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An Evaluation of the Teaching Activities Implemented in the Elementary Science and Technology Courses in Terms of Multiple Intelligence Theory: A Sample from Adana*

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Abstract

The aim of this study was to evaluate to what extent class activities at the Elementary Science and Technology course address intelligence areas. The research was both a quantitative and a qualitative study. The sample of the study consisted of 102 4th grade elementary teachers, 97 5th grade elementary teachers, and 55 6th, 7th, and 8th grade science and technology teachers, including 254 teachers in total. The data in the study were collected through "The Inventory of Class Activities Done in line with the Intelligence Areas", and "the Semi-structured Interview Form". The quantitative data were analyzed by descriptive statistics such as mean, standard deviation, and one-way analysis of variance. The qualitative data were analysed by content analysis as well. It was found that teachers generally used activities addressing for all intelligence areas, they were aware of the multiple intelligence theory, not the subject teachers but the elementary teachers and the senior teachers use teaching activities for more than one intelligence area in their classes. It was determined from the teachers' responses to the questionnaire that teachers were aware of the activities for intelligence areas. However, the interviews revealed that they could not transfer their knowledge about intelligence areas into their classes. Therefore; it could be observed and investigated why teachers did not implement their knowledge about multiple intelligence theory into their classes and their efforts in the preparation, planning, practice and evaluation phases of teaching.

Key Words

Multiple Intelligence Theory, Elementary Science and Technology Teaching, Teaching Activities.

For the future of societies, science teaching plays a vital role in today's information and technology era in which scientific knowledge gradually increases, the technology improves fast and we can see the effects of science and technology in every phase of our lives prominently (Milli Eğitim Bakanlığı [MEB], 2005; Öztürkmen 2006; Şenyüz, 2008). If we associate the world we live with a rich science and technology class, we can understand the importance of the innovations and inventions in sciences in both making great contributions to the development of the countries and in becoming the basis of scientific and technological developments. Besides, a point of view like this makes both science and its teaching become more important day by day and causes all nations give more importance to develop sciences. (Ayas, Çepni, & Akdeniz, 1993; Başdağ, 2006; Çepni, 2005; Victor & Kellough, 1997).

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According to Bakaç and Doğan (1994) and Gürdal, Şahin, and Çağlar (2001), science is the course in which the elementary students have the most difficulty in understanding although science teaching comes into prominence so as to serve the knowledge in the area of science into the benefits of the individual and society. As Brooks and Brooks (1993, 1999a, 1999b) claimed, traditional teacher approaches are mostly limited with the information given in the course book, they do not help students to think scientifically and to make their thinking skills develop adequately. For this reason, the understanding "the teacher teaches, the student learns" replaces with the understanding "the teacher provides the learning, the teacher and the student learn and share together" (Boyd, 2000; Gough, 1999; Sani, 2000; Smerdon, Burkam, & Lee, 1999). Therefore; in this context, the students need to be guided to be more qualified, not passive and receptors of the knowledge only. Instead, they need to be active individuals who construct knowledge, think, do research, question, and produce. (Ercanlı, 1997; Gültekin, 2004; İşman, Baytekin, Balkan, Horzum, & Kıyıcı, 2002).

The multiple intelligence theory is one of the theories which put the student into the centre and support the necessity for using various teaching strategies in teaching (Baragona, 2009; Gardner, 1993). Both right and left hemisphere of the brain become active through the usage of multiple intelligence theory in the learning environments in the classrooms (Gardner 2004). As a result of this, the usage percentage of the human brain increases. The students develop higher thinking skills; their imagination grows rich and their learning activity increases in environments in which the brain is actively used. The multiple intelligence theory, which is used together with the curriculum based on constructivist philosophy (Dougiamas, 1998; Epstein, 2002; Jonassen, 1994 cited in Deryakulu, 2001; Kabapınar, 2006; Razon, 1997) that has been applied in all elementary schools in Turkey since the 2005/2006 academic year, undoubtedly supports the development of the teaching processes which give opportunities to reach all students no matter what their individual differences are by the different point of view which the multiple intelligence has brought to education. During a learning-teaching process in which individual differences are regarded as a base, accepting the existence of the individuals who learn in different ways brings the understanding of teaching in a variety of ways (Akınoğlu, 2008; Turkish Ministry of National Education, 2005, 2006).

Individuals prefer learning through their dominant intelligence areas, understanding their environment and realizing themselves. For this reason, the dominant intelligence areas of the students must be addressed with the activities presented to them through the teaching process, their attention must be attracted, they must be motivated and they must be given opportunities to develop their other intelligence areas that are not dominant by making them participate in other activities. Accordingly, the focus of the multiple intelligence theory-based teaching is addressing not only to the dominant intelligence areas but also to the non-dominant ones and providing opportunities to use and develop all intelligence areas (Armstrong, 2000; Bümen, 2005; Eisner, 2004; İflazoğlu, 2003; Kornhaber, 2004; Saban 2004; Temiz, 2007).

Among modern learning theories, multiple intelligence theory is one of the leading ones regarding the importance given on individual differences. In related studies, different aspects of this topic has been investigated such as the effects of multiple intelligence theory on students' achievements (Akamca & Hamurcu, 2005; Aydoğan, 2006; Bümen, 2001; Coşkungönüllü, 1998; Ercan, 2008; Etli, 2007; Greenhawk, 1997; Işık, 2007; İflazoğlu, 2003; Kaptan & Korkmaz, 2000; Kuloğlu, 2005; Özyılmaz & Hamurcu, 2005; Temur, 2001; Torun, 2009; Yıldırım, 2006; Yıldırım, Tarım, & İflazoğlu, 2006); the effects of multiple intelligence theory on students' attitudes (Akamca & Hamurcu, 2005; Coşkungönüllü, 1998; Kuloğlu, 2005; Şengül & Öz, 2008); the distribution of students according to intelligence areas (Gürçay & Eryılmaz, 2002; Kuloğlu, 2005; Rammstedt & Rammsayer, 2000; Saraç, 2007; Sarıcaoğlu & Arıkan, 2009); the reflection of multiple intelligence theory into education (Talu, 1999; Tarman, 1999); students' and teachers' point of views about multiple intelligence-based practices (Aydoğan, 2006; Kutluca, Çatlıalp, Birgin, Aydın, & Butakın, 2009). In these related studies, Aydoğan (2006) investigated students' and teachers' point of views about class activities related to the multiple intelligence theory. Also, Kutluca et al. focused on teachers' views about teaching activities related to the multiple intelligence theory. In the studies by Aydoğan (2006) and by Kutluca et al., teachers' opinions in line with the multiple intelligence theory principles were investigated only in the experimental process. However, after the change in the primary school teaching programme in 2005, the multiple intelligence theory was regarded as one of the main tenets of the programme. Because Gardner (2004) claims that there is a relationship be-

tween individuals' thinking and learning processes and dominant intelligence area. He adds that it is possible to develop activities in line with the dominant intelligence area for individuals. Making use of these intelligence areas, individuals may solve a problem which can be regarded within one or more than one cultural frameworks and may have a skill of creating a product. Because intelligence areas have a structure which makes a combination of a skill, an ability and a talent possible. In other words; intelligence areas can be developed, can be improved and can be changed. That's why, investigating primary school science and technology teachers' point of views about the process of teaching in science and technology courses is important. Also, it is essential to focus on this teaching process from the perspective of the multiple intelligence theory. The research question of this study is: What class activities do teachers implement in teaching science and technology courses and to what intelligence areas do these activities address?

The Purpose of the Research

The overall objective of this study is to determine the class activities that Science and Technology teachers do in their classes and to determine teachers' ideas about which intelligence areas these activities address. In line with these aims, this study intends to answer the following research questions:

1. What is the distribution of activities that primary school teachers, Science and Technology teachers use in their classes according to intelligence areas?
2. Do these activities vary according to the grade of their classes?
3. Do these activities vary according to teachers' experience period?
4. What are teachers' views about mind, the theory of multiple intelligence, and the class reflections of the multiple intelligence theory?

Method

The Model of the Study

This study is based on a mixed model (Creswell, 2003), integrating a descriptive (survey) research and a qualitative research. This research design enables researchers to work with both a small group and a big group. Also, it helps to obtain deep and general knowledge, comprehension and understanding (Creswell; Johnson & Onwuegbuzie, 2004; Yıldırım & Şimşek, 2005).

Sample

The sample of this research consists of 102 4th grade elementary teachers, 97 5th grade elementary teachers, and 55 6th, 7th and 8th grade science and technology teachers, including 254 teachers in total. 141 of these 254 teachers were female and 113 of these 254 teachers were male. The range of teachers' professional seniority was between 1 and 26 years. It was defined that a great majority of the sample had 11 or more years of professional seniority.

Interviews were done with seven 4th grade elementary teachers, seven 5th grade elementary teachers, and six 6th, 7th and 8th grade science and technology teachers, including 20 teachers in total.

Data Collection Tools

The Inventory of Class Activities Done in line with the Intelligence Areas: This questionnaire was developed in order to define the teaching strategies that the teachers use in science and technology classes. The eight intelligence areas which Gardner defined were taken into consideration while developing this questionnaire according to teaching strategies used. Related resources were made use of while developing this questionnaire (Akınoğlu, 2003; Armstrong, 2000; Avcı, 2006; Baragona, 2009; Bümen, 2001, 2005; Campbell, 1997; Çakmak, 1999; Çavuş, 2004; Demirel, 2005; Ergin, 2007; Ekici, 2003; Gömleksiz & Bulut, 2006; Iyer, 2006; Özdemir, 2006; Saban, 2004; Sarıgöz, 2008).

The last form of the questionnaire was constructed with 5 questions about personal information, 10 questions about checking the teachers' knowledge about the multiple intelligence theory and 64 statements about activities, which had 79 questions in total. The statements in the second section of the questionnaire were scaled as "never", "rarely", "sometimes", "often", and "always".

To asses the structure of "*The Inventory of Class Activities Done in line with the Intelligence Areas*", exploratory factor analysis by means of principal components analysis with varimax rotation and confirmatory factor analysis were used. Factor solution resulted in eight factors. The eight-factor solution accounted for 61.113% of the total variance. In selecting items for the final scale, minimum .30 factor loading was used a guideline for considering an item to be part of a factor (Tabachnick & Fidell, 2001). The process resulted in the elimination of 16 items from the questionnaire because of weak factor loadings or high cross loadings on more than one factor.

Next, the construct validity of "*The Inventory of Class Activities Done in line with the Intelligence Areas*" was retested with confirmatory factor analysis (CFA). CFA results show that the model fitness indicator indexes meet the statistical standards (Byrne, 1998; Jöroskog & Sörbom, 1993; Kline, 1998; Sümer, 2000; Şimşek, 2007) [Non-Normed Fit Index (NNFI)=0.95; Normed fit index (NFI)= 0.90; Comparative Fit Index (CFI)= 0.96; Incremental Fit Index (IFI)= 0.96; Root mean square error of approximation (RMSEA)=0.050; Standardized Root Mean Square Residual (SRMR)=0.064].

The Interview Form: In the research, "semi-structured interview form" was used as the second data collection tool. While developing the form, related literature was reviewed (Akınoğlu, 2003; Armstrong, 2000; Avcı, 2006; Ergin, 2007; Gömleksiz & Bulut, 2006; Iyer, 2006; Özdemir, 2006; Sarıgöz, 2008), the resources were browsed for the multiple intelligence areas and the applicable activities in the 4th, 5th, 6th, 7th and 8th grade elementary science and technology courses. The interview form consisted of 8 questions. The interviews took about 20 minutes.

Data Analysis

The evaluation ranges were calculated in order to explain the mean appropriate for five scales used in the questionnaire. Accordingly, the range 1.00 to 1.80 means "never", the range 1.81 to 2.60 means "rarely", the range 2.61 to 3.40 means "sometimes", the range 3.41 to 4.20 mean "often" and the range 4.21 to 5.00 means "always". The quantitative data obtained from the interview form were analyzed by descriptive statistics such as mean, standard deviation, t-test, and one-way analysis of variance.

For the qualitative data in the study, content analysis was conducted. Firstly, verbal data was transferred into the computer with the Microsoft Office Word. Secondly, as the interviews were not audio-recorded, notes taken during the interviews were carefully considered and added into the written data. Two interviews among all were randomly selected and coded by two independent coders. Their codings were compared and the consistency between these two coders was calculated (Miles & Huberman, 1994). It was found as 0.89. Thirdly, all interviews were coded by two different researchers independently. These coders were also the ones who participated in the reliability study. Lastly; the codes emerged were grouped and main categories were formed. Related codes were taken together while interpreting the results (Maykut & Morehouse, 1994).

Results

Findings Obtained from the Inventory of Class Activities Done in line with the Intelligence Areas

It was seen that all teachers used activities intended for verbal and linguistic intelligence in their classes and the mean of the responses was centered on the "often" scale in other activities except from *"I want my students to memorize some rules about science and technology topics"*. The first three activities that the teachers stated that they used are respectively *"I read/tell the information presented in the course books or resource books related with the topic"*, *"I present detailed verbal information about the topic"* and *"I dictate the explanations about the topic"*.

It was seen that both the 4th and 5th grade elementary teachers and science and technology teachers who participated in this research used activities for mathematical and logical intelligence in their classes in different frequencies. It was also seen that the 4th and 5th grade elementary teachers always or usually used the activities of *"I allow students to interpret their observations with their own statements"* , *"I associate the covered topics each other in order to facilitate remembering"* ,and *"I associate some topics with other courses"*, science and technology teachers used the activities of *"I want students to give examples which connect the newly learned topics with the previously learned ones"* and *"I reveal the similarities and differences to explain the topic"* more.

> *It was determined that the 4th grade elementary teachers used more activities for musical and rhythmic intelligence than the other teachers and activities for this intelligence area were rarely or never used while the grades become higher.*

It was revealed that teachers in all grades usually used activities of "*using the drama method", "making them prepare materials for the lesson", "making them prepare models about the topic" and "making them prepare cards about the topic that would be dealt with"* for bodily and kinaesthetic intelligence.

All of the teachers stated that they always used activities of *"I use concrete objects which are supportive to the content"* for visual and spatial intelligence and usually used other activities in their classes. It was observed that teachers usually used all the activities for interpersonal intelligence.

It was determined that teachers in all grades used activities of "*I give some homework which the students should do on their own", "I want students to tell their emotions and thoughts about the topics", "I provide opportunities for students to assess their own work", "I encourage students about various thinking*

styles" and "*I provide alternatives to students during the application of the activities*" for intrapersonal intelligence in their classes.

> It was determined that teachers in all grades usually used activities of *"I make them watch videos and documentaries about the nature"* and "*I organize some work for students to identify various species (feeding animals, breeding plants etc.)"*, sometimes used the strategy of "*I allow students to do collection work*" and rarely used the strategy of *"I organize educational trips in order to facilitate the learning of science and technology topics*" for natural intelligence.

Independent t-test was conducted in order to see whether the scores taken from the The Inventory of Class Activities Done in line with the Intelligence Areas differed. It was seen that the mean of the scores based on the inventory differed. Independent groups t-test was repeated to see whether the difference among the means were significant or not. According to this, the primary school and Science and Technology teachers' scores about class activities addressing the intelligence areas were significant in the following points: verbal/linguistic [t(252)= 2.063, p=.040], musical/rhytmic [t(252)= 4.783, p=.0001], physical/kinesthetic [t(252)= 2.017, p=.045], personal/intrapersonal [t(252)= 2.344, p=.020], and naturalistic [t(252)= 2.745, p=.006]. When the mean scores of this difference are considered, it can be seen that this difference is in favor of the primary school teachers.

One-way analysis of variance was used to see if the activities of the teachers differ according to their professional seniority. The results of one-way analysis of variance revealed that there was a meaningful difference for "logical/mathematical intelligence [F (2,251) = 3.407; p<.05]", visual/spatial intelligence [F (2,251) = 3.279; p<.05]", bodily/kinaesthetic intelligence [F (2,251) = 3.009; p<.05]", interpersonal intelligence [F (2,251) = 3.279; p<.05]" and natural intelligence [F (2,251)= 3.013; p<.05]". LSD test was performed to determine for which teachers of professional seniority this difference was in favour of. LSD test showed that regarding interpersonal and natural intelligences and visual/spatial intelligences, there was a meaningful difference between the teachers with professional seniority of 11-20 years and the teachers with professional seniority of 21 years or more, in favour of the teachers with 21 years or more professional seniority. Then, as for logical/mathematical intelligence, there was a meaningful difference between the teachers with professional seniority of 1-10 years and the teachers with professional seniority of 21 years or more in favour of the teachers with 21 years or more. Next, in terms of bodily/kinaesthetic intelligence, there was a meaningful difference between the teachers with professional seniority of 1-10 years and the teachers with professional seniority of 21 years or more and between the teachers with professional seniority of 1-10 years and the teachers with professional seniority of 11-20 years in favour of the teachers with 11-20 years professional seniority and the teachers with 21 years or more professional seniority.

Findings Obtained from the Interviews

A great majority of teachers (n=18) defined the intelligence as *"using the learning strength and problem solving skills"*. Most of the teachers (n=18) stated that they learned about the multiple intelligence theory from the in-service teacher training courses that they participated in, the internet, and the books published about this theory. Only two of them stated that they learned about this theory from the internet, magazines and newspapers. Teachers generally explained that the multiple intelligence theory addressed to different intelligence areas, the curriculum was changed in order to address to all intelligence areas by the activities during the teaching process and intelligence areas could be addressed through the activities in the course books and workbooks. All the teachers evaluated their knowledge about the multiple intelligence theory as inadequate and stated that collaboration between the Directorate of National Education and the university should be established. Two of the teachers emphasized the necessity of organizing workshops with the specialists at the university about putting this theory into practice.

While the 4th and 5th grade elementary teachers reported that they used activities for different intelligence areas of the students, the science and technology teachers reported that they could not use activities for different intelligence areas in classes because the curriculum was intense and they had to prepare their students for the Placement Exam and they added that they used the activities in the course books and workbooks as homework. Both the 4th and 5th grade elementary teachers and science and technology teachers told that they adopted the new Science and Technology curriculum which has been in practice since 2005/2006 school year, but they could not see themselves as good practitioners of this curriculum because of the crowded classrooms.

All of the teachers stated that activities for musical/rhythmic and intrapersonal intelligences in the

course books and workbooks were fewer than the ones for the other intelligence areas. Besides, the 4th and 5th grade elementary teachers told that they used songs or some lyrics in music classes in the process of associating the science and technology course with the others although there were not any activities like these in the course books.

Discussion

The results of the research revealed that both the 4th and 5th grade elementary teachers and science and technology teachers usually used strategies for verbal/linguistic, visual/spatial, interpersonal, intrapersonal intelligences in their classes, used strategies for logical/mathematical and natural intelligences in different frequencies, rarely or never used strategies for musical/rhythmic intelligence in higher grades and usually used strategies of "*using the drama method", "making them prepare materials for the lesson", "making them prepare models about the topic" and "making them prepare cards about the topic that will be dealt with*" for bodily and kinaesthetic intelligence in all grades. This result can be commented that both the 4th and 5th grade elementary teachers and the science and technology teachers arranged the process of teaching for different intelligence areas. The results obtained from the interviews, however, does not support this finding. While the 4th and 5th grade elementary teachers used activities for different intelligence areas in science and technology classes, the science and technology teachers did not use the activities which were predicted by the curriculum for different intelligence areas and generally used them as homework. The results of the comparisons done according to the grades also support this finding. This contradictory situation can be explained by the opinions of Campbell, (1997); Goodlad, (2004); Kornhaber, Fierros, and Veenema, (2004). Campbell; Goodlad and Kornhaber et al., stated that the researches which were done about the multiple intelligence theory and their results made teachers to develop awareness about the necessity of using teaching strategies for the other intelligence areas in addition to the verbal/linguistic and logical/mathematical intelligence areas. This can be commented that the teachers who were the sample of this study had knowledge about the multiple intelligence theory and reflected this to the questionnaires but could not put this knowledge into practice. In other words, it can be said that the teachers were aware of the implications of the multiple intelligence theory (Eisner, 2004) but did not have proficiency to put this knowledge into practice. Because the teachers who were interviewed stated that the curriculum was changed so as to address to all intelligence areas by the activities in the teaching process, all multiple intelligence areas could be addressed through the activities in the course books and workbooks, the science and technology curriculum which was in practice was designed in order to address all intelligence areas and the students could learn better if the activities in the curriculum were done. On the other hand, both the 4th and 5th grade elementary teachers and science and technology teachers told that they adopted the new Science and Technology curriculum which has been in practice since 2005/2006 school year but they could not see themselves as good practitioners of this curriculum because of the crowded classrooms and limited time.

It was seen that there was a meaningful difference according to the professional seniority of teachers in terms of the mean scores of the teaching strategies they used for "logical/mathematical, visual/spatial, bodily/kinaesthetic, interpersonal and natural intelligences and this difference was in favour of the experienced teachers. This finding can be commented that experienced teachers could use teaching strategies for more than one intelligence area by the help of activities which were based completely on their experiences without regarding the individual differences and dominant intelligences of the group of students they were teaching (Bullough & Baughman, 1995; Emmer & Stough, 2001)

All the teachers who were interviewed stated that activities for musical/rhythmic and intrapersonal intelligence were fewer than the ones for the other intelligence areas in both course books and workbooks. Similarly, in his study in which he investigated the activities in science and technology course books and workbooks in terms of the multiple intelligence theory, Muradoğlu Özbay (2008) reported that the naturalist, musical/rhythmic, intrapersonal and logical/mathematical intelligence areas were extremely disregarded and the new curriculum required to be improved based on activities.

Consequently, it can be said that teachers generally used activities for all intelligence areas; they had knowledge about the multiple intelligence theory, not the science and technology teacher but the elementary teachers and experienced teachers used teaching strategies for more than one intelligence area in their classes. Besides this, the responses that the teachers gave in the questionnaire and the data

obtained from the interviews did not overlap. This can be commented with the contradiction between having knowledge and not putting that knowledge into practice. For this reason, it is important to investigate the activities in the curriculum which has been in practice since 2005/2006 school year, the teacher's book, student's books and workbooks considering the necessity of addressing to all intelligence areas equally, to improve the activities for intelligence areas which were fewer and to make arrangements which not only inform the teachers but also allow them to put those activities into practice. Especially science and technology teachers stated that they could not use the activities in the existing curriculum due to the crowded classrooms and the placement test but they believed that the students could learn better and permanently if they could use those activities. The effects of these situations on the application of the curriculum can be investigated. The data in this research were collected by a questionnaire and a semi-structured interview form developed by the researcher. The preparations of the teachers for the teaching process, their studies in the planning, application and evaluation stages, the strategies they used while doing these studies and their consideration of the multiple intelligence theory were not investigated. This can be a limitation of this research in evaluating the results. Some observation and document analysis techniques can be used to get rid of this limitation in further studies.

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