Participatory Educational Research (PER)
Special Issue 2016-II, pp., 112-120; 01 February 2016
Available online at http://www.partedres.com
ISSN: 2148-6123
http://dx.doi.org/10.17275/per.16.spi.2.12

The Effect of Formative Assessment Technique on Academic Success of the Students and Their Attitudes in the Unit "The Solar System and Beyond: The Space Puzzle" At 7th Grades

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Abstract
This study has been carried out to fulfill the effect on 7th grade students' academic achievement and their attitudes towards the Science and Technology course in the unit of "solar system and beyond: space puzzle". The semi–experimental methods with pre-test post-test, experiment and control groups were used in the study. 60 (sixty) 7th grade students who were studying in a secondary school in the city center of Agri, participated as a sample in this research. The experimental group was composed of 30 students of 7-A class and the control group included 30 students of 7-C class. The practice of this research was performed in the spring season of the 2014-2015 academic years in three weeks. During the practice the formative assessment method was used in the experimental group and traditional method in control group. The data of this research were collected by using an academic achievement test and a science attitude test both as pre-test, post-test. The independent sample t-test was used to analyze the data between the groups and paired t-test was used to analyze the data in the groups. According to the results, at the end of the formative assessment activities applied to the experimental group, obtained from the analyses it was concluded that the average success of the students participated in the experimental group is very high compared to the average success of control group. It was seen that the students' academic success in the experimental group was higher than the students' academic success in the control group and the significant difference between them was very high. As another result a very small difference was identified between experiment and control groups in terms of students' attitudes towards science.

Key words: Science education, formative assessment, academic success.

Introduction

Assessment in Science Education

"The point of view that is taken as the basis in measurement-evaluation process is based on an understanding that consists of the evaluation of the process as well as the product itself. For this reason it is recommended that at the end of the learning process that the students revealed is evaluated with their performance. The use of supplementary measuring tools and techniques must be considered because the digital data obtained with traditional measuring tools do not make sense alone. These tools and techniques provide multiple

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opportunities to the students to reveal their information, skills, senses and other performances. With the use of supplementary measurement tools and techniques, the *self* and *peer assessment* approaches that the students have found chances to evaluate himself and peers have been adopted by caring for the evaluation approach for the process. In addition, the technology is also made use of to observe and evaluate the performances of the students during the learning process" (MoNE*, 2013).

The types of assessment in education are classified as the evaluations based on the purpose of their application and the ones that are based on the norms (criteria).

Assessments based on the purpose of its application and Assessment based on the definition and conceptualization

The assessments that are based on definition and conceptualization are generally conducted before the they are the evaluations that students 'characteristics in the prerequisite qualifications have been revealed before starting the training program, The assessment of results to be obtained from the characteristics of the students provide information about the shaping of the academic period (Demirel, 2006; as cited in Balta, Türel, 2013).

Formative Assessment and Summative Assessment

In formative assessment both teacher and students may be in the center of the teaching method effectively. When students are in the center of the learning teachers may motivate them and wise verse. In summative assessment teachers are always in the center of the teaching method and the results tend to be reported as grades. When learning takes place feedbacks affects the results in formative and summative assessment gradually.

"Considering assessment to be formative only when the information it provides is used for improving performance places the student the learner in the central role. Yet, perhaps because it is teachers who plan and administer classroom assessments, much of what has been written about assessment has focused on the role of the teacher, not the student" (Brookhart, 2001). A formative interaction is one in which an interactive situation influences cognition, i.e., it is an interaction between external stimulus and feedback, and internal production by the individual learner (Black & Wiliam, 2009).

"Since formative assessment mainly aims to gain insight into what students know and do not know for changes to be made in the learning-teaching process, techniques such as teacher observations and classroom discussions as well as homework and test analyses play a crucial role in this assessment approach" (Boston, 2002, as cited in Oren *et al.,* 2011). "Formative assessment provides to teachers and students with feedback. The teachers can use the feedback to revise their classroom practices, and the students can also use the feedback the monitor their own learning. This purpose, often called formative assessment, is also receiving greater attention with the spread of new teaching methods" (National Research Council, 1999, pp 1-2, as cited in Bell, Cowie, 2001).

"Formative assessment has to be carried out by the teacher, but so is a great deal of

* MoNE ~ Ministry of National Education

assessment for summative purposes (including certification in cases where course work is part of the process). Thus in this section we discuss the characteristics of formative assessment, particularly in relation to how these differ from the characteristics of summative assessment. Unlike summative assessments, which may be either criterion-referenced or normreferenced, formative assessments are always made in relation to where pupils are in their learning in terms of specific content or skills. To this extent, formative assessment is, by definition, *criterion-referenced.* At the same time, it may also be *pupil-referenced* (or *ipsative).* This means that a judgement of a pupil's work or progress takes into account such things as the effort put in, the particular context of the pupil's work and the progress that the pupil has made over time. In consequence, the judgement of a piece of work, and what is feed back to the pupil, will depend on the pupil and not just on the relevant criteria. The justification for this is that the individual circumstances must be taken into account if the assessment is to help learning and to encourage the learner. If formative assessment were purely criterion-referenced it would be profoundly discouraging for many pupils who are constantly being faced with failure. This hybrid of criterion-referenced and ipsative assessment does not matter as long as this information is used *diagnostically* in relation to each pupil, which is consistent with the notion that formative assessment is essentially part of teaching" (Harlen, James, 2006).

The Purpose of the Study

Astronomy has a characteristics that examines and interprets the basic sciences like physics, chemistry and biology as well as it examines all the structures from the smallest particles (from sub-atomic particles, atoms and molecules) to the biggest bodies (planets, stars, star constellations, galaxies, terrestrial bodies and super clusters) all together and provides information and data to all fields of science.

Kocer and Gulsecen, (2001), as cited in Turk, C., (2010) reported that astronomy was considered as a difficult subject by primary school students because it involves 3D concepts, and the heavenly bodies are so far away from students that they cannot touch, feel and carry out an experiment. For this reason, they also expressed that the subjects in astronomy must be given in such an order that would fit the mental developments of students. In addition, astronomy, as an old and a new science, has influenced the development of the other sciences with space explorations and the fast-developing technology. Since students do not encounter directly with the abstract concepts of astronomy in their daily lives, they make mistakes that contradict with the scientific facts while they are structuring these concepts. In order to prevent these mistakes and make students understand the concepts more easily, it may be recommended that these types of abstract concepts may be taught by using activities and getting feedbacks from the students continuously with formative assessment technique during the course. This study has been planned with the purpose of revealing the effects of the Formative Assessment Activities, which is one of the alternative assessment methods included in Science Program, on student success and attitudes. For this purpose, an Academic Success Test was developed for 7th Graders for Solar System and Beyond: Space Puzzle (S. S. and B: S. P.) Unit, the Formative Assessment Technique was used, and the effect of the evaluation activities, which were prepared for the same units, on student success and attitude was examined.

Method

Sampling: The sampling of the study consisted of the students of Class 7/A, and 7/C at Selcuk Secondary School in the center of Agrı A total of 60 students participated in the study.

Data Collection Tool: In this study, the effects of two different teaching methods (the Formative assessment Technique and the Traditional Teaching Method) on the academic success of the students on astronomy, and their attitude towards science classes were examined. The Academic Achievement Test, and the Attitude Test were prepared by and was also used by Nuhoglu (2008). After Item Analysis was performed, some of the questions that should be omitted from the Academic Achievement Test items were determined, and by considering the distributions of the acquisitions, the Academic Achievement Test was given its latest form. In order to determine the reliability of the Academic Achievement Test, which consisted of 24 multiple-choice questions, the Cronbach Alpha reliability analysis was performed, and the Cronbach Alpha internal consistency coefficient of the test was found as 0.77.

The semi–experimental methods with pre-test post-test, experiment and control groups were used in the study. 60 (sixty) 7th grade students who were studying in a secondary school in the city center of Agri, participated as a sample in this research. The experimental group was composed of 30 students of 7-A class and the control group included 30 students of 7-C class. The practice of this research was performed in the spring season of the 2014-2015 academic years in three weeks. During the practice the formative assessment method was used in the experimental group and traditional method in control group. The data of this research were collected by using an academic achievement test and a science attitude test both as pre-test, post-test. The independent sample t-test was used to analyze the data between the groups and paired t-test was used to analyze the data in the groups.

Findings

The findings obtained in the study are given in this part. The results obtained with two different teaching methods are provided here. The pre-test and post-test results of the study were tested at 0, 05 significance level.

Table 1: The findings obtained from the academic achievement pre-test of the Experimental and Control Group.

Groups	N	Arithmetic Means	Standard Deviation	T	P	F
Experimental Group	30	10,6333	5,65370	,512	0,610	1,071
Control Group	30	10,0333	3,03410			

P > 0,05

As it is observed in Table 1, there is a difference between the pre-test results of the Experimental Group and the Control Group (p=0,6). Since it is p>0, 05, it is understood that there is not a significant difference between the pre-test results of the Control Group and the Experimental Group. It has been concluded that both groups are homogenous (F=1,071) and the success levels of both groups are close to each other.

Table 2: The success levels of the post ***t*** test between the Experimental and Control Groups.

Group	N	Arithmetic Means	Standard Deviation	T	P	F
Experimental Group	30	18,1333	3,08202	13,86	0,000**	1,174
Control Group	30	8,4000	2,29843			

**P<0,001

As it is observed in Table 2, the independent post t-test results between the Experimental Group and the Control Group are p=0,00. Since the P<0,05, (F=1,174), it is observed that there is a significant difference between the post-test results of the Control Group and the Experimental Group, and this significant difference is at a very high level. It has been concluded that the success level in the Experimental Group, where the teaching was conducted by using the activities and the Formative Assessment Technique, is higher than the Control Group where the teaching was conducted by using the traditional method.

Table 3: The pre-test and post-test findings between the Experimental and the Control Groups.

	Arithmetic Means	N	Standard Deviation	T	p
Pretest	9,7667	30	3,00211	10,791	0,000**
Posttest	18,1333	30	3,08202		

**P<0,001

As it is observed in Table 3, there is a difference between the pre-test and post-test values of the Experimental Group and the Control Group at p=0,00 level. Since P<0,05, it is understood that there is a significant difference between the pre-test and post-test values of the group; and this difference is at a very high level. The effect of the Formative Assessment Technique which is one of the alternative evaluation methods used in constructivist approach used in the Experimental Group, was observed as being at a very high level in terms of teaching activities.

Examining the Pre-test and Post-test findings of the Control Group

Table 4: The Pre-test and Post-test findings of the Control Group.

	Arithmetic Means	N	Standard Deviation	T	P
Pretest	10,0333	30	3,03410	2,768	0,010**
Posttest	8,4000	30	2,29843		

**P<0,05

As it is observed in Table 4, there is a difference between the pre-test and post-test values of the Experimental Group at p=0,01 level. Since P<0, 05, it is understood that there is a meaningful difference between the pre-test and post-test values of the group. It has been understood that the average values of the teaching in the Control Group are high. This difference may be an effect that is based on the learning of the topic well by the students.

The science attitude pre-test and post-test was applied for the purpose of determining the attitudes of the students towards the science classes at the study school before the unit "Solar

System and Beyond: Space Puzzle" (S. S. and B: S. P.) started and after it ended. As the statistical process, the Paired t-test was used to determine the internal attitudes of the groups in them, and the findings are given in Tables.

T-test results of science attitude pre-test and post-test scores of the experimental group

Table 5: The comparison of the findings of the *t*-test of science attitudes between pre-test and post-test points of Experimental Group.

	Arithmetic Means	N	Standard Deviation	T	P
Pretest	20,8000	30	3,19	9,651	0,000**
Posttest	26,9000	30	2,69		

**P<0,001

When Table 5 is examined it is observed that p= 0,000, and since p< 0,001, a significant difference is determined between the positive attitudes of the students towards science classes at the beginning of the units and at the end of the units. This shows that the students developed a positive attitude for science classes.

The T-Test Findings of Pre-Test and Post-Test Scores of Science Attitude Test of Control Group.

Table 6: The comparison of t-test findings of science attitude test for science between the pre-test and post-test points of the Control Group.

	Arithmetic Means	N	Standard Deviation	T	P
Pretest	24,6667	30	4,51307	1,743	0,092
Posttest	22,6667	30	3,68906		

P>0,05

When Table 6 is examined it is observed that p=0, 09, and since p>0, 05, there is not a significant difference between the attitudes of the students for science classes before the units started and after the units ended. Based on the findings it has been concluded that there has not been any changes in the attitudes of the students in the Control Group where the plain teaching method, which is one of the traditional teaching techniques, was used.

Result, Discussion And Recommendations

The purpose of this study is examining the effect of the Formative Assessment Technique on the academic success of the students in astronomy unit. In the study, the effect of the use of formative assessment activities on academic success of the students have been given in the study.

Since P>0, 05 in the pre-test findings of the Experimental and Control Groups, it is understood that there is not a significant difference between the Control Group and the

Experimental Group. It has been concluded that both groups were homogenous before the application started and the success levels of the groups were close to each other. According to this result of the study, the readiness of both groups at the beginning of the study was at the same level. The equality of the Experimental Groups are confirmed by the findings. In a study conducted by Aksakal in (2012) it was reported that the readiness of the students was analyzed as being similar.

By examining the points received by the Experimental Group and the Control Group, and evaluating the results received by the students in the post-tests of the "Solar System and Beyond: Space Puzzle" (S. S. and B: S. P.) units, it has been observed that there is a difference at p=0,00 level between the post-test results of the Experimental and Control Groups. Since it is P<0,05, it is understood that there is a significant difference between the post-test results of the Control Group and the Experimental Group, and this difference is at a very high level. It has been concluded that the success level of the Experimental Group was higher; because here, the teaching was based on Formative Assessment Activities, and the success level of the Control Group, where Expression Teaching Method was applied. Cauley, Kathleen M. & McMillan, J. (2010) conducted a study and reported that the Formative Assessment Technique had a powerful influence on the motivation and success levels of the students. Each of these techniques are influential on the success levels of the students as well as on the motivation. The Formative Assessment Technique has influenced the academic success positively with feedbacks throughout the study.

When the difference between the Experimental and Control Groups in terms of science attitude pre-test and port-test points is examined it is observed that the difference between the Experimental Group science attitude pre-test and post-test points is significant, while the difference between the Control Group science attitude pre-test and post-test points is not significant.

In the Traditional Teaching Method, when the teacher is in the center, students are mere listeners in the classroom, the communication is one-way, and the sensory perceptions of the students are not cared for. In addition, the most important problems encountered by the individuals that are raised with Traditional Teaching Methods is the fact that they cannot use the subjects they learn in classes in real life situations, and cannot transfer the learnt subjects into different situations. In this context, it may be suggested that the Traditional Evaluation and Teaching Methods are not sufficient alone, and have to be reinforced with alternative assessment methods or alternative learning techniques (Durmus, 2013). Calveric, S. (2010) conducted a study and reported that in order to ensure that the students select the '*in-class activities*' in an efficient way and gain the skills to perform the activities, the education leaders have to understand the relation between the beliefs and evaluation values of the students. Oswalt, S. G. (2013) conducted a study and reported that the self-assessment being a power in students' learning might pose a powerful influence in Formative Assessment Technique. Heritage, M. (2010) conducted a study and found that the attention of the students should also be activated during peer-evaluation as well as the self-assessment process. In order to receive feedback, students have to evaluate the learning status of the decisions taken individually. Pierson, D. R. (2013) conducted a study and reported that a planned form of Formative Assessment Technique was more related with the purposes of the lesson. In addition, it was also expressed in the same study that the contribution of the research-based constructivist framework to educational programs emphasized the critical nature of the Formative Assessment in science education. Before the application started, it was determined that there was no significant difference between the academic success levels of the

Experimental and the Control Group. After the application, the significant difference between the post-tests of the Experimental and the Control Groups has shown that the Formative Assessment has an influence on the results. Both formative and summative assessment influence learning. In other words, to improve learning outcomes, we need to consider not only the teaching and learning activities but also the assessment tasks (Bell and Cowie, 2001).

It has been determined after the activities based on evaluation that the success level of the Experimental Group is higher than the Control Group in which the traditional methods and question-answer techniques were used. It was also determined that this method is highly influential. Although the "Solar System and Beyond: Space Puzzle" (S. S. and B: S. P.) tests are not included in the TEOG (Transition From Primary To Secondary Education) exam, which is applied to the 8th Graders, the students participated to the activities with great enthusiasm.

It is recommended that Science and Technology teachers design activities in order to activate the Formative Assessment Technique parameters and to fit these parameters; use the activities, which they will prepare, to increase student success, to activate them, and increase and enhance their academic success, motivations and attitudes with feedbacks without giving points to the students.

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