

The Effect of Learning with the Environmental Approach on the Third Graders' Ability of Mathematics Problem Solving

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This study aimed at investigating the effect of learning with the environmental approach on the third graders' ability of mathematics problem solving. The sample of the study consisted of 73 third grade students from two sections distributed randomly to an experimental group who learned during the "Statistics and Probability" unit by using the environmental approach; and a control group who learned using the traditional method of instruction. After the completion of the study, a post problem solving test was applied to the two groups, and data were analyzed using SPSS program to answer the research questions. Results of the study revealed that the learning with the environmental approach had, in general, a positive effect on improving students' ability in problem solving, specifically on students with medium level of achievement.

Keywords: environmental approach, third graders, problem solving, mathematics.

أثر التعلّم بالمدخل البيئي في قدرة طلبة الصف الثالث الأساسي على حل المسألة الرياضية

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هدفت هذه الدراسة إلى فحص أثر التعلّم بالمدخل البيئي في قدرة طلبة الصف الثالث الأساسي على حل المسألة الرياضية، وقد تكونت عينة الدراسة من ٧٣ طالباً من طلبة الصف الثالث، موزعين على شعبتين تم تقسيمهما عشوائياً إلى شعبة كمجموعة تجريبية درست وحدة (الإحصاء والاحتمالات) باستخدام المدخل البيئي، وشعبة كمجموعة ضابطة درست الوحدة نفسها بالطريقة التقليدية، وبعد الإنتهاء من تطبيق التجربة تم تطبيق اختبار حل المسألة الرياضية البعدي على المجموعتين، وتحليل نتائج الدراسة باستخدام برنامج الحزمة الإحصائية للإجابة عن أسئلة الدراسة. وقد أظهرت نتائج الدراسة أن التعلّم بالمدخل البيئي له تأثير إيجابي في قدرة الطلبة بشكل عام على حل المسألة الرياضية، وتحديداً لدى الطلبة ذوي مستوى التحصيل المتوسط.

الكلمات المفتاحية: المدخل البيئي، طلبة الصف الثالث، حل المسألة، رياضي.

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Science and technology are developing quickly, and there is a revolution of knowledge; so the human must think of the environment that surrounds him, which is full of experiences that make his life easier to understand (Othman, 1998), so there are new trends in education to use the environment in the learning and teaching process. Stern (2013) said: 'Often, on my way to work, I walk through broken glass, empty cans, paper, and other debris scattered throughout the school yard. I watch young people walk around eating junk food and dropping the wrappers wherever they happen to be, with seemingly no awareness of the consequences of their actions. It seems clear that we have a pressing need for environmental education' (P.1).

As Greenman (2007) said, "Just as one would not expect to see an unhappy teacher every morning, the same logic applies to the environment" (p. 84). He said that space and objects within the space speak to our emotions and influence our behavior.

The environmental education is an educational curriculum that increases environmental awareness through supplying student with the knowledge, the values, the attitudes and the skills that control his behavior, and enable him to interact with his social and natural environment, so as to investigate it as well as possible (Abu Aon, 2007). Students are typically weak in linking mathematical world and the real world (Crouch & Haines, 2004). This supports the view that students need much stronger experiences in building a real world, mathematical world connections. Mathematics learning through real word connections provides opportunities to the student to explore the key dimensions of environmental education. For example, students might research the amount of water commonly used by households, and then calculate the savings made by fixing a dripping tap, showering rather than bathing, or placing a brick in the cistern.

The environment is the real life laboratory the student can use to acquire and enhance daily real life skills. In addition, it provides the student with direct experiences through the continuous contact with different things in different situations. Using environmental approach in learning mathematics, especially in solving problems, is more motivational than teaching the skills of solving the problem without a

context. This way allows students to see the reason for learning mathematics, and hence become more deeply involved in learning it.

To raise environmental awareness and improve environmental quality, environmental education is necessary (Jianguo, 2004). In order to provide environmental education through the learning and teaching process, teacher quality must be improved and environmental awareness must be enhanced.

Teachers plan for children's meaningful learning experiences by deliberately arranging the indoor and outdoor learning environments (Seefeldt; Galper & Stevenson-Garcia, 2012, p. 15), through beginning with the essentials concepts such as: beauty, space, and aesthetics.

Jianguo (2004) mentioned some examples of teaching environmental education in mathematics class, such as: planting trees to keep the environment clean; conserving resources and develop Clean Energy; utilizing land resources wisely; constructing water conservation projects to save water; and controlling population growth by family planning.

An environmental approach is a teaching strategy that can be applied in learning and teaching process. Activities structured in ways allowing students to explore, explain, extend and evaluate their progress (National Research Council, 1999). When deciding to use the environmental approach in teaching and learning process, teachers' role can be summarized by:

1. Determining the objectives that he aims to achieve through the exit to the environment.
2. Giving students the opportunity to participate in preparation and organization of material, in addition to giving them roles and responsibilities.
3. Concentrating students' attention to the information they must collect, and the questions they must answer.
4. Developing an evaluation plan to verify that the objectives were achieved.

One of the strategies that experimental studies is the collection between learning in the class and the field journey, because it is the suitable way to increase the students' knowledge of the environmental issues (Disinger, 1986). Projecting is a positive attitude about mathematics and about students' ability to "do" mathemat-

ics. The teacher builds students' sense of efficacy and makes a belief that "doing mathematics" is not only the achievable goal, but also that students are capable of reaching that goal. Mathematics is not presented as something magical or mysterious (Protheroe, 2007).

To most educators, environmental math may appear strange. Scientific literacy requires skill in math, as does learning about ecology and environmental systems. There is a large amount of math to be discovered in the natural world, from patterns in Nature to Nature's engineering, and a symbiosis exists between basic scientific principles and their mathematical expressions in Nature (Adam, 2003).

Sarama and Clements (2006) suggested that if students spend long periods of time playing in an enriched environment they will be more open to exploration of mathematical ideas.

Professional organization's standards (such as: NCTM (1991, 1995, 2000), NAEYC (2009), and NCATE (2007)) include developmentally appropriate learning environments that are safe, nurturing and challenging (Smith, 2013, p. 7). NCTM (1991) professional standards state that: The teacher of mathematics should create a learning environment that fosters the development of each student's mathematical power by:

1. Providing and structuring the time necessary to explore sound mathematics and grapple with significant ideas and problems.
2. Using the physical space and materials in ways that facilitate students' learning of mathematics.
3. Providing a context that encourages the development of mathematical skill and proficiency.
4. Respecting and valuing students' ideas, ways of thinking, and mathematical dispositions.
5. Consistently expecting and encouraging students to: Work independently or collaboratively to make sense of mathematics; Take intellectual risks by raising questions and formulating conjectures; And display a sense of mathematical competence by validating and supporting ideas with mathematical argument.

NCTM (2000) principles and standards state that: Instructional programs from pre-

kindergarten through grade 12 should enable all students to: Create and use representations to organize, record and communicate mathematical ideas; Select, apply and translate among mathematical representations to solve problems. And use representations to model and interpret physical, social and mathematical phenomena.

National Centre for Excellence in the Teaching of Mathematics (NCETM) emphasizes that 'Learning mathematics outside the classroom is not enrichment; it is at the core of empowering the understanding of the subject.' It therefore needs to be planned into the curriculum from the beginning (Symons, 2009). NAEYC and NCTM (2002) pointed out that "play does not guarantee mathematic development, but it offers rich possibilities" (p. 11).

Learning beyond the classroom offers a host of opportunities one may struggle to find within the confines of the classroom's four walls (Creative Education, 2011), a few of them are:

1. Make learning more engaging: It is difficult to keep students in the classroom, especially when the weather is nice outside.
2. Make learning relevant: learning concepts can be real and relevant by putting them into a more realistic context.
3. Nurture creativity and imagination: Sometimes, students' minds were free to explore and you can often end up with some very creative results no matter what subject you are teaching them.
4. Develop learning through play and experimentation: Children learn more when they are happy and engaged in playing experiences.
5. Improve attendance: Students will be more motivated to turn up to school.
6. Reduce behavior problems: It can mean a general improvement in behavior.
7. Develop interest in the environment and wider surroundings: It can give you an opportunity to teach about the environment and the local area.
8. Expose children to new opportunities: Students can find out how things are made, and acquire experiences that would not be forgotten fast.

9. Keep healthy: A well directed learning experiences outside the class can offer a great opportunity for fresh air and exercise.
10. Enjoy almost limitless resources: Students will be able to develop free, meaningful learning opportunities that will stick to them.

The educational Literature mentioned that students remember 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they hear and see, and 90% of what they do and practice (Zaytoun, 1999, pp. 195-196).

Reviewing the antecedent researches and studies revealed the importance of using the environmental approach in students learning.

Brian (1999) examined the effect of contextualized math instruction on students' performance in problem-solving, the sample of the study consisted of 17 middle school remedial students and 49 average-achieving pre-algebra students. Results of the study showed that remedial and average students receiving contextualized-problem instruction were better than the group that received word-problem instruction.

Mohammadeen (2003) investigated the effect of using environmental approach in teaching social studies on first preparatory graders achievement. Results of the study showed that the achievement of the experimental group, who was taught using the environmental approach, were better than the control group who was taught using the traditional method of teaching.

Bashayreh (2010) investigated the effect of suggested program on environmental education based on systemic approach on faculty sciences students' achievement at Mutah University. The sample of the study consisted of 113 male and female students. Results of the study showed that the achievement of experimental group who was taught using the systemic approach, were better than the control group, who was taught using the traditional method of teaching.

(Knezek, Christensen, Tyler-Wood, & Periathiruvadi, 2013) examined the impact of hands-on authentic projects as an environmental approach study on middle school students' skills in four aspects: science, technology, engineer-

ing and mathematics, which are called (STEM) project content knowledge. The participants of the study were 246 middle school students in the United States. Employing a quasi-experimental design, the students who participated in the project activities were measured on their STEM knowledge and dispositions before and after the project participation. The findings indicate that middle school students who participated in standby power monitoring activities not only reported gains in their STEM content knowledge, but also showed an improvement in their creative tendencies and their perceptions about STEM subjects and careers.

Research problem

The current study aims to (1) testing the effect of learning using environmental approach on the third graders' ability of mathematics problem solving.

Research hypotheses

The current study aimed at testing the following hypotheses:

- 1- There is no statistically significant difference between the mean scores of students using environmental approach and the control group (which was taught traditionally) on the problem solving test.
- 2- There is no statistically significant difference between the mean scores of the experimental group, and the control group on the problem solving test, according to students' level of achievement.

Research importance

The importance of the research can be derived from the benefits of the research results, which may give teachers the best confidence of using the environmental approach in teaching mathematics in general and especially in problem solving skills, since these skills require seeing a reason for learning more than applying an abstract rule to reach the solution.

1. The current research has an importance related to the theoretical and practical benefits of its results, which may be reflected on students' ability to solve mathematics problems.
2. The use of environmental approach as a learning strategy will enhance students'

understanding and conceptualization of mathematical ideas, through learning mathematics by doing.

Limitations of the study

The instruments of the study were developed by the researcher, so the interpretation of the results depends on the validity and reliability of these instruments. Though the researcher verified these psychometric characteristics.

1. The study was applied to UNRWA schools in South Amman area, and this makes the generalization of results specific to the population of the study or to similar community.

Procedural definitions

2. Environmental Approach: is a teaching-learning strategy, which requires posing the student with a mathematics experiences, can be taught and learned outside classroom, through engaging the student in activities depend on his natural environment to explore the knowledge.
3. Third-Graders: students' age 8-9 years, who were in the third grade in the scholastic year 2012/2013.
4. Mathematics problem - solving: The process of working through the details of a mathematics problem to reach a solution. It can be measured by the score of the student on the problem-solving test, which was developed for the purposes of the current study.

METHOD

Population and sample

The population of the study consisted of all third graders at UNRWA schools of South Amman area, in the school year 2012/2013. The sample of the study consisted of two sections from the elementary Amman Camp boys' school, which was specifically and on purpose selected from South Amman Area schools. One section was selected randomly as an experimental group, which was taught using the environmental approach, and the other section was selected as a control group, which was taught by the traditional method.

Students participated in the experiment were classified into three levels of achievement based on their marks of the first semester final exam, depending on the following criteria:

1. (80% and above): high level of achievement.
2. (60% - less than 80%): average level of achievement.
3. (Less than 60%): low level of achievement.

Table 1 shows the number of students participating in the experimental group and the control group according to students' level of achievement.

Table 1
The distribution of the study sample on the study groups according to students' level of achievement

Group	Students' Level of			Total
	High	Average	Low	
Experimental	9	18	7	34
Control	11	21	7	39

Instruments of the study

Lesson Plans using the environmental approach

Lesson plans were designed and developed by the researcher and by the help of the experimental group teacher, to clear the application conditions during the learning process. A detailed explanation was introduced to the teacher of how to plan to use the environmental approach in the lesson activities. For example, the teacher takes the students out of the classroom, and plans for a football game in the playground between two teams of the class, to explain the definitions of the winning opportunities of the match.

The activities were given to the experimental group during the study period, (nearly, a daily activity), and students were asked to work on these tasks, sometimes individually and sometimes in groups. The control group was taught the same unit traditionally, using the textbook only.

The Problem Solving Test

Depending on content analysis, a problem solving test was designed and conducted on test students' mathematical knowledge taught in unit "Statistics and Probability", from the third grade mathematics curriculum in the scholastic year 2012/2013. Table 2 reveals the specification table of the problem solving test.

Table 2
The specification table of the problem solving test

The content	Compre- hension	Applica- tion	Upper skills	Total
Representing Data 1	2	1	2	5
Representing Data 2	1	2	2	5
Random Ex- periment	1	2	2	5
total	4	5	6	15

The test was developed to consist of (15) multiple choice items, every item has three alternatives with one of these alternatives correct. After the completion of the workout of the problem solving test, it was given to a panel of (5) judges, who are professional in methods of teaching mathematics and measurement and evaluation, to give notes about the validity of the items and the overall test. Their remarks were taken into consideration, and the corrections were made. To establish the reliability of the problem solving test, it was applied to (33) students from the population of the study. Those were not included in the sample. And by using a Split-Half method, a Spearman-Brown Formula, it was found out that the reliability coefficient for the overall test was (0.84) which is an acceptable value for research purposes.

Procedures

1. A meeting with the experimental-group teacher, who participated in the application of the study, was administered, and the teacher was trained on how to use the environmental approach in teaching mathematics during the application period of the research.
2. The same teacher taught the two groups to control the teacher's factor.
3. The experimental group learned during their study of the unit "Statistics and Probability" by using the environmental approach in the regular mathematics lessons, in addition to the textbook. Meanwhile, the control group was taught by the traditional method using the textbook only.
4. Students' marks on the problem solving items were derived from their marks of

the first semester final exam, to be as pre- test marks of the experiment.

5. After the completion of the study application, a problem solving test was administered to the two groups.
6. The results were analyzed using SPSS program to test the hypotheses of the study.

Study variables

The research followed the quasi- experimental method, and had the following variables:

- 1- Independent variable: The teaching method, which has two levels:
 - Teaching using the environmental approach.
 - Teaching traditionally.
- 2- Dependent variable:
 - Mathematics problem solving.
- 3- Moderator variable:
 - Students' level of achievement.

Statistical analysis

To examine the equivalence of the two groups before the experiment, and to test the two hypotheses of the study, Mann-Whitney Test was used, since the sample size in the achievement levels is so small, so a non-parametric procedure was used with such small sample sizes.

RESULTS and DISCUSSION

Students' mathematics problem solving results on the first semester final exam of the third grade were administered as a pre-test, which were the latest marks of the student before participating in the study.

To examine the equivalence of the two groups before the experiment, students' marks on the problem solving were derived from their marks of the first semester final exam, and Mann-Whitney Test was used. Table 3 shows these results.

There were no statistically significant differences between the marks of the two groups in the problem solving before the experiment, since the significant levels were greater than (0.05).

Table 4 reveals that there was a statistically significant difference between the mean of the

Table 3
Mann-Whitney test results to compare between the two groups in the pre-test

Achievement level	Group	N	Mean rank	Sum of ranks	Z value	Sig. level
High	Experimental	9	13.06	117.50	1.802	0.080
	Control	11	8.41	92.50		
Medium	Experimental	18	19.00	342.00	0.537	0.626
	Control	21	20.86	438.00		
Low	Experimental	7	8.64	60.50	1.044	0.318
	Control	7	6.36	44.50		
Total	Experimental	34	37.46	1273.50	0.174	0.862
	Control	39	36.60	1427.50		

Table 4
Mann-Whitney test results to compare between the two groups on the problem-solving test

Group	N	Mean rank	Sum of ranks	Z value	Sig. level
Experimental	34	42.99	1461.50	2.263	0.024
Control	39	31.78	1239.50		

two groups in the problem solving which is less than (0.05). Table 4 shows that the differences between the two groups were in favor to the experimental group, in comparison with the control group. This means that the problem solving skill of the experimental group was better than that of the control group.

This result seems logical since using the environmental approach gives the opportunity for the student to do and practice during their learning, which is reflected on their ability to understand because they can make connections between the ideas that are required to solve problems.

The use of the environmental approach in the learning also provides the learner the opportunity to experience contact with the environment, which contributes building a stronger relationship between the student and his surrounding environment. This makes recognizing the problems and the thinking of solving them easier.

When using the environmental approach in the learning process, the student can hold the effect of his learning for a long period of time; because he can make connections between the ideas, which enable him to benefit from this

effect in other learning situations. This makes the student more familiar with dealing with problems that need to be solved. It is easier for the teacher to assess students' understanding and misunderstanding when using the environmental approach in the teaching process; because the teacher can individuate every case of the students, and put the suitable solution for the difficulty of learning for every student

alone, and also he can use the alternative assessment easily in this situationsince every work of the students will happen under his control.

This result of the study coincides with the study results of (Brian, 1999; Mohammadeen, 2003; Bashayreh, 2010; & Knezek et al., 2013) in the positive effect of using the environmental approach in improving students' knowledge.

Table 5 reveals that there were no statistically significant differences between the marks of the two high level achievement groups in the problem solving, since the significant level is (0.112), which is greater than (0.05). This means that the problem solving skill of the experimental group and the control group is equivalent.

Table 5
Mann-Whitney test results to compare between the two groups in the post-test according to students' level of achievement

Achievement level	Group	N	Mean rank	Sum of ranks	Z value	Sig. level
High	Experimental	9	12.89	116.00	1.696	0.112
	Control	11	8.55	94.00		
Medium	Experimental	18	27.89	502.00	4.055	0.000
	Control	21	13.24	278.00		
Low	Experimental	7	8.36	58.50	0.781	0.456
	Control	7	6.64	46.50		

* Significant at the significant level $\alpha = 0.05$

There was a statistically significant difference between the marks of the two medium level achievement groups in the problem solving ($p < .01$).

There was no statistically significant difference between the marks of the two low level achievement groups in the problem solving ($p = .456$). This means that the problem solving skill of the experimental group and the control group is equivalent (Table 5).

This result can be clarified from the point of view that students on these classifications (high and low level of achievement) may have a nearly constant level of achievement, depending on their foregoing knowledge, which is accumulative, so the high level achievement student still seeks to become in a better situation, regardless the teaching process teacher will use, and also the low level achievement student may have many difficulties that counter his improvement in this restricted period of time during the procedure. In other words, students of high and low level of achievement may need more time in applying a new procedure of teaching to obtain an obvious improvement, and they may need more special and restricted situations and exercises suite to their special needs, since the teaching of most teachers is directed to the students of medium level of achievement, so this category of students in the experimental group with medium level of achievement in this study, benefited from the environmental approach in the learning process, more than students in the experimental group with high or low level of achievement.

Conclusion and recommendations

As a learning strategy, the environmental approach can enhance student's knowledge in mathematics, it can foster the concepts, which can be easily related to make generalizations and practice skills, and this is reflected on student's ability to solve problems. The use of the environmental approach makes the student the core of the learning process, because he is the person that discusses, interprets and analyzes to reach the intended goal. The use of this kind of learning helps the student to acquire the information subjectively, from their original resources, which eliminates the process of rote of information without understanding them.

It is recommended to use the environmental approach to enhance students' learning of mathematics. For future work in this area, researchers might conduct other studies to examine the effect of the environmental approach on samples of other grades and other communities.

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Appendix

الدرس: طرق جمع البيانات

الصف: الثالث

اليوم والتاريخ:

الزمن: حصة واحدة

التغذية الراجعة	التقويم	الأساليب والأنشطة	الخبرات السابقة	تحليل المحتوى	الأهداف
	- عرّف الطريقة المسحية في جمع البيانات.	- مراجعة الطلبة في مفهوم البيانات. - تقديم مفهوم عملية المسح من خلال طرح سؤال حول اللعبة التي يفضلها كل طالب من طلبة الصف. وتوضيح ذلك من خلال ربط المفهوم بجمع المعلومات عن السؤال المطروح من جميع الأفراد أو الأشياء المراد الحصول على معلومات منها. - مراجعة الطلبة في طريقة تنظيم البيانات في جدول إشارات.	- مفهوم البيانات	- مفهوم عملية المسح	١- أن يتعرف الطالب إلى مفهوم عملية المسح ٢- أن يستخدم الطالب الطريقة المسحية في جمع البيانات.
	- متابعة الجدول التي أنشأها الطلبة لتصنيفات كتب المكتبة	- اصطحاب الطلبة في زيارة مكتبة المدرسة وتقسيمهم إلى مجموعات متعاونة لخصر جميع أنواع تصنيفات الكتب فيها: (دينية، أدبية، علمية، ترفيهية، ...) بالتعاون مع القائمين على أنشأها المكتبة. وعمل جدول بتصنيفات الكتب. والحصول على عدد الكتب في كل تصنيف. - واجب بيتي: تكليف الطلبة خصر عدد الذكور لدى (١٠) عائلات في المنطقة التي يسكنون بها. وتنظيم البيانات في جدول.	- طريقة تنظيم البيانات في جدول إشارات	- مهارة جمع البيانات بالطريقة المسحية.	