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The Effect of Project Based Learning on the Statistical Literacy Levels of Student 8th Grade

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This study examines the effect of project based learning on 8th grade students' statistical literacy levels. A performance test was developed for this aim. Quasi-experimental research model was used in this article. In this context, the statistics were taught with traditional method in the control group and it was taught using project based learning in the intervention group. Statistics was given for four weeks according to project based learning at intervention group. The performance test was applied to total 70 students as pre and post-test. Participants are from two different classes of a middle school in Trabzon. The data were analysed using Rasch (1980) measurement techniques. This measurement allowed both students' performance and item difficulties to be measured using the same metric and placed on the same scale. All raw scores converted lineer score in order to obtain equal interval scale. Acquired linear scores were compared. In the analysis of gained datum covariance analysis are used. According to gained results in pre-processing application there isn't substantial difference between the achievements of intervention group and control group; but after processing between the achievements of intervention group and control group there is a substantial difference statistically in favor of intervention group. The results of the study revealed that the project based learning increased students' statistical literacy levels in the intervention group.

Keywords: statistical literacy, project based learning, statistics education, middle school students, rasch measurement

Introduction

Increasing recognition has been given over the last decade to the importance of statistical literacy. Statistics education has emerged as its own area, with the study of statistics highly relevant to both mathematics and science, yet distinct from each and providing a critical link between this two area (Ben-Zvi & Garfield, 2008). The content of introductory statistics courses has also changed dramatically, both because more sophisticated concepts are covered and because technological tools have helped to shift the focus from the minutiae of statistical computations to the more fundamental meaning of the statistics constructs being used (Kirk, 2007). This shift in focus has played a role in distinguishing statistics education from the broader realm of mathematics education, in which statistics education finds many of its roots.

Changes in what is expected in the teaching of probability and statistics do not just concern the age of learning or the amount of material, but also the approach to teaching. Researchers and educators have often suggested improvements to statistics teaching methods, especially those that focus on implementing the scientific method through authentic statistical experiences (Bryce, 2005). The consensus

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among many researchers is that statistics is taught most effectively with real data (Cobb & Moore, 1997). In particular, there is greater benefit to students' learning when they collect their own data rather than merely working with data already collected by others (Hogg, 1991). This finding parallels the suggestion by many researchers that statistics education should be studentcentered (Roseth et al., 2008).

When best-practice pedagogies have been implemented in statistics courses, the results have been positive for achievement and for improved attitudes toward statistics. For instance, students who have participated in all aspects of statistical research – collecting data, performing analyses, and communicating results have demonstrated benefits in exam performance and in students' evaluations of the course (Smith, 1998). This finding is consistent with research suggesting that apprentice learning, wherein students complete real-world mathematics in authentic settings, develops better conceptual understanding and better knowledge transfer to non-mathematical and non-school settings (Boaler, 1998). Research also suggests that statistics courses based on more constructivist models improve student attitudes toward statistics and that personal relevance is important for successful learning in statistics (Mvududu, 2003). One case study revealed that students learned more from a real-world project than from any other instructional component of a statistics course; the project also fostered an increase in student motivation (Yesilcay, 2000).

In 2005 the Board of Directors of the American Statistical Association approved the Guidelines for Assessment and Instruction in Statistics Education (GAISE). Following years of "reform efforts"– that produced workshops, papers and NSF grants–GAISE was an attempt to make the need for reform more visible and to make recommendations about important features of a modern, introductory statistics class. The GAISE college report (ASA, 2005) described a set of guidelines for teaching the introductory, college statistics course and included six basic recommendations:

1. Emphasize statistical literacy and develop statistical thinking.
2. Use real data.
3. Stress conceptual understanding rather than mere knowledge of procedures.
4. Foster active learning in the classroom.
5. Use technology for developing conceptual understanding and analyzing data.
6. Integrate assessments that are aligned with course goals to improve as well as evaluate student learning.

The intent of these recommendations was to encourage statistics instructors to make introductory statistics courses more modern, engaging and authentic. These recommendations included the use of real data and the fostering of active learning. Also among the guidelines offered was the stipulation that "teachers of statistics should rely much less on lecturing, [and] much more on the alternatives such as projects" (Guidelines for Assessment and Instruction in Statistics Education [GAISE], 2005). In agreement with this recommendation, Landrum and Smith (2007) suggest as a best practice "that students receive some 'hands-on' experience with a research project. An ideal situation would be to finish a complete project that included data collection and analysis" . Nevertheless, although the use of projects has been increasingly recommended as a sound pedagogical practice in statistics, many instructors still do not incorporate projects into their statistics courses.

Two statistical literacy model stands out in the literature. These statistical models are Gal (2002) and Watson and Callingham (2003). These models are used to define and characterize the level of statistical literacy or components. Gal (2002) model involves both knowledge elements and dispositional elements. Knowledge elements are literacy skills, statistical knowledge, mathematical knowledge, context/world knowledge, critical questions. Dispositional elements are attitudes, beliefs and critical stance. Watson and Callingham (2003) model based on a general developmental model (SOLO Taxonomy). Context, sampling, data representation, average, chance, variation, inference, mathematical and statistical skills are components of this statistical literacy. It has six levels. This levels are idiosyncratic, informal, inconsistent, consistent non-critical, critical and critical mathematical. This model are used to determine the level of students' statistical literacy. Watson and Callingham (2003) model exhibit beneficial a purpose compared to the other. Both models are historical. Gal (2002) model arising from the discipline of statistics while Watson and Callingham (2003) model originating from statistics education research. There is emphasis on both models to be critical.

Purpose of the study

This paper reports on how changed of (14-15 year-old) students' statistical literacy levels using the new approach. The present study was designed to examine the contribution of projects based learning to student outcomes in statistics courses. Projects used were student-defined and authentic in that students selected their own variables, crafted their own research questions, and collected and analyzed their own data sets. Students usually conducted these projects in groups of three. The student outcomes of interest were content knowledge, perceived usefulness of statistics, and self-efficacy for statistical tasks. Further, because the study was conducted with multiple instructors and a wide variety of students, the researchers aimed to examine potential variations in these outcomes associated with different instructors' implementations of the course and different students' overall achievement levels. Thus, the research question guiding the present analysis was as follows: Does the use of project based learning in statistics course have a positive impact on student's statistical literacy level?

Methodology

Quasi-experimental research model was used in the study. In experimental models, the data to be observed are produced directly under the control of the researcher with the aim of determining cause-effect relationships (Karasar,2008). In some cases, it may be impossible to randomly assign individuals to experimental and control groups. Quasi-experimental research model is used in these cases. In this model, individuals are not randomly assigned to intervention and control groups. Quasi-experimental research model is also used when the existing educational system does not allow randomly assigning students to groups (Çepni, 2007).

Participants

A pilot study was conducted in 2010–2011 Academic Year on total 60 students in two 8th grade mathematics classroom in urban middle school in Trabzon city of Turkey. Pilot study was conducted for gain to experience, organization of questions and in order to determine validity and reliability of data collection instruments. The study took place during the 2011–2012 Spring semester same school. The study group consists of total 70 8th grade (14 years old) students studying in two different classes. Of the 70 students who participated in the study, 35 were in the control phase. The remaining 35 students were in the treatment phase.

Project Based Learning

Project-based learning (PBL) is the learning method that places students at the center of the learning process. It is extensively used to replace the traditional teaching method in which the Project Based Learning Project-based learning (PBL) is the learning method that places students at the center of the teacher, who is the center, strictly follows the teaching plan. In a PBL classroom, the teacher leads the students to the learning that they desire or the learning following the project objectives. The PBL process thus includes an in-depth learning process with systematic learning management to get useful and applicable results, create motivation, and strengthen necessary living skills (Buck Institute for Education, 2010; Harris and Katz, 2001; Moursund, 1999 Boondee et. all, 2011). PBL has complicated working procedure and requires more time for operation. However, it is flexible and the learning process involves interaction and cooperation among learners, between learners and teachers. More importantly, when the teacher implements the project and the project is completed, the learners will feel proud of themselves. This generates motivation to the learners to create better projects in the future (Jung, Jun, and Gruenwald, 2001). In the PBL classroom management, students are divided into groups of different sizes. For small groups, all students will have equal roles and responsibility in creating the project. The Project enables the learners to deeply understand the ideology and standard of project-making. It can re-inforce lifelong working skills and behavior. The project also provides the learners with an opportunity to solve community problems, survey future careers, consult specialists and communicate with the in-tellectuals using the internet technology. The learners can also present their projects to the target groups outside classroom. The project can also motivate other low-motivated learners, who view studying as boring and useless, to see the significance and value of learning (Buck Institute for Education, 2010).

To control for inevitable variations introduced by differences between groups, a quasi-experimental design was employed. Control group is perform statistics course without using projects. Project based learning was applied on experimental group. Courses in both groups were made by the same teacher. These two groups were comprised. Thus, aimed to evaluate the effect of project based le-arnıng to the student success 8th class by investigators.

Firstly heterogeneous groups were created in the experimental group. Students usually conduc-ted projects in groups of three. Students were informed about the project preparation by teacher. At in-tervention group statistics is given for 4 weeks according to project based learning. Students worked on the project topics for 4 weeks. Each group was asked to draw up a report and submit the classroom. They asked teachers questions they were curious. Students in this process has been guided by the teac-her. Projects used were student-defined and authentic in that students selected their own variables, craf-ted their own research questions, and collected and analyzed their own data sets. The project topics are given to students are shown below.

- The average monthly income and expenses of a family.
- Statistics of the blood groups of students.
- Turkey super league teams score statistics.
- How many seconds 100 meters is run?
- Students' height and weight statistics.
- Students' success in math classes.
- Trabzon Airport aircraft and passenger statistics.
- Waste in our invironment.
- Statistics of daily activity.
- Usage statistics for internet and mobile phone TV.
- Popular career statistics in class.

Students were given four weeks to prepare projects. At the end of this period, each group pre-sented their projects in class. Each group made a presentation about 15-20 minutes. Video recording was taken for each group. Students aren’t given information about the research in control group. Teac-her prepared lesson plan before coming to class. Teacher was used lectures, question-answer, problem-solving methods and techniques. He supported them with exercises and examples. These courses are the same as everyday course. In order to measure the success of the students, statistics of the pre-test before it is processed, after processing the last test, the experimental group and the control group performed together. Project-based learning is applied in the experimental group were made to the traditional classroom environment but class seating plans wasn't changed in control group. Figure 1 shows in detail the traditional learning environment.

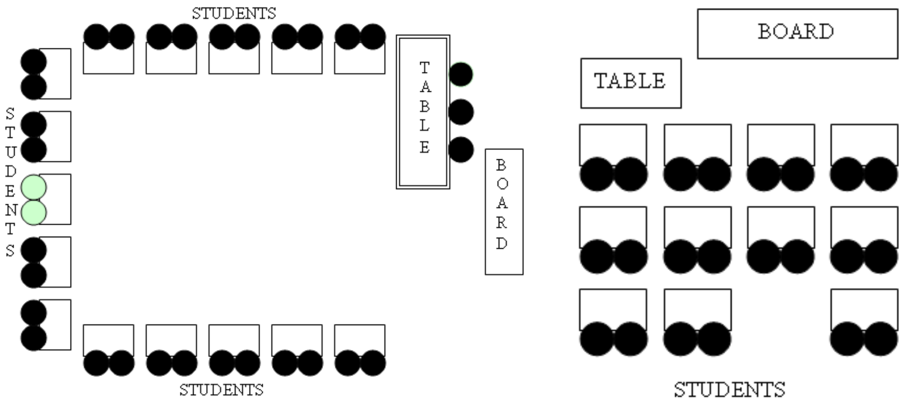

Figure 1. Project based learning and traditional learning invironment

Students' views about project-based learning was taken at the end of the application. Students are used to get the information ready for the teacher. For this reason, some students had difficulty in the process of project-based learning. While the division of labor and sharing some groups quite well in some groups were more active and more passive students. The desired level of interaction between the students in some groups did not. But most of the students was found to have positive thoughts about project-based learning. They said they enjoyed learning in this way. Some students had difficulties in the preparation graphics at computer.

Procedure

This study was conducted on the subject of statistics. Both groups were taught the same theoretical concepts. Exercises solved in the control group. In the experimental group was project-based learning activities. The data in this study are collected using the performance test for the subject of statistics and projects. In the first stage of the development of student performance test, preliminary interviews were conducted with middle school mathematics teachers about statistics and their instruction. As a result of the interviews with teachers, students were determined to have difficulties in comprehending statistics. So, it was understood that effective materials in teaching statistics are needed. To meet this need, project based learning was used. Statistical literacy test was developed by the researcher. It has 69 items related sampling (13), data representation (12), average (15), probability (9), inference (10) and change (10). Vast majority of test questions are similar to Watson and Callingham (2003). Some of the questions were rearranged or replaced by considering the characteristics of the language and culture.(see appendix 4). Developed these test were examined by two mathematics educators and two mathematics teachers. Teachers and academicians confirmed that the materials may appropriately serve the aim of the study.

The statistical literacy test regarding statistics was developed considering student attainments included in the 8th grade mathematics curriculum, teacher views and the statistical components reported in the literature. Watson and Callingham (2003) statistical literacy framework was used for statistical literacy levels. Watson and Callingham (2003) and Callingham and Watson (2005) approached the issue of identifying a framework for assessing Statistical Literacy through the use of Rasch modelling (Rasch, 1960). Using archived data from surveys conducted over a number of years that addressed the aspects of statistical thinking suggested by Holmes (1980), Watson and Callingham demonstrated that a unidimensional scale of Statistical Literacy could be constructed that provided interpretable information about students' achievement. They described a six level hierarchy characterised by increasingly complex cognitive processes in which statistical processes and contextual understanding were both involved. This hierarchy is summarised in Table 1. A framework, therefore, existed that could provide information about Statistical Literacy development. This framework, however, had been identified using items administered under traditional test conditions, and the issue of providing alternative types of assessment remained.

Table 1. Statistical literacy construct (Adapted from Watson and Callingham (2003))

Level	Brief characterization of levels
6 Critical Mathematical	Critical, questioning engagement with context, using proportional reasoning particularly in media or chance contexts, showing appreciation of the need for uncertainty in making predictions, and interpreting subtle aspects of language.
5 Critical	Critical, questioning engagement in familiar and unfamiliar contexts that do not involve proportional reasoning, but which do involve appropriate use of terminology, qualitative interpretation of chance, and appreciation of variation.
4 Consistent Non-critical	Appropriate but non-critical engagement with context, multiple aspects of terminology usage, appreciation of variation in chance settings only, and statistical skills associated with the mean, simple probabilities, and graph characteristics.
3 Inconsistent	Selective engagement with context, often in supportive formats, appropriate recognition of conclusions but without justification, and qualitative rather than quantitative use of statistical ideas.
2 Informal	Only colloquial or informal engagement with context often reflecting intuitive non-statistical beliefs, single elements of complex terminology and settings, and basic one-step straightforward table, graph, and chance calculations.
1 Idiosyncratic	Idiosyncratic engagement with context, tautological use of terminology, and basic mathematical skills associated with one-to-one counting and reading cell values in tables.

Scoring Rubrics

A scoring rubric is a rule or guide for making a judgment about a performance. Each activity on the performance tasks has an associated scoring rubric that addresses specific learning and takes account of the quality of the response. Each step of the rubric describes the qualitative difference between successive levels of response; that is, what makes the particular level of performance or response different from the one below it and the one above it. This is very clearly defined, and not simply a global statement such as "demonstrates partial understanding ...". The rubrics were critiqued by teachers before and after use, and considerably modified during the design phases to incorporate the responses that teachers had observed from their students. Each level of each rubric is given a score code for ease of marking, and to provide a basis for Rasch measurement. Table 2 shows an example scoring rubrics.

Table 2. Sample scoring rubrics

Question	Score	Rubrics
25 country students watched an average of 8 hours of TV per weekend 75 city students watched an average of 4 hours of TV per weekend. Show how to get the average TV viewing time for the total 100 students	2	Use of the algorithma. 25.8=200 and 75.4=300 500/100=5. Appreciate the need to have an answer between 4 and 8 hours per weekend.
	1	Add the amount of kids together and you get 100 and divide it by the 12 hours of TV.
	0	8+4=12 ve 12/2=6 and no reason.

Analysis

The data were analysed using Rasch (1980) measurement techniques, which allowed both students' performance and item difficulties to be measured using the same metric and placed on the same scale. Rasch calibration was used to evaluate the fit of data to the unidimensionality of the Rasch model and for the construction of the statistical literacy test. The 69 items were analyzed using the partial credit model (Masters, 1982). Items were calibrated in terms of the degree to which students agreed with the items. A high item difficulty means low levels of agreement with the item. Winsteps computer software was used to perform the partial credit analysis. The item difficulties and step thresholds as well as indicators of the extent to which each item fitted the model were examined. The Rasch model requires that data fit the model and it follows three main requirements. Equal differences have to be found between two sets of item difficulties on the scale and between the two corresponding sets of measures on the scale, an individual's measure on the scale should not be affected by any omissions of any items, the construct of the final scale cannot be affected by any opinions/answers of students.

The scale so produced is a genuine interval scale that allows comparision of person performance on the set of items used (Bond&Fox,2007). Each item score was then transcribed to an individual student data line within a larger data file inclusive of all children's performances (see Appendix 5). Each data line consisted of the following types of data: the first two digits indicate the participant's identifying code; the following 69 digits represent the participant's score on the 69 statistical literacy test of number items (see example below).

05 1201101210030…

Each data line represents the transformation of qualitative data to quantitative data, which can then be subjected to Rasch analysis. Responses for each item, for all four sets of criteria, were divided into hierarchically ordered levels of ability to which partial credit, for partial success, could be assigned. Thus, scoring was completed using a progressive two-step (0, 1) or three-step (0, 1, 2) system as required by Rasch analysis and espoused by Bond and Fox (2001). The statistical analysis was completed using Winsteps software (Linacre,2011), a computer program developed from Rasch principles. Rasch models of measurement use the interaction between persons (cases) and items to place both persons and items on a single measurement scale. The unit of measurement is the logit, the natural logarithm of the odds of success.

The usual meausre of fit reported is the infit mean square statistic (The most ideal value is 1.00), acceptable levels of fit lie between 0.77 and 1.3 (Keeves&Alagumalai,1999). The satandardised fit measured fit measure provides a z statistic, providing the statistical significance of the fit figure, using the asual accepted values of ∓ 2.00. The Person Separation Reliability indicates the extend to which the set of items separates the persons along the scale. It has an ideal value of 1, and values above approximately 0.7 provide acceptable separation, allowing persons to be compared onthe basis of their measured ability. Estimates of person ability were obtained in logits. Logit is logarithm of the odds of succes. Item (*R*I) and Person (*R*P) Separation Reliabilities indicate the extent to which the test provides a wide spread of items or persons along the variable, and avoids a "ceiling" or "floor" effect. These statistics provide a measure of internal consistency. Cronbach alpha statistics were also obtained as a measure of the reliability of the test.

Results

In this part, the data obtained from the performance test were analyzed using Winsteps 3.72 computer program and the results were presented summary statistics, item calibration, rating scale diagnostics, person abilility measures, person item maps, t test and covariance analysis. Appendix 1 shows summary statistics. Summary statistics are includes all persons' pre and post test results. Fit to the model, of both items and persons, was evaluated using the Infit Mean Square (IMSQ) statistic and the standardized infit (Infit t). The acceptable values lie between 0.77 and 1.3 (Keeves and Alagumalai, 1999) with an ideal value of 1.00. For both items ($IMSQ_I$ = 1.01, s.d. =1.3; Infit t = .0) and persons ($IMSQ_P$ = 1.04, s.d. =0.8; Infit t =.2) the overall fit was acceptable indicating that the performance tasks were composed of activities (items) that worked together consistently to measure a single unidimensional construct, and that the students who responded to the task did so in ways that were coherent with the intentions of the task developers. Reliability figures were also satisfactory (*R*I = 0.98; *R*P = 0.94; Cronbach alpha = 0.95) indicating that the internal consistency of the tasks was good. These findings indicated that all items worked together to measure a single underlying construct, and the persons who attempted the tasks performed in expected ways.

Table 3 shows summary statistics for groups. This table ise include summarizes infit, outfit, reliability, means and standard deviation of both raw score and Rasch measure.

Table 3. Summary statistics for groups

	Raw Score		Rasch Score		Infit	Outfit	Reliability	N
	Mean	Standard Error	Mean	Standard Error				
Intervention								
Pre test	34.8	13.2	-0.9	0.6	1.03	0.99	.85	35
Post test	79,2	25,3	0.1	0.9	1.06	1.07	.95	35
Control								
Pre test	42.1	13.8	-0,7	0.5	1.04	1.00	.81	35
Post test	53.6	17.7	-0.4	0.6	1.04	1.02	.90	35

Infit and outfit close to ideal value (1.00). Person reliability between 0.81 and 0.95 (good). As is shown in this table, learners' performance has improved in posttest. But intervention group shows a large improvement in ability, from -0.9 to 0.1 logits. Figure 2 shows pretest and post test item difficulties.

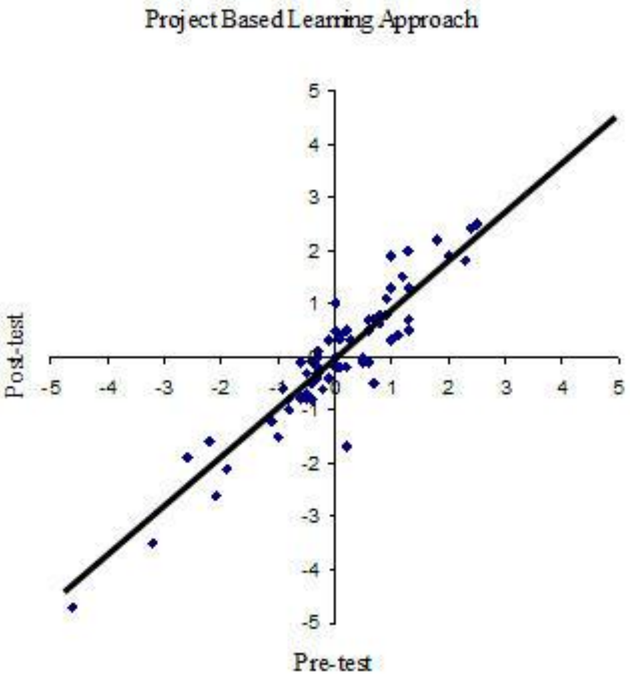

Figure 2. Pretest and posttes item calibration

According to the Figure 2 clearly show that item difficulty at pre and post are statistically invariant. Items that were hard at pre test remain easy at post. In this study post test item difficulties was taken as the pre test item difficulties and used post test steps difficulty.

Rating scale diagnostics provide information on how the rating scale is functioning by giving us frequency measurement reports for each point of the scale and the step difficulty threshold, which is essentially the cut-point for each point on the scale. Appendix 2 is the summary of the scale diagnostics for the posttest. The first column shows each point on the scale from ‘1’ to ‘4’. Then the second and third columns present the frequency counts and their percentage values so that we could see how often each point is being used. Notice how ‘0’, ‘1’, and ‘2’ are used the most. The fourth column is the average measure for each point. It reports the average ability (in logits) of all of the examinees who received that point on any of the items in the test. The fifth column contains the fit statistics, and according to Bond and Fox (2007), outfit mean squares that are greater than ‘2’ indicate that the particular point on the scale is causing ‘noise’ in the measurement process. However, in the current diagnostics, no rating point was found to be troublesome in terms of fit. Finally the sixth column shows step difficulty thresholds. Fair distance among the thresholds demonstrates that each point defines a distinct position in the measure of the construct.

Appendix 4 shows person ability measures for pretest and post test. These Rasch scores are linear and suitable for comparasions. Rasch scores are used for covariance analysis in this study. Person levels are determined according to the thresholds in the rating scale diagnostics (Appendix 3). A hierarchy of the easiest to most difficult task items and a hierarchy of persons based on best to worst performance can be established using Rasch analysis because the items are placed on one scale and so are the persons. The current study used a score of zero as the midpoint of difficulty. For the scores from the statistical literacy tests the items with more positive logit values were harder than those with more negative values. In contrast, persons with more positive logit values had a greater abilities to perform tasks independently than those with negative logit values. Because each item of the statistical literacy tests had its own scaling, the Partial Credit Rasch Model (PCM) was applied, to solve the different intermediate levels that come from different numbers of responses for different items on the same instrument (Bond & Fox, 2007; Linacre, 2007). Figure 3 shows person item map for intervention group at pre-test and post-test.

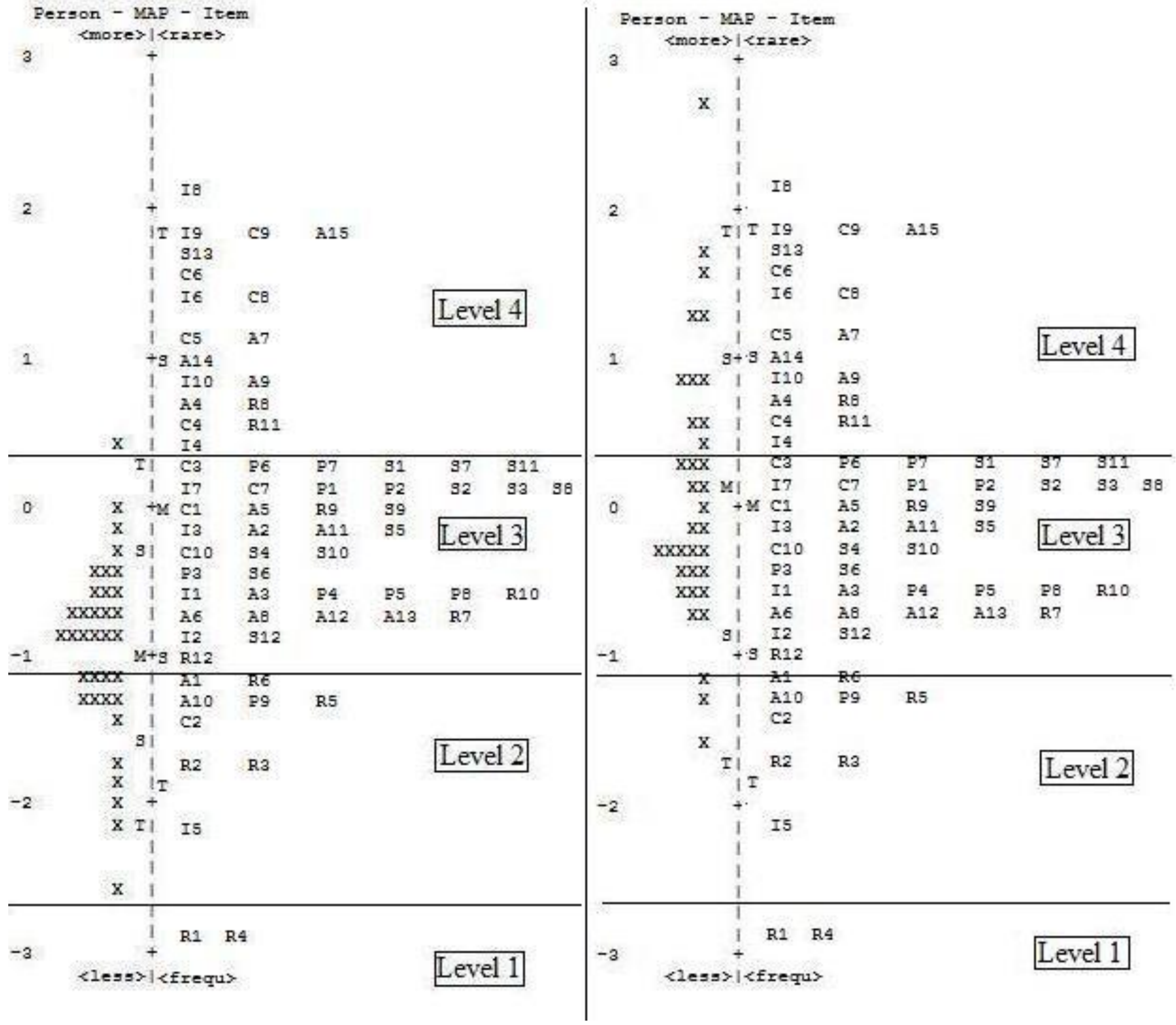

Figure 3. Person item map for intervention group at pre and post test

Person item maps are useful for identifying meaning constructs, as these graphical illustrations visually display any potential relationships amongst item responses. These maps display person and items distributions along a hierarchy. Here the numbers along the left column indicate logit measure. On this map, these logits descend according to the difficulty, meaning the hardest item to endorse will fall at the top of the map and the easiest item to endorse will fall at the bottom of the map. "M" markers along the map indicate the location of the mean measure. Likewise, a marker of "S" indicates one standard deviation from the mean and "T" indicates two standard deviations from the mean, as shown by Figure 3. There are 69 items in maps about sampling (S), data representation (R), average (A), probability (P), inference (I) and change (C).

Compared to the pretest, the performances of the examinees differed in the posttest. Appendix 4 demonstrates how the ability logit of each examinee changed from the pre-test to the post-test. Figure 3 is illustrates changes in the levels of students. According to the this figure after project based learning particularly observed increase in fourth-level. All person ability measures are shown in person item map. After project based learning 10 student are rose to from level 2 to level 3, 10 student are rose to from level 3 to level 4. Levels of the 15 student did not change in spite of the rise their logit in intervention group. Levels of 27 students didn't change in Levels of the only 7 students increased in control group. Level of a student decreased. The student may not show enough interest to statistical literacy post-tetst.

A one-way analysis of covariance (ANCOVA) was conducted for this study. The independent variable project based learning, the dependent variable was the students' statistics ability scores and the covariate was the students' score on the pretest. Table 4 shows analysis of covariance results.

Table 4. Analysis of Covariance Results

Source	SS	df	MS	F	p
Pretest	24.177	1	24.177	89.749	
Method	9.489	1	9.489	35.226	.000
Error	18.049	67	.269		

The ANCOVA was significant, $F(1, 67) = 35.226$, $p < .001$ and $\omega^2 = .35$. According to the results of ANCOVA, the intervention group and control group pre-test scores of students is under control, a statistically significant difference was found between post-test scores.

Discussion and Conclusion

According to gained results in pre-processing application there isn't substantial difference between the achievements of two groups; but after processing between the achievements of two groups there is a substantial difference statistically in favor of intervention group. These results support the project-based learning is applied in other studies (Korkmaz, 2002; Demirhan, 2002; Coşkun, 2004; Özdener ve Özçoban, 2004; Aladağ, 2005; Başbay, 2006; Çiftçi, 2006; Yıldız 2008). These studies were made in various disciplines and project-based learning in favor of the experimental group is significant and positive developments have emerged.

Data literacy has become a fundamental skill for living in an information era where important decisions are made based on available data. In order for students to develop robust data literacy skills, there ought to be significant changes to the instructional methods in statistics instruction. The aim of this study was to investigate the effect of project based learning on 8th grade students' statistical literacy level. Findings of the current study are very encouraging. The results of the study, project-based learning is more effective than traditional teaching methods in the teaching of statistics revealed. After the experiment, it was found that the project-based learning to promote cooperative working of the students in primary school using student centered principle was efficient and effective. Levels of the students after studying was increased. Thus the project-based learning helps to train students to work cooperatively via the projects and provides the learners with an opportunity to work face to face. It also helps to create better cooperation and interaction among the learners, which is similar to the way they live their life in the society.

The ultimate goals in our classes: to develop statistical literacy and competency in our students. Quite often students will ask, 'Why am I taking this course?' Students in the course should lead them to answer that question with, 'Because data are interesting and useful in understanding the world.' As statistics deals with uncertainty in the real world we teach our students caution in drawing conclusions from statistical analyses. In particular, we think it is important our students approach questions from multiple perspectives. By teaching our students in this fashion we believe we are providing them the tools necessary to develop statistical literacy and competency.

References

Aladağ, S. (2005*). İlköğretim matematik öğretiminde proje tabanlı öğrenme yaklaşımının öğrencilerin akademik başarısına ve tutumuna etkisi*. Gazi University: Unpublished, MA thesis.

American Statistical Association (2005). *GAISE college report.* Retrieved 20 December 2011, from www.amstat.org/education/gaise/GAISECollege.html

Başbay, A. (2006). *Basamaklı öğretim programıyla desteklenmiş proje tabanlı öğrenmenin sürece, öğrenen ve öğretmen görüşlerine etkisi*. Hacettepe University: Unpublished, PhD dissertation.

Ben-Zvi, D. & Garfield, J. (2008). Introducing the emerging discipline of statistics education. *School Science and Mathematics*, 108, 355–361.

Bryce, G. R. (2005). Developing tomorrow's statistician. *Journal of Statistics Education*, 13(1). www.amstat.org/publications/jse/v13n1/bryce.html

Boaler, J. (1998). Open and closed mathematics: Student experiences and understandings. *Journal for Research in Mathematics Education,* 29, 41–62.

Bond, T. G. & Fox, C. M. (2001). *Applying the rasch model; fundamental measurement in the human sciences.* Mahwah New Jersey: Lawrence Erlbaum Associates.

Bond, T. & Fox, C. (2007). *Applying the Rasch model. Fundemental measurement in the humen sciences (2nd)*. Mahwah, NJ: LEA

Boondee V., Kidrakarn P. & Sa-Ngiamvibool W. (2011). A learning and teaching model using project-based learning (PBL) on the web to promote cooperative learning. *European Journal of Social Science,* 21(3), 498–506.

Buck Institute for Education (2010). *What is PBL?* http://www.bie.org/about/what_is_pbl

Callingham, R. & Watson, J. M. (2005). Measuring statistical literacy. *Journal of Applied Measurement*, 6(1), 29, 19–47.

Çepni, S. (2007). *Introduction to research and project studies. (Extended 3rd edition).* Trabzon: Celepler Press.

Cobb, G. W. & Moore, D. (1997). Mathematics, statistics, and teaching. *The American Mathematical Monthly,* 104, 801–823.

Coşkun, M. (2004). *Coğrafya eğitiminde proje tabanlı öğrenme yaklaşımı*. Gazi University: Unpublished, PhD Dissertation.

Çiftçi, S. (2006). *Sosyal bilgiler öğretiminde proje tabanlı öğrenmenin öğrencilerin akademik risk alma düzeylerine, problem çözme becerilerine, erişilerine kalıcılığa ve tutumlarına etkisi*. Selçuk University: Unpublished, PhD Dissertation.

Demirhan, C. (2002). *Program gelistirmede proje tabanlı ögrenme yaklasımı*. Hacettepe University: Unpublished, MA thesis.

Gal, I. (2002). Adult statistical literacy: Meanings, components, responsibilities. *International Statistical Review,* 70(1), 1–25.

Guidelines for Assessment and Instruction in Statistics Education [GAISE] (2005). *Guidelines for assessment and instruction in statistics education (GAISE) college report.* Alexandria, VA: American Statistical Association. www.amstat.org/education/gaise/GAISECollege.pdf

Harris, J. H., & Katz, L. G. (2001). *Young investigators: The project approach in the early years*. New York: Teachers College Press.

Hogg, R. V. (1991). Statistical education: Improvements are badly needed. *The American Statistician,* 45, 342–343

Holmes, P. (1980). *Teaching statistics 11–16.* Slough: Schools Council and Foulsham Educational

Jung, H., Jun, W. & Gruenwald L. (2001). *A Design and Implementation of Web-Based Project-Based Learning Support Systems*. www.cs.ou.edu/~database/documents/jjg01.pdf

Keeves, J.P. & Alagumalai, S. (1999). *New approaches to measurement*. In Masters, G. N. & J. P. Keeves (Eds), Advances in Measurement in Educational Research and Assessment. Pergamon, pp. 23–48.

Karasar, N. (2008). *Scientific research method. (18th edition),* Ankara: Nobel Publications.

Kirk, R. E. (2007). *Changing topics and trends in introductory statistics*. In D. S. Dunn, R. A. Smith, & B. C. Beins (Eds.), Best practices for teaching statistics and research methods in the behavioral sciences (pp. 25–44). Mahwah, NJ: Lawrence Erlbaum.

Korkmaz, H. & Kaptan, F. (2002). Fen egitiminde proje tabanlı ögrenme yaklasımının ıkögretim ögrencilerinin akademik başarı, akademik benlik kavramı ve çalısma sürelerine etkisi. *H.Ü. Egitim Fakültesi Dergisi*, 22, 91–97.

Landrum, R. E., & Smith, R. A. (2007). *Creating syllabi for statistics and research methods courses*. In D. S. Dunn, R. A. Smith, & B. C. Beins (Eds.), Best practices for teaching statistics and research methods in the behavioral sciences (pp. 45–57). Mahwah, NJ: Lawrence Erlbaum.

Linacre, J.M. (2011). Winsteps® (Version 3.72.3) [Computer Software]. Beaverton, Oregon: Winsteps.com. www.winsteps.com

Masters, G. N. (1982). A rasch model for partial credit scoring. *Psychometrica*, 47(2), 149–174.

Moursund, D. (1999). *Project based learning using ınformation technology*. ISTE Publications.

Mvududu, N. (2003). A cross-cultural study of the connection between students' attitudes toward statistics and the use of constructivist strategies in the course. *Journal of Statistics Education,* 11(3). Retrieved from. www.amstat.org/publications/jse/v11n3/mvududu.html

Özdener, N. & Özçoban, T. (2004). A project based learning model's effectiveness on computer courses and multiple ıntelligence theory. *Educational Science: Theory&Practice,* 4(1), 176.

Rasch, G. (1960). *Probabilistic models for some ıntelligence and attainment tests*. Copenhagen: Danmarks Paedagogiske Institute.

Rasch, G. (1980). *Probabilistic models for some intelligence and attainment tests (Expanded ed.).* Chicago MI: University of Chicago Press.

Roseth, C. J., Garfield, J. B., & Ben-Zvi, D. (2008). Collaboration in learning and teaching statistics. *Journal of Statistics Education*, 16(1).

Smith, G. (1998). Learning statistics by doing statistics. *Journal of Statistics Education,* 6(3). Retrieved from. http://www.amstat.org/publications/jse/v6n3/smith.html

Watson, J. M., & Callingham, R. (2003). Statistical literacy: A complex hierarchical construct. *Statistics Education Research Journal,* 2(2), 3–46.

Yesilcay, Y. (2000). Research project in statistics: Implications of a case study for the undergraduate statistics curriculum. *Journal of Statistics Education*, 8(2). www.amstat.org/publications/jse/secure/v8n2/yesilcay.cfm

Yıldız, F. (2008). *İlköğretim 7. sınıflarda "oran, orantı ve yüzdeler" ünitesinin proje tabanlı öğrenme ile öğrenilmesinin başarı ve tutuma etkisi*. Marmara University: Unpublished, MA thesis.