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Turkish elementary school students' performance on integrated science process skills

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Abstract

The purpose of this research is to determine the students' level of performance on integrated science process skills (ISPS) and whether there are statically significant differences in their performance linked to their gender, grade level, economic background, the education background of their mother, the number of family. Data were collected with the authors' constructed ISPS test. The test is comprised 12 items related to ISPS. The results indicated that the subjects' mean score was satisfactory. Moreover, there was a positive relationship between their performance and their gender, grade level, economic background, the education background of their mother, the number of family.

Keywords: Science education; integrated science process skills; science inquiry; elemantr school students; assessment

1. Introduction

For more than four decades it has been widely accepted that SPSs are essential for scientific inquiry as a part of cognitive and investigative skills (Gagne, 1963; Germann, 1989). Teaching science by inquiry includes in science process skills (SPSs), critical thinking, scientific reasoning skills used by scientists to learn about the world (Padilla et al., 1983; Westbrook and Rogers, 1994; Pratt and Hackett, 1998). Researches on SPS abilities have taken many directions since the early 1960s when the debut some programs such as Biological Science Curriculum Study (BSCS), Science Curriculum Improvement (SCIS), Intermediate Science Curriculum Study (ISCS), and Science-A Process Approach (SAPA) in America. The importance of these skills has long been recognized and leaders in science education have actively promoted SPS since then and continue to do so today. Various models have been presented for teaching and acquisition of the SPSs (Padilla et al., 1984; Baird and Borich, 1987; Goh et al., 1989; Mattileis et al., 1992; Roth and Roychoudhury, 1993). SPSs that are important enough to teach are important to evaluate the understanding of the process of science as reflected by students' skill performance. More than a dozen instruments have been developed for assessing SPSs achievement. Initially, the efforts of SPSs test development during the 1960s and 1970s were generally aimed at specific curricula mentioned above (Walbesser, 1966; McLeod et al., 1975). However, non-curriculum specific SPSs tests have been developed by researchers for more than four decades to asses elementary, middle and high school students' performance on basic or integrated SPSs (Tannenbaum, 1971; Molitor and George, 1976; Dillashaw and Okey, 1980; Tobin and Capie, 1982; Burns et al.,

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1985; Beaumont-Walters and Soyibo, 2001; Temiz et al., 2006; Dökme and Aydınlı, 2009). Most of these instruments have been multiple-choice format. While the multiple-choice tests for assessing students' performance on SPSs have been commonly used, some researchers have discussed the need for more authentic assessment of students' process skills (Rebza et al., 1995; Harlen, 1999). In authentic assessment, students are asked to perform certain hands-on activities developed by researcher to assess SPSs through experimentation (Ayala et al., 2002; Klein et al., 1998; Solano-Flores et al., 1999; Rezba et al.,1995).

Although considerable attention has given performance assessment of SPSs the development of standardized instruments is one more hardship for participants in a large sample. In this case, the SPS assessment instrument with multiple-choice format can be preferable for introducing of the level of performance for large sample size in particular region. In this research study, the instrument developed by authors consists of multiple-choice items. This study is to determine if: (a) some Turkish elementary school student' level of performance on a test of integrated science process skills is satisfactory or not; and (b) there is any statically significant difference in students' performance on the test of integrated science process skills linked to their gender, grade level, economic background, the education background of their mother and the number of family.

2. Method

The main study sample is comprised 670 students (410 boys, 260 girls; 230 sixth grades, 239 seventh grades, 201 eighth grades; 249 from a low economic background, 238 from a middle economic background, and 183 from a high economic background). The education background of their mother is categorized four kinds called a) non-literacy (217) b) graduated primary school (284) c) graduated high school (108) d) graduated university (61). The number of their family is categorized four kinds called a) 2-3 (265) b) 4-7 (271) c) 8-11 (103) and d) above 12 (31). The sample students randomly selected from five state elementary schools.

In this study, data were collected with the authors' constructed integrated science process skills test. Prior to the pilot study, to ensure that the integrated science process skills test items had satisfactory content and construct validity, one university senior lecturer in science education department, one assessment and evaluation lecturer, and one experienced elementary science teacher were given copies of 14 written performance test items, and guidelines for its content and construct validation. The validators' comments were used in correcting the pilot test items. The integrated science process skills test with 16 items was asked 50 students in *Konakdüzü School* for the pilot study. After the analysis of the pilot study results 4 items were omitted due to decrease reliability. The integrated science process skills test measured six skills: interpreting data, formulating hypotheses, identifying variables, defining operationally, experimenting and formulating models. The test comprised twelve written performance items and maximum score is 12. The Cronbach alpha of the integrated science process skills test was found 0·8. The integrated science process skill test, finally, applied the students in sample.

3. Result and Discussion

The first purpose of this study was to determine whether the level of the performance of selected Turkish sixth, seventh and eighth graders on integrated science process skills test was satisfactory or not. For each item of the test if the students find the proper answer, this scored 1 point, if not 0 point. Single factoral analysis of variance (One–Way Anova) was used while an answer was being sought for some problems of the research. Table 1 indicates that the performance score of sixth, seventh and eighth graders on integrated science process skills test. When the student find the proper answer between 1-6 items, her/his performance on integrated science process skills is accepted insufficient and when the student find the proper answer between 7-12 items, her/his performance on integrated science process skills is accepted sufficient. Table 2 suggests that the subjects' mean score on the entire the integrated science process skills test (5.61) is not less than a score of 2.50 on a five-point scale, their overall

level of performance in this study is considered as high but not satisfactory. The interview of the teachers in the sample schools have been reveal that these teachers faced some uncomfortable case by using new science curriculum as follow: a) Lack of materials, b) high number of students in the class c) inquiry approach is too difficult and much more time consuming. Although science new curriculum today continue to promote inquiry-based science, rapid implementation will not occur until the issues articulated by Eltinge and Roberts (1993) and Welch et al. (1981) are implemented. Figure 1 show the change in students' performance on the test of integrated science process skills linked to their gender, grade level, economic background, the education background of their mother and the number of family.

Table 1: The subjects' performance on integrated science process skills test

		F	%
Sixth grade	1 - 6	181	78.7
	7 – 12	49	21.3
	Total	230	100.0
Seventh grade	1 - 6	103	43.1
	7– 12	136	56.9
	Total	239	100.0
Eighth grade	1 - 6	121	60.2
	7 – 12	80	39.8
	Total	201	100.0

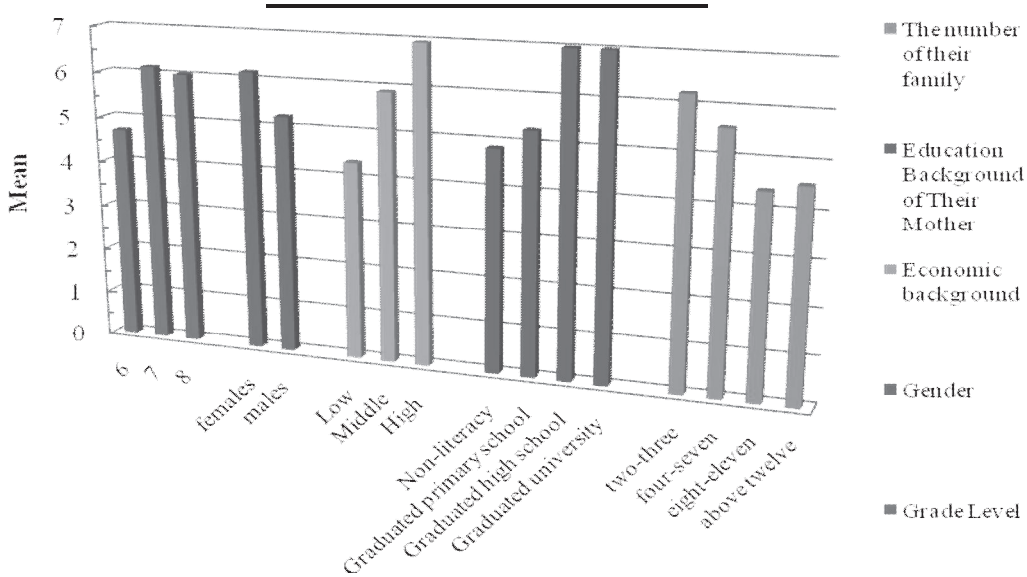

Figure 1. The graph of the change in means on the test of ISPS as a function of gender, grade level, economic background, the education background of their mother and the number of family.

The second purpose of this study is to determine if there are any statically significant differences in the students' performance on the integrated sciences processes skills test linked to their grade level, their gender, economic background, the education background of their mother, the number of family.

Table 2: Means and standard deviations (SD) by grade level, gender, economic background, education background of their mother and the number of their family on the test of integrated science process skills.

VARIABLES	N	M	SD
Grade Level			
6	230	4.70	2.33
7	239	6.15	2.70
8	201	6.02	2.92
TOTAL	**670**	**5.61**	**2.73**
Gender			
Females	260	6.16	2.69
Males	410	5.25	2.69
Economic Background			
Low	248	4.35	2.12
Middle	238	5.91	2.60
High	184	6.96	2.88
Education Background of Their Mother			
Non-literacy	217	4.87	2.41
Graduated primary school	284	5.29	2.57
Graduated high school	108	7.08	2.79
Graduated university	61	7.24	2.86
The number of their family			
2-3	265	6.23	2.94
4-7	271	5.59	2.61
8-11	103	4.40	1.98
above 12	31	4.56	2.32

Table 3. The findings related to students' science process skills in terms of their grade levels.

		Sum of Squares	df	Mean Squares	F	p
Integrated Science	Between Groups	292,005	2	146,002	20,726	,000
Process Skills	Within Groups	4698,646	667	7,044		
	Total	4990,651	669			

Table 3 shows that there is a statistically difference in the students' performance on the integrated sciences processes skills test linked to their grade level ($p<0.05$). The means of the sixth graders was lower than the others. The means of the seventh and eighth graders were close to each other. This finding indicates that the students could gradually improve their process skills. Because it is expected that subjects' performance in increasing order should be as 6^{th}, 7^{th} and 8^{th} grade.

Table 4. The findings related to students' science process skills in terms of their genders.

		N	M	S.D.
Integrated Science Process Skills	Female	260	6,1583	2,69115
	Male	410	5,2567	2,68987
	Total	670	5,6149	2,73128

Table 4 indicates that the means of the females was higher than that of males. There is statically significant difference in the subjects' score linked to their gender. The finding that there was significant gender difference in their performance is inconsistent with the finding in other some countries (Greenfield, 1996; Walters and Soyibo, 2001). We could not explain the likely reason for this finding based on this study's data.

Table 5. The findings related to students' science process skills in terms of parents' total income

		Sum of Squares	df	Mean Squares	F	P
Integrated Science Process Skills	Between Groups	732,648	2	366,324	57,383	,000
	Within Groups	4258,00	667	6,38		
	Total	4990,65	669			

As seen in Table 5, the means are increasing with increasing parents' total income. This finding receives some indirect support from Gallagher (1994) regarding middle school students' performance on integrated science process skills and the finding of many previous studies on the link between students' economic background and science performance (Blosser, 1994). No studies in literature have reported that differences in students' integrated science process skills performance were linked to the education background of their mother, the number of their family (Table 6).

Tablo 6.The findings related to students' science process skills in terms of mother education background

		Sum of Squares	df	Mean Squares	F	p
Integrated Science Process Skills	Between Groups	529,761	3	176,587	26,364	,000
	Within Groups	4460,89	666	6,69		
	Total	4990,65	669			

In this study it is found that there is statically significant difference in the students' performance on the integrated sciences processes skills test linked to the education background of their mother ($p<0,05$).

The means of subjects' students in increasing order are as follows: non-literacy, graduated primary school, graduated high school, graduated university. The means of the students whose mother graduated from a university are highest. While mother education background level decreases, the students' science process skill levels also decrease. However, there is no statically significant difference in the students' performance on the integrated sciences processes skills test linked to the number of subjects students' family. It is open to researchers that the correlation between students' performance on science process skills and cognitive ability or motivation according to these variable.

4. Conclusion and Suggestion

The 2004 Science and Technology curricula of Turkey suggest inquiry-based pedagogical innovation in science teaching and learning as an innovative and ambitious science education initiative. These curricula suggest a lot of science activities required science process skills by expecting the teachers to use inquiry teaching strategies.

Therefore, it was significant to determine Turkish elementary school students' level of performance on science process skills. For this reason, Turkish primary school second grade students' level of performance on integrated science process skills was to determine in this study. On the contrary our expectation, the subject students' level of performance on integrated science process skills was of moderate means. In this sense the results obtained interviews to teachers in sample schools do suggest that further research should be carried out in future studies on some topics. They include the effect of the lack of materials, the number of students in the class and physical condition of class, teachers' qualifications, teaching experience and teaching styles on students' level of performance on basic science process skills. This study determined the relationships among the subjects' grade level, their gender, economic background, the education background of their mother, the number of family. With respect to these conclusions to improve poor students' understanding and performance on integrate science process skills it is recommended that science teachers should give these students additional opportunities as follows: a) When these student practice activities in class teachers should help these student to use basic science process skills and get them to be aware of using these skills. b) Teachers should concentrate on more hands-on activities including more basic science process skills for these students. c) Teachers should give these student homework including hands-on activities and encourage them use basic science process skills.

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