



Abstract. *The aim of this study is to examine the effect of alternative assessment techniques supported by learning cycle model and traditional teacher centered education on chemistry competency perception and chemistry success of prospective science teachers. As the data collection tools chemistry competency perceptions scale and chemistry success test was used.*

It was determined that there is a significant effect of alternative assessment techniques supported by learning cycle model on chemistry competency perceptions and chemistry success of prospective science teachers. It has been determined that there is significant effect of traditional teacher centered education on chemistry success. Also it has been revealed that there was an increase in chemistry competency scores of prospective science teachers in control group however this increase was not statistically significant.

Key words: *alternative assessment techniques, chemistry competency perception, chemistry success, learning cycle, traditional teacher centered teaching.*

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THE EFFECT OF ALTERNATIVE ASSESSMENT TECHNIQUES ON CHEMISTRY COMPETENCY PERCEPTIONS AND CHEMISTRY SUCCESS OF PROSPECTIVE SCIENCE TEACHERS

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Introduction

Cognitive scientists tell us that students need to relate new ideas to their experience and place new ideas into a framework for understanding (Bransford, Brown & Cocking, 2001). Thus exploring phenomena before explaining them is critical for learning. Constructivism is a dynamic and interactive model of how humans learn (Bybee, 1997). A constructivist perspective assumes students must be actively involved in their learning and concepts are not transmitted from teacher to student but constructed by the student. Teachers can make learning meaningful when they employ activities that call on students to use their prior knowledge and experiences to construct their own frames of thought. The learning cycle rests on constructivism as its theoretical foundation. Learning cycle as a model of instruction is far superior to transmission models in which students are passive receivers of knowledge from their teacher.

The learning cycle instructional model provides a roadmap through the teaching experience. It really doesn't lock the teacher into one instructional strategy, but opens the teaching episode to the use of cooperative learning, guided inquiry and the use of technology. These models allow for different forms of interaction between teacher and learners and provide time and opportunities for learners to meet the instructional goals for the lesson. Much of the research supporting the learning cycle approach is discussed in detail in Lawson, Abraham and Renner (1989) and supports the conclusion that the learning cycle approach can result in greater



achievement in science, better retention of concepts, improved attitudes toward science and science learning, improved reasoning ability, and superior process skills than would be the case with traditional instructional approaches (Abraham & Renner, 1986; Gerber, Cavallo & Merrick, 2001). Thus, providing opportunities for preservice teachers to experience this approach as a learner can be critical to their understanding of the learning cycle. Also necessary, however, is the opportunity to plan instruction using the learning cycle as a teacher. Learning cycle provide a venue for sequencing learning experiences to help preservice teachers understand and apply this approach.

It is acknowledged in the new education curriculum in accordance with constructive approach in which students have individual differences and every individual construct knowledge according to his/her own experiences (Yetkin & Dascan, 2006). New insight in learning approaches has lead to different methods to come to the fore in assessment and evaluation (Fourie & Van Niekerk, 2001). Depending on reconstruction in learning approaches, the structure of assessment and evaluation, which are parts of learning process, have changed and the necessity to use different assessment opportunities for evaluating students' knowledge, skills and attitudes has been pointed out (Vural, 2004). Therefore, alternative assessment approaches have came up such that assessment has a broader meaning than just giving an answer to a set of test items and should be discussed in different dimensions.

Although traditional measurement instruments are regarded as an identifier of what students learned in classical education system, it is stated that these tests does not mostly reflect dimensions of students' real learning experience (Korkmaz, 2004). Furthermore, it is necessary that not only gains in cognitive field but also the gains of students in affective and psychomotor domain should be assessed. Cognitive development of learner can be assessed substantially with classical assessment methods; however, assessment of gains in affective and psychomotor domain is not easy. Constructivism supports alternative assessment methods compared to traditional assessment methods (Anderson, 1998). Traditional multiple choice tests are criticized in recent years and authentic assessment methods consisting of alternative assessment approaches are regarded as an important alternative (Ruiz-Primo & Shavelson, 1996). The aim of alternative assessment approaches is to reveal knowledge and skills of students in cognitive, psychomotor and affective domains with different ways, so the individual should present his/her performance to show the capacity related to these fields (Adanali & Doganay, 2010).

Alternative assessment and evaluation methods help students to participate in courses actively give them opportunity to express their opinions freely and help them to express themselves easily (Yildiz & Uyanik, 2004). Also, alternative assessment and evaluation methods help students to reveal their abilities through various projects and presentations, they motivate them for lessons, thus high level cognitive and affective skills that are not assessed with standard tests, can be assessed (Hodges, Lamb, Brown & Foy, 2005). Alternative assessment and evaluation methods are effective in assessing higher order thinking skills such as analysis, synthesis and evaluation and help students to develop problem solving skills (Cepni, 2005).

The Aim of Research

The aim of this study is to determine the effect of alternative assessment techniques supported by learning cycle model and traditional teacher centered education on chemistry competency perception and chemistry success of prospective teachers.

Methodology of Research

General Background of Research

In this study, the effect of alternative assessment techniques supported by learning cycle model and traditional teacher centered education on chemistry competency perceptions and chemistry success of prospective teachers has been examined. A pre-test post-test control group design was used. The experimental and control groups were determined by using simple random sampling.



Sample of Research

The study group of the research is composed of 100 prospective science teachers studying at Hacettepe University, Faculty of Education and Department of Science Education. The research has been carried out within the course of General Chemistry. In the research, participants of experimental group (N=50) have been taught with learning cycle model supported by alternative assessment techniques, participants of control group (N=50) have been taught with traditional teacher centered education.

Instrument and Procedures

Chemistry Competency Perception Scale

The scale has been developed by Gunes, Kavak and Yamak (2011). Scale consists of three sub-scales which are chemistry field knowledge, chemistry education field knowledge and chemistry literacy with 119 item. During the treatment process, prospective teachers have been asked to rate their performance by reading performance indicators in the scale carefully and score themselves between 0 and 100. It is stated in the scale that scores between 0 and 30 means "not sufficient", scores between 31 and 60 means "partly sufficient" and scores between 61 and 100 means "sufficient". The cronbach alpha reliability coefficient of the scale for the research group is 0.98.

Chemistry Success Test

A chemistry success test consists of 15 questions has been used in the study in order to determine chemistry success of prospective teachers. Chemistry success test has been developed to assess conceptual knowledge level in quantitative analysis of analytic chemistry and determine problem solving achievement of prospective teachers. Chemistry success test has the same content with the materials prepared with alternative assessment techniques. During the development of test, three chemistry instructors' opinions have been taken for content validity. Pilot study of chemistry success test has been done with 35 prospective teachers. Comprehensibility of questions has been tested with pilot study and in line of feedbacks has been given the test its final form. Cronbach Alfa reliability coefficient of the test has been found 0.62.

Experimental Process Steps

Alternative assessment techniques supported by learning cycle model consists of the stages of exploration, concept introduction and concept application. Alternative assessment techniques supported by learning cycle model is structured according to Lawson (as cited in Kanli, 2009).

Stage of Exploration: In this stage, the students study new instruments and other materials in learning environment. The students got concrete experiences with these materials. In the stage of exploration, the students have been given the materials which are prepared with alternative assessment techniques, like semantic analysis tables, structured grid, descriptive branched tree and puzzles. The aim of these materials is to create cognitive conflict in students' minds and, at the end of this process makes them ready to learn.

Stage of Concept Introduction: At this stage, the students are given definition of a new concept directly by the teacher or indirectly with materials. The students organize their own knowledge and match them with concepts through the guidance of the teacher at this stage. The students have been given information related to the quantitative analyze of analytical chemistry and are helped to organize their knowledge at this stage.

Stage of Concept Application: At this final stage, the students apply the concepts they learned into



new and different situations, give meaning to them and consolidate them. The stage of concept application encourages the students to apply new concepts into other problems by using the techniques of isolating and generalizing. At the stage of concept application, the students evaluate the materials prepared with alternative assessment techniques given themselves at stage of exploration and correct their mistakes.

Data Analysis

In the study, chemistry competency perception scale and chemistry success test have been implemented to experimental and control groups before and after the study. The data obtained from the chemistry competency perception scale and chemistry success test used in the research were analyzed using SPSS 15 package program. The pre-test and post-test scores were obtained from experimental and control groups regarding chemistry competency perception and chemistry success variables for intergroup and intragroup comparisons. In the data analysis for intragroup comparisons of chemistry competency perceptions and chemistry success used t-test for dependent groups analyse method and for the comparisons of intergroup chemistry competency perceptions and chemistry success used t-test for independent groups analyse method.

Results of Research

In consequence of the research, firstly it has been started comparing the analysis of the data obtained from experimental and control groups with chemistry competency perceptions. The analysis of the data has been continued with the comparison of chemistry success of prospective science teachers.

Findings Related to Chemistry Competency Perceptions

The chemistry teacher competencies are defined by the Ministry of National Education as chemistry knowledge, chemistry teaching knowledge and chemistry literacy (Demirelli, Yuruk & Kavak, 2009). The data of chemistry competency perception scale can be analyzed in terms of general competency levels as well as each competency levels can be analyzed separately via the sub-scales (Gunes, 2011). For this reason the chemistry competency perceptions of prospective science teachers are primarily discussed in terms of general competency levels and then in terms of chemistry field knowledge, chemistry education field knowledge, chemistry literacy levels.

At the end of the study chemistry competency perception of experimental group pre-test post-test scores have been examined using dependent samples t-test. The results of analysis are given in Table 1.

Table 1. Results of t-test Analysis for Chemistry Competency Perceptions of Experimental Group.

	N	Mean	SD	df	t	p
Chemistry Competency Perceptions						
Pre-test	50	75.79	10.79	49	-4.736	0.000
Post-test	50	81.43	7.55			
Chemistry Field Knowledge						
Pre-test	50	72.08	12.51	49	-3.532	0.001
Post-test	50	78.11	8.98			
Chemistry Education Field Knowledge						
Pre-test	50	76.61	12.59	49	-3.205	0.002
Post-test	50	81.66	8.42			



	N	Mean	SD	df	t	p
Chemistry Literacy						
Pre-test	50	78.37	12.36	49	-4.054	0.000
Post-test	50	84.08	7.71			

When Table 1 analyzed, it has been seen that before study mean scores of chemistry competency perceptions of experimental group was 75.79 and after the application their scores increased to 81.43. After the application prospective science teachers have higher scores in chemistry field knowledge, chemistry education field knowledge and chemistry literacy sub-scales. As the result of dependent t-test analysis the increase in chemistry competency perceptions scores and chemistry field knowledge, chemistry education field knowledge and chemistry literacy sub-scales scores are statistically significant ($t=-4.736$; $t=3.532$; $t=3.205$; $t=4.054$ $p<0.01$).

Dependent t-test has been made to determine significance of difference between the chemistry competency perception pre-test and post-test scores of control group prospective science teachers after the traditional teacher centered education. The results of analysis are summarized in Table 2.

Table 2. Results of t-test Analysis for Chemistry Competency Perceptions of Control Group.

	N	Mean	SD	df	t	p
Chemistry Competency Perceptions						
Pre-test	50	76.79	9.82	49	-0.647	0.521
Post-test	50	77.73	7.54			
Chemistry Field Knowledge						
Pre-test	50	75.60	10.38	49	-1.569	0.179
Post-test	50	77.86	11.42			
Chemistry Education Field Knowledge						
Pre-test	50	76.03	8.08	49	-1.673	0.101
Post-test	50	78.66	11.13			
Chemistry Literacy						
Pre-test	50	77.80	11.00	49	-0.616	0.541
Post-test	50	78.84	5.83			

Before the traditional teacher centered education chemistry competency perception scores of the control group was 76.79 and after the application it has been increased to 77.73. When the chemistry field knowledge, chemistry education field knowledge and chemistry literacy sub-scales scores examined it has been seen that there is a increase. From Table 2 it has been seen that there is a difference between the chemistry competency perception, chemistry field knowledge, chemistry education field knowledge and chemistry literacy sub-scales pre-test scores and post-test scores of the control group but that this difference is not statistically significant ($t=-0.647$; $t=-1.569$; $t=-1.673$; $t=-0.616$ $p>0.05$).

Chemistry competency perceptions of experimental and control group post-test scores are compared with independent samples t-test. T-test results are given in Table 3.



Table 3. Results of t-test Analysis for Chemistry Competency Perceptions of Experimental and Control Group.

	N	Mean	SD	df	t	p
Chemistry Competency Perceptions						
Post-test Control Group	50	77.73	7.54	49	-2.565	0.013
Post-test Experimental Group	50	81.43	7.55			

When the Table 3 analyzed, it has been seen that there is a significant difference between post-test chemistry competency perception scores of experimental and control groups prospective science teachers ($t=-2.565$; $p<0.05$). This result can be interpreted that post-test chemistry competency perception scores of the experimental group are higher than the scores obtained from control group, and this result is statistically significant in favour of experimental group.

Findings Related to Chemistry Success

As being analyzed the success of prospective science teachers, initially it has been compared pre-test post-test chemistry success scores of experimental and control group, then compared post-test chemistry success of experimental and control groups with the aim of the analysis of efficiency in applied methods.

The effect of alternative assessment techniques supported by learning cycle model on chemistry success of prospective science teachers is search with pre-test post-test chemistry success scores. The results of analysis are seen in Table 4.

Table 4. Results of t-test Analysis for Chemistry Success of Experimental Group.

	N	Mean	SD	df	t	p
Chemistry Success						
Pre-test	50	7.73	2.80			
Post-test	50	12.63	4.78	49	-8.614	0.000

When the table analyzed, whereas the chemistry success of experimental group teacher prospective science teachers was 7.73 before the application of alternative assessment techniques supported by learning cycle model it has been increased 12.63 after the application. As the result of dependent t-test analysis, it has been determined that the difference between pre-test post-test scores of the chemistry success ($t=-8.614$; $p<0.01$) is significant.

Chemistry success of control group pre-test post-test scores is compared with dependent t-test. The results of analysis are summarized in Table 5.

Table 5. Results of t-test Analysis for Chemistry Success of Control Group.

	N	Mean	SD	df	t	p
Chemistry Success						
Pre-test	50	7.83	3.41			
Post-test	50	10.83	3.59	49	-7.698	0.000

It has been observed that chemistry success scores was 7.83 before traditional teacher centered education by control group, the success scores has become 10.83 after the application as figured in the table. The result of dependent samples t-test analysis has revealed that the increase in chemistry success scores of control group is statically significant ($t=-7.698$; $p<0.001$).



Independent t-test has been used to determine the significance of difference between post-test chemistry success scores of experimental and control group prospective science teachers. T-test results are given in Table 6.

Table 6. Results of t-test Analysis for Chemistry Success of Experimental and Control Group.

	N	Mean	SD	df	t	p
Chemistry Success						
Post-test Control Group	50	10.83	3.59	49	-2.085	0.042
Post-test Experimental Group	50	12.63	4.78			

When Table 6 analyzed, it has been observed that the chemistry success scores of experimental group who's applied alternative assessment techniques supported by learning cycle model are higher than the success scores of control group prospective science teachers applied traditional teacher centered education. It has been revealed that as the result of the analysis, there is a significant difference between post-test chemistry success scores between experimental and control group ($t=-2.085$; $p<0.05$).

Discussion

This research has been carried out in order to examine the effect of alternative assessment techniques supported by learning cycle model and traditional teacher centered education on chemistry competency perception and chemistry success of prospective science teachers. In the research, whereas alternative assessment techniques supported by learning cycle model has been implemented to experimental group, traditional teacher centered education has been implemented to control group. At the end of the research, it has been determined that there is a significant effect of alternative assessment techniques supported by learning cycle model carried out in experimental group on chemistry competency perceptions and chemistry success of prospective science teachers. It has been determined that there is a significant effect of traditional teacher centered education on chemistry success whereas it has been revealed that there is an increase in chemistry competency perception scores of control group prospective science teachers but this situation doesn't cause a significant difference.

The comparison of efficiency of teaching method has been carried out in the last phase of the research. The impact of traditional teacher centered education and alternative assessment techniques supported by learning cycle model has been examined on post-test scores of chemistry competency perceptions and chemistry success of experimental and control group. It has been determined that post-test scores of chemistry competency perceptions and chemistry success scores have significant difference in favour of experimental group. According to this result, which is obtained from comparison of the efficiency of teaching method has indicated that alternative assessment techniques supported by learning cycle model is more effective than traditional teacher centered education.

The research has revealed that alternative assessment techniques supported by learning cycle model has an impact on the success of prospective science teachers. During the implementation process, prospective science teachers has been given an opportunity to test their knowledge by means of alternative assessment techniques comparing with classic assessment techniques and they have evaluated their learning. Alternative assessment and evaluation methods have attracted prospective science teachers on the course. Testing of the knowledge in lots of phase of the course and being assessed by on their own have provided more lasting and efficient learning. Findings obtained from other studies have supported the result that there is impact of alternative assessment approaches on the success (Corconan, Dershimer & Tickhenor; 2004; Izgi, 2007; Karahan, 2007; Orhan, 2007; Kaptan, Aslan & Atmaca, 2002; Harurluoglu & Kaya, 2011; Powell-Moman & Brown-Schild, 2011; Whannell, Whannell & Allen, 2012).



Traditional teacher centered methods can be used in every phase of education and their practicality is indisputable. According to research result, traditional teacher centered method has a significant effect on success and this result indicate similarity to other research findings. When the success came into question, both teacher centered and alternative methods result in positively. However, traditional teacher centered methods are not sufficient alone for the concepts in affective domain such as self efficacy or competency is the most important result of this research. Hence, while organizing teaching and training environment, it should be taken into consideration that affective features have important impact on the level of the students' success, besides acquisition of the behaviors' related to cognitive domain and the activities should be organized in order to be acquired affective features. In traditional assessment approaches, teacher assesses success based on written examination or multiple choice tests instead of the process. Self-confidence of the students decrease in these assessment approaches which test only what they know or don't know in a limited time span. Besides, they don't have detailed knowledge about what and how they should learn.

Alternative assessment approaches aim to test what, how and how much the student understands. Both students and teacher participate in assessment process at alternative assessment approaches. In this process, students are active, detailed knowledge about their progress is provided. Alternative assessment approaches provide reliable and significant feedback to students in order to improve their learning process. It is claimed that alternative assessment approaches are more effective in determining the level of the student's learning (Herman, Aschbacher & Winters, 1992). Therefore it has been determined there is a significant difference between competency scores of experimental group and the control group. It has been revealed in the research that alternative assessment approaches has an impact on the features related to affective domain (Moon, Brighton, Callahan, & Robinson, 2005; Zimbicki, 2007; Izgi, 2007; Ozcan, 2011). It has been clarified that alternative assessment approaches is more compatible with real life situations and help students to make progress in their studies (Zimbicki, 2007).

Conclusions

The teachers are seemed in the eyes of the students and parents as a main source of information. In other words while teachers are center of teaching activities, students are the receiver of the knowledge and stand in an inactive position. Thus, the aim of this study is to gain students questioning and learning skills towards their abilities, an active role in their learning. The importance of this study in the literature comes from its emphasis on how the alternative assessment techniques are affected in chemistry competency perception and chemistry success of individuals supported with learning cycle. In this study the effectiveness of learning cycle, which consists of sequential levels, is deepened through alternative assessment techniques used in the level of concept application.

The findings of the study indicated the effects of alternative assessment techniques supported by learning cycle model on chemistry competency perception and chemistry success. The alternative assessment techniques used in this study may provide information prospective science teachers about their learning level by including them in the assessment process. Used alternative assessment techniques allowed prospective science teachers self-evaluation. As a result, prospective science teachers determined the subjects they had problems or they didn't understand easily and their success increased dramatically. So, alternative assessment techniques could be considered as an assessment tool and as a teaching material. Therefore, it is very important to increase the number of studies in this field as well as contributing to the literature with new resources.

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