image in their minds. After the worksheets were studied and discussed in a computer environment, the achievement test on the topic was administered as the posttest. The difference between the pre and posttests was found to be significant favoring the posttest. Moreover, during the application of the worksheet-based material, students' attitudes towards the utilization of computers were also assessed. The study was concluded with suggestions for teachers and students on the effective utilization of similar teaching materials in this field.

KEYWORDS

Computer-assisted Education, Worksheet, Chemistry Education.

INTRODUCTION

In order the education and teaching quality to be increased, the effective utilization of modern teaching technologies in teaching concepts is getting more and more important everyday. One of the important advantages of computer utilization in teaching environments is its increasing the level of learning through referring to more than one sense at the same time which also leads to permanent learning. It is noted that, by using animations, pictures, visualizations and sounds together, the learning environments are saved from being traditional and the level of learning is increased (Clark and Craik, 1992). On the other hand, technological-based teaching materials are widely required in constructing teaching environments for students, who have different physical, biological and cognitive characteristics and are from different social environments. However, the differing cognitive, affective and psychomotor characteristics of students challenge the development of such a teaching technology. It is stated that there is no technology that enables the learning of a topic by all students at the same levels and at the same time (Akpınar, 1999). The obligation of presenting knowledge in various ways during the teaching process lead to a replacement of currently used teaching tools with new information technologies (Kaput, 1991). In this respect, computers are suitable resources for the preparation of teaching materials, which serve a wider group of students by taking the requirements of all students into

consideration to some extent. The effective utilization of this resource in teaching increases the quality of teaching materials. The complex graphics, animations, sounds and scenes are explained to be important for interaction. It is emphasized that the targeted aims in teaching could be reached by considering the learners' individual differences and learning styles in interactive teaching technologies (Tezci and Gürol, 2001). The effectiveness of computers in teaching process lead also to the utilization of computers in chemistry education. By modeling the systems in computer environments and asking the students to interact via these models, the targeted behaviors are tried to be taught (Hoffman, 1996). Worksheets, when prepared consciously, were thought to contribute to the teaching of theoretical knowledge provided that students could interact with teaching at the expected level. The development and utilization of worksheets in computer-assisted teaching have become a necessity in terms of enabling the achievement of targeted learning conclusions by providing practical and economical solutions. Since many concepts are abstract in chemistry, students usually have difficulties in learning chemistry, constructing the mental structure on basic chemistry concepts; and, this leads to the misconstruction of these concepts in students' minds. Many studies have been conducted on how much students understood scientific concepts and their misconceptions. The analysis of the conducted studies showed that atom and the characteristics of atom came first among the most challenging topics for students. Because the construction of the topic in mind is too abstract, students have difficulties in learning the topic well and experience learning with many misconceptions.

OBJECTIVE

This study aims to develop computer-assisted worksheet-based teaching materials on challenging concepts related to atoms and screening as topics of chemistry, and to determine the effects of these materials on achievement level.

METHOD

In the study, a chemistry student teachers group of 40 were administered an open-ended test of 10 questions on atoms and screening under the supervision of specialists and instructors. The results of this application were taken as pretests and students' achievement levels were determined. Later the group was administered a worksheet activity as PowerPoint presentations on computers in the Internet Class. All activities were supervised by an observer. The observer used the natural observation technique and avoided any interruptions that might have affected the result. The achievement test was administered once again at the end of the activities as the posttest. The pre and posttest findings were compared and contrasted for examining the effectiveness of the teaching material. In this study, observation technique, interviews and achievement test was used as data collection tools. The factors that might have increased or decreased the effects of the developed material on achievement were tried to be determined and evaluated together with the achievement test results.

Examination of the Data

The pre and posttest results of the study were statistically evaluated. Additionally, the interview and observation findings were evaluated and compared with the achievement test results.

The Development Steps of the Teaching Material

- Resources related to computer-assisted education, worksheets and learning theories in science were reviewed.
- Worksheets and computer-assisted teaching materials were examined from the worksheets and computer-assisted education literature.
- Depending on the data collected from the interviews with student teachers of chemistry and instructors, "atom and screening" was chosen as the topic as an abstract subject of chemistry in terms of construction in mind.
- The determined topic was reexamined and divided into the below-mentioned subtitles for developing the worksheets:
 - The screening characteristic of the orbitals

- Orbital energies
- Sizes of atoms
- Ionization energy
- Electron Affinity

The Application of the Developed Teaching Material

The lessons on the content of the developed teaching material were taught to the group of 40 in a classroom environment. However, the worksheets were applied in the Internet Class of the same department. The Internet Class involves one computer for every two students as well as a projection device, OHP, camera and educational CD's on certain topics. The worksheets were applied in a total of 6 hour as 2+2+2 sessions. During the application, drawings and explanations on the whiteboard were also used.

FINDINGS

The results of the pretest and posttest, which were administered before and after the application of the developed teaching material, were organized as follows:

Paired Samples Statistics			
	Mean	N	Std. Deviation
Pre-test	4,0750	40	1,4916
Post-test	7,0750	40	1,6701

Paired Samples Test						
	Paired differences			t	df	Sig (2-tailed)
	Mean	Std. Deviation	Std. Error Mean			
Pre-test and post-test	-3,0000	2,3966	,3789	-7,9	39	,000

The average of the students' answers to the pretest that was administered before the application was 4,07. The average increased up to 7,07 after the application. In the examination of the paired sample t-test, it was concluded that the difference between the average scores was significant.

Moreover, during the interviews, student teachers indicated that they found the material interesting, practical, enjoyable and easy to use. They mentioned that they understood the topic better at the end of the application, since it had been a challenging topic for them because of its being abstract. Student teachers also said that they enjoyed the application.

At the end of the application, the evaluation results did not display an improvement in the attitudes of the student teachers towards the utilization of computers.

DISCUSSION

The findings of the achievement test results, which was administered at the end of the application involving the developed teaching material, indicate that worksheets in computer-assisted chemistry teaching were effective factors in increasing achievement levels for teaching the characteristics of atoms and screening.

The contents of the worksheets not only supported the teaching of the screening characteristics of orbital, orbital energies and the characteristics of atoms conceptually but also enabled the understanding of some challenging details with the help of visualization. Thus, the conceptual dimensions of the previously prepared questions were considered in terms of being in line with the content of the presentation with worksheets. A question such as "What is the screening characteristics of orbital?" would cause more questions in a student's mind, if it is asked in a direct speech way. A question on the

difference between the concepts of screening and penetration would be answered correctly by a student, who has comprehended these two concepts well and understood the shade of meaning between them. The accuracy of the estimates that the answers to such questions would be given much more easily with the help of the presentations with worksheets and the misconceptions would be overcome, were also supported with the statistical analysis. On the other hand, the questions on the energy of the electron at s and p orbitals on the outer surface of the atom, and the effects of distance from the nucleus on the energy of this electron as well as the questions on the energy of the s and p electrons and the effects of being close to the nucleus on the electrons were responded more clearly with the help of the computer-assisted worksheet presentations. Students had the chance to visualize the scene, which she would normally have difficulty in visualizing; and this increased the chance of learning accurately. Similarly, other questions on the electrons at d and f orbitals, the results of their distance from the nucleus, the results of basic tendencies of atoms with s, p and d, f orbitals were also clarified with the help of the computer-assisted worksheets.

The computer-assisted worksheets were found to have great contributions to the comprehension of students about the characteristics of atom and screening. In the light of students' views, these worksheets are thought to have a motivating effect on students which leads to a better performance by providing an enjoyable learning environment. Here are some recommendations for computer-assisted worksheet designers in education:

- Opposite colors should be chosen when comparing concepts in teaching abstract topics. Since the approach of the rays to the eye is a physical action, the reaction of the eye to these rays is a physiological action and the perception of these rays in the brain is a psychological action; the opposite colors should be used in order to reveal each others' real power and create movement. For example, red could be used for the electrons at s and p orbitals together with green for d and f orbitals. Blue could be the opposite of orange, yellow could be used as the opposite color of purple in visualizations, which would emphasize the effects caused by different characteristics.
- The unnecessary features that disturb the attention should be avoided in worksheets. Background should be as simple as possible.
- Before the worksheets are designed, the topic and the contents should carefully be planned.
- Additional time should be given for slow learners and additional activities should be planned for fast learners.

The worksheets, which are prepared by considering these conditions, would serve as modern and effective tools that save education from being traditional and increase the level of achievement. The developed material is thought to be interesting and easy to use for teachers and students, and it is believed that it made learning enjoyable. Therefore, the developed teaching material was found to have an increasing effect on students' motivation for the course.

REFERENCES

Akpınar, Y. (1999). Computer-assisted Education and Human Qualifications in Knowledge Society, Conference Proceeding, Middle East Technical University, 15-17 May 1999, Ankara, 145-149.

Clark, R. E; Craik, T.G. (1992). Interactive Multimedia Learning Environments, NATO ASI Series F: Computer and System Sciences, 93, Springer, Berlin.

Hoffman, K. H., Schreiber, M. (1996). Computational Physics, Springer-Verlag Heidelberg, Berlin.

Kaput, J.J. (1991). Handbook of Research on Mathematics Teaching and Learning, Macmillan, New York.

Tezci, E., Gürol, A. (2001). The Role Of Technology In Constructivist Learning Design, Conference Proceeding in I. International Educational Technologies Symposium, Sakarya University, 28-29-30 December 2001, Sakarya.

Yılmaz, M and Saka, Z.A .(2004). “Material Development Based On Worksheets In Computer-Assited Physic Education”, pp: 136-144. Conference Proceedings International Educational Technology Symposium, November 24th-26th 2004.

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