Group Learning Effects and Gender Differences in Mathematical Performance

Anowar Hossain[1], Rohani Ahmad Tarmizi[1], Zahara Aziz[2] and Norazah Nordin[2]
[1] Institute for Mathematical Research, Universiti Putra Malaysia;
[2] Faculty of Education, Universiti Kebangsaan Malaysia.

Abstract

This study investigated the effects of group learning and gender differences in mathematical performance in co-educational schools. A total of 88 students in grade 9 in Natore, Bangladesh participated in the study. The research design employed for this study was a quasi-experimental equivalent control group with pre- and post-test design. The experimental group (n=44) underwent the group learning mode whilst in the control group (n=44), the conventional mode of learning was applied for 15 weeks. The independent-samples t-test and MANOVA with repeated measures were used to analyze the data. The results showed a significant effect of group learning, and a significant gender difference in mathematical performance. The findings revealed that the experimental group students outperformed the control group students, and both male and female students in the experimental group improved their mathematical performance with the performance of female students being better than that of male students after group learning integration. Hence, it can be concluded that group learning enhanced mathematics performance for female students while the male counterparts did not benefit as much as the female group. Therefore, group learning may be an approach that can be professionally incorporated to develop female students' performance in Bangladesh.

Key words: *co-educational schools; 9th grade student; mathematics performance.*

Introduction

Group learning in mathematics teaching and learning is increasingly being used in today's science and technological world and the topic of gender differences in performance has attracted the attention of educators over the past few years. Many

studies investigated the effects of group learning in various disciplines such as English, mathematics, physics, chemistry, history, geography and other areas of education while a few of them examined gender differences in performance as a result of group learning. Researchers like Carroll (2002) and Sax (2005) established the existence of gender differences in learning and mentioned that in co-educational classrooms female students performed better in mathematics with more concrete objects and were manipulative, while male students performed higher in calculations taught using the chalkboard. The trend in international mathematics and science study (TIMSS) 2003 assesses mathematics achievement of 4th and 8th grade student and shows gender differences in mathematics achievement. According to Mullis et al. (2004), gender differences in favor of female students were found in 4th grade in 3 participating countries (Armenia, Moldova and Philippines) with small female advantages ranging from 11 to 12 points. Although small in magnitude, these gender differences are the first instance of female advantages in mathematics achievement in 4th grade in the entire international association for the evaluation of education achievement (IEA) history. Gender differences in favor of boys occurred in 6 participating countries. The male advantage (ranging from 6 to 11 points) was quite similar in magnitude to the female advantages. In the 8th grade, two phenomena appeared in gender differences in mathematics achievement. Firstly, for the first time in the entire IEA history, gender differences in favor of female students are observed. Among all participating countries, those showing gender differences in favor of female students were the same in number as countries showing gender differences in favor of male students. The second phenomenon is that among three countries (Bahrain, Jordan and Tunisia) with the largest gender differences, two (Bahrain and Jordan) showed gender differences in favor of female students. Such gender differences indicate that when female students in these countries are provided with equal opportunities to learn, they tend to achieve far better results in mathematics than their male counterparts. Given the discrepancy between demonstrated ability and interest in mathematics and performance on standardized tests among females, researchers have investigated plausible causes for these differences. These are possibly influenced by the demographic profile of male and female students, differences in experiences in the same classrooms, and subsequent interest in mathematics careers. Gender differences in mathematics achievement in group learning were studied by Kolawole (2007). Kolawole concluded that male students perform better on mathematics than female students do while Joiner (1999) reported that female students perform best in group learning setting whereas male students perform best in the conventional teaching environment.

To compare the performance of male and female students in mathematics in terms of group learning effects, a research was conducted in co-educational secondary schools in Bangladesh. The Secondary school certificate (SSC) is the first major public examination significant for pupils and teachers all over Bangladesh. The result of SSC has a great significance for the success of both individual and communal

life. The percentage of students passing the SSC at many rural secondary schools as seen in years 2000, 2001, 2003, 2004 and 2005 were below twenty percent (Board of Intermediate and Secondary Education, 2005). These results reflect the poor quality of secondary education particularly when most of the students failed in mathematics. As a group, children from these rural schools were from disadvantaged and low-income families and they performed substantially worse in mathematics than their counterparts from higher-income families. Samad (2005) reported that based on the samples of Bangladesh's secondary students' mathematics performance there is a crucial need for improving and reinforcing students' mathematical knowledge through various modes of instruction. What it required is some creativity and endeavor on the part of the teacher as that may be the area where education is suffering. Therefore, in order to minimize the failing rate in SSC examination, teachers should find ways to enhance students' learning. The poor performance among students may be due to lack or insufficient considerations of meaningful, explicit, situational, social and student-specific learning taking place in the classrooms. Bottge (2001) identified these (meaningful, explicit, situational, social and student-specific contexts) as the key to learning mathematics especially for the low ability students. Group learning is well documented as a meaningful, explicit, situational, social and student-specific learning condition in which high-ability and low-ability students work together to solve a problem. It is a basic ideology of group learning that group members are connected together in such a way so as to perceive that they cannot succeed unless they all work, they will actively assist each other to ensure that the task is completed and the group's goal obtained (Deutsch, 1949). They achieve this by providing help and assistance with the task, sharing resources, and encouraging each other's efforts. As a consequence, group members who work in cooperative groups outperform students who work by themselves or in competition with each other (Johnson, & Johnson, 2004). According to Akinbobola (2006), group learning is a mode of learning in which students of different levels of ability work together in small groups to achieve a purpose. Johnson and Johnson (1994) defined group learning as an instructional method in which students are grouped in small learning teams and work in cooperation with each other to solve a common problem or to perform a task presented by the teacher. Group learning is a method of learning which is both flexible and effective i.e., students learn to think, do and develop feelings towards their tasks. There are many strategies in group learning such as Learning Together model, student teams-achievement division (STAD), teams-games-tournaments (TGT), team accelerated instruction (TAI), cooperative integrated reading and composition (CIRC), Jigsaw, group investigation (GI) etc., but the researcher in this study focused on Johnson and Johnson's (1994) Learning Together model because their approach of developing group learning based on five basic principles is widely applicable in any group learning situation.

The Learning Together model consists of five basic elements such as positive interdependence, individual accountability, face to face promotional interaction,

interpersonal and small-group skills, and group processing. According to Johnson and Johnson (1994), for the successful implementation of group learning in the mathematics classrooms the following five elements are essential:

1. Positive interdependence: All members in a group cannot succeed unless everyone succeeds.
2. Individual accountability: Everyone is responsible toward contribution of sharing his/ her part in the group.
3. Face-to-face promotional interaction: Group members should play their role by praising, supporting, encouraging each other to reach a common goal.
4. Interpersonal and small-group skills: Group members should be aware of decision making skills, group management, and trust building in case of any conflict for the benefit of greater success.
5. Group processing: Group members should know the supportive action. Every group member should acknowledge each other's effort in the group work to achieve a shared group goal.

Vaughan (2002) supported Johnson and Johnson's model that Learning Together, a group learning strategy, is crucial to the cultivation of individual and academic success. Rimmerman (2004) referred to Johnson and Johnson's work as the modern era of group learning. Their model of group learning is known as Learning Together and can be applied to any discipline and grade level. Students learn content through group learning strategies where they interact with each other, exchange information and knowledge, and work as a team to achieve the learning goals. Johnson and Johnson (1994) supported the idea that small groups in group learning promoted students' mathematics achievement in grade nine and ten. Other studies had similar findings in different mathematics grades reported by Web (1984), Davidson (1990), Kagan (1994) and Slavin (1995). These results indicated that those students who worked with group learning had higher mathematics performance than the conventional group in the same setting.

Effandi (2003) and Zakaria et al. (2010) also found, based on the results of their studies conducted in Malaysia, that group learning enhanced mathematical performance among students and promoted positive attitudes toward mathematics more than the traditional way of teaching. The effectiveness of group learning has shown rapid growth in mathematical performance and attitudes toward mathematics in various studies (Barbato, 2000; Faizah, 1999; Kolawole, 2007; Lee, 1999; Martin, 2005; Ozsoy, & Yildiz, 2004; Yee, 1995; Vaughan, 2002). Thus this study aimed at identifying the effects of group learning and to examine the gender differences in mathematical performance in co-educational schools in Natore, Bangladesh. Specifically, the objectives of this study were:

1. To identify the effects of group learning in students' mathematical performance in co-educational schools.
2. To examine gender differences in mathematical performance in the experimental group.

Methods

Research Design

To identify the effects of group learning in comparison to conventional teaching, the study employed a quasi-experimental "Equivalent Control Group with Pre-Post test" (Berg, & Latin, 1994; Campbell, & Stanley, 1963; McMillan, & Schumacher, 1984) design. The equivalent control group refers to the elements of which no characteristics between two groups had a different expected value. Prior to the experimental treatment, two groups should be similar in every respect. An initial observation (e.g., a pre-test) can confirm that the two groups are at least similar in terms of the dependent variables under investigation. If one group receives the experimental treatment, group differences can be found with respect to the dependent variable, and then the study comes to a conclusion that the post-treatment differences are the result of that treatment (Leedy, & Ormrod, 2001). In this study, a total of 88 full-time students from two co-educational schools in Natore, Bangladesh constituted the sample. The preliminary pre-test was conducted on students' mathematical performance in both the control (n=44) and experimental (n=44) groups, and the results illustrated that both groups were equivalent in terms of the students' mathematical performance prior to the treatment, and they started out equal before the treatment strategy was given (Table 3 & 6).

After the pre-test, the experimental group underwent the group learning mode whilst the control group underwent the conventional mode of learning. The group learning mode was based on the Learning Together model of Johnson and Johnson (1994). The group learning and the conventional teaching were guided by the same teachers in one academic session for the duration of 15 weeks of classroom teaching. Post-test of students' mathematical performance was administered to both experimental and control groups. Table 1 shows a graphic form of quasi-experimental design of this study. A represents the experimental group while B represents the control group. O_1 represents the pre-test while the post-test is represented as O_2 for the experimental and control groups respectively. The group learning treatment is represented as X.

Table1. *Pre and post-test control group design*

Group	Pre-test	Treatment	Post-test
A (n = 44)	O_1	X	O_2
B (n = 44)	O_1	-	O_2

A: Experimental Group; **B**: Control Group; **O_1**: Pre-test; **O_2** Post-test;
X : Treatment (Group learning); – : No treatment (Conventional teaching)

Participants

For the formal study, two co-educational secondary schools in Natore, where both male and female students are taught in the same classes were selected by the District

Education Officer of the Govt. of the People's Republic of Bangladesh. The schools located in the rural areas of Natore were Kachugari Fakir Bari High School and Poal Shura Patpara High School. The research sample in this study were 9th grade students. A total of 88 full-time students (44 students for experimental group and the other 44 students for control group) from two co-educational schools participated in this study. The sample distributed based on group and gender is shown in Table 2.

Table 2. *Sample distribution by group and gender*

Group		Male Student	Female Student	Total
Experimental Group	No.	20	24	44
	%	45.45	54.55	100
Control Group	No.	23	21	44
	%	52.27	47.73	100

Data in Table 2 shows that out of the total sample of 88 participants, both the experimental and control group consisted of 44 participants. In terms of gender, the participants in the experimental group comprised 44 students of which 20 (45.45%) male and 24 (54.55%) female students. As for the control group, there were 23 (52.27%) male and 21 (47.73%) female students.

Each experimental school comprised two sections in which Section-I was represented as the experimental group while Section-II represented the control group in Grade-IX mathematics classrooms as per the directives of the Headmasters of experimental schools. Both groups were told that they had been selected as subjects of an experiment to examine the effects of group learning, and to make a comparison of mathematical performance between male and female students. Two teachers (one from each school) who had more than twelve years of teaching experience in mathematics were selected. Each teacher taught two classes in each school.

Instruments

The instruments used in this study were the students' mathematical performance test (MPT) and Secondary Algebra and Secondary Geometry, compulsory mathematics text books which are used in the secondary school context under the auspices of the Government of the People's Republic of Bangladesh. The researcher himself designed the students' mathematical performance test instrument from the chapter of Algebraic expression consisting of unit 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7 and 3.8; geometric theorem of unit 2, 3 and 11; trigonometric ratio of unit 12.1 and 12.2 in accordance with the suggestions of the Secondary Teachers' Association and mathematics teachers who were teaching algebra and geometry in the rural secondary schools. Mathematical performance, for this study, is the outcome which was acquired by the students after the learning process. In this study, mathematics learning has been measured through the MPT instrument. Mathematical performance, the measurement of mathematics learning, resulted in significantly higher post-test scores on MPT than the students had previously scored on the pre-test.

The mathematical performance test (MPT) instrument is divided into two parts (A and B). Part A is concerned with demographic data of the respondents, namely gender and roll (serial) number while Part B tested students' mathematical performance. A pilot study was conducted prior to the actual study in order to test the reliability of the instrument. The instrument was pilot tested with a sample comprising 40 secondary students from Krishi Karigari ML High School in Natore. Krishi Karigari ML High School was selected by the District Education Officer of the Govt. of the People's Republic of Bangladesh for the pilot study in which Section-I and Section-II were represented as the experimental and control groups respectively. Each small group heterogeneous by gender consisted of four students with low and high-ability in the experimental group. Both the experimental and control groups were guided by the same teacher who had more than twelve years of teaching experience in mathematics. Both the experimental and control groups had undergone mathematics instructions for fifty five minutes each for four weeks. All the students in the pilot test were administered the pre-test and the post-test. This ensures the reliability of the instrument in Bangladesh context.

The Content validity of mathematical performance test (MPT) instrument was determined through the consensus of the experts in the relevant field. The instruments in this study were content validated by the District Education Officer of the Government of the People's Republic of Bangladesh; a Professor of the Institute of Education and Research, University of Dhaka; an Associate Professor of mathematics and Ex-Controller of Examination, Board of Intermediate and Secondary Education, Rajshahi; a professor and Ex-School Inspector of Board of Intermediate and Secondary Education, Rajshahi; and finally approved by an expert in mathematics education, Faculty of Education, Universiti Kebangsaan Malaysia.

Experimental Group

At the beginning of the treatment, pre-test of the MPT was administered in the experimental group and the students were informed that they would be exposed to group learning from February 2nd to May 15th, 2008. The experimental teachers who were assigned to implement group learning were properly trained. Prior to the treatment, students in the experimental group were well-briefed about group learning and detailed descriptions of group learning were distributed to all of the students in the experimental group. The description of group learning included matters such as an introduction to group learning, Learning Together model, process of applying this model to improve mathematical performance being cooperative students within the group learning environment, setting up cooperative groups and social skills training. The teachers discussed with the students the importance of using Learning Together model in the mathematics classrooms. The teachers spent time to introduce the concepts with regard to how students can become cooperative within the group learning environment, why they would learn group learning, and how they could apply this group learning in improving their mathematical performance.

After discussing the Learning Together model, students were assigned into groups based on their ability. They were divided into high and low-abilities based on their pre-test scores in the mathematical performance test (MPT). The median of the scores was the criterion of assigning students to the groups. Scores above the median were labeled as high-ability and below the median were labeled as low-ability. Each group was formed by randomly choosing two high-ability students and two low-ability students. Students were encouraged to share their knowledge among one another and solve the assigned mathematical problem in groups. The students were told to devise their own method regarding the division of tasks amongst members. After group learning treatment, students were asked to complete the MPT (post-test) in the last mathematics session of the experiment.

Control Group

For the control group, the pre-test of MPT was conducted first, and then the teachers in the control group continued teaching as they usually did, and the students were not exposed to group learning. After the teachers' explanation, the students practiced the mathematical items individually using their textbooks and teachers' notes. When the students faced difficulties in solving mathematical problems, they asked for the teachers' help. Teachers intervened when they needed to help some students to solve their problem. Sometimes, the teachers explained and informed the students about the procedures for solving the problems. At the end of each session, the teachers reviewed the day's lesson with the whole class. On the 15th of May in 2008, the students were asked to complete the post-test of MPT.

Data Collection and Data Analysis

This study took place from the 2nd of February to the 15th of May in 2008. The students in both the experimental and control groups completed the pre-test of MPT on 2nd of February 2008. All of these were coded and recorded first on paper and later on computer in the SPSS file. On the 15th of May 2008, the post-test of MPT was done and recorded in the SPSS file. The researcher managed to get back 100% of the distributed instruments.

Descriptive and inferential statistics were used to analyze the collected data. Descriptive statistics such as frequency, mean and standard deviation were used to summarize the demographic information of the research subjects. Inferential statistics were conducted to test the hypotheses. The specific inferential statistics used were independent-samples t-test and MANOVA with repeated measures.

Results

This study was conducted to find out the effects of group learning and gender differences in students' mathematical performance in co-educational schools in Natore, Bangladesh. The results of the study are reported based on the objectives stated earlier as follows:

To identify the effects of group learning in students' mathematical performance in co-educational schools

To identify the effects of group learning in comparing the mathematical performance between experimental and control groups, pre and post-test mean scores were analyzed using independent-samples t-test.

As depicted in Table 3, the pre-test mean score for experimental group was 25.28 (SD=4.11) and that of the control group was 24.88 (SD=3.65). The results reveal that the difference between pre-test mean scores of experimental and control groups [t (86) = 0.47, p > 0.05] was not significant at 0.05 alpha level. This suggests that performance of both groups was equivalent at the beginning of this study.

Table 3. *Independent-samples t-test comparing means of mathematical performance pre-test scores between experimental and control groups*

Group	n	Mean	SD	t	df	Sig(2-tailed)
Experimental Group	44	25.28	4.11	0.47	86	0.63
Control Group	44	24.88	3.65			

Results in Table 4 show that the mean score on the post-test of the students in the experimental group was 47.15 (SD = 2.56), and for the students in the control group it was 34.65 (SD = 2.05). It was found that the students who participated in group learning scored higher than the students who followed the conventional method of teaching. The t-test showed that this difference is significant [t (86) = 25.22, p < 0.05] in favor of the experimental group which revealed that the performance of experimental students was significantly better than that of conventional students. Hence, these results suggest that the group learning integration in co-educational schools showed positive impact in enhancing students' mathematical performance.

Table 4. *Independent-samples t-test comparing means of mathematical performance post-test scores between experimental and control groups*

Group	n	Mean	SD	t	df	Sig(2-tailed)
Experimental Group	44	47.15	2.56	25.22	86	0.00
Control Group	44	34.65	2.05			

The results relating to mathematical performance indicate that at the pre-treatment stage both the experimental and control groups were equivalent in their performance with a low overall mathematical performance pre-test mean scores. The results show that there was an increase in the post-test mean scores of MPT in the experimental group after the treatment. As such, it can be concluded that the treatment strategy of group learning appeared to have substantial and positive effects on students' mathematical performance. As for the control group, there was minimum improvement in their overall mathematical performance post-test mean scores.

The effects of group learning on mathematical performance based on repeated measures of test performance over the 15 weeks of intervention period

The multivariate analysis of variance (MANOVA) with repeated measures was used to examine the main effect of group learning and different test-time as well as the interaction between them. The multivariate analysis of variance illustrated the main and interaction effect on the variable identified at the 0.05 level of significance. Table 5 presents the overall multivariate test results.

Table 5. *MANOVA with repeated measure (main and interaction effect of group learning and test time)*

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Observed Power
Test time	Wilks' Lambda	0.070	1148.971	1.000	86.000	.000	0.930	1.000
Test time* Method	Wilks' Lambda	0.339	168.019	1.000	86.000	.000	0.661	1.000

The multivariate tests indicate a significant main effect of time, Wilks' Lambda=0.070, $F(1,86)=1148.971$, $p=0.000$, $\eta 2=0.930$; a significant interaction effect of group learning by time, Wilks' Lambda= 0.339, $F(1,86)=168.019$, $p=0.000$, $\eta 2=0.661$. The observed power for all factors was 1.000. There was a difference in the students' mathematics performance before and after exposure to group learning as measured and indicated by the pre-test and post-test score of the students' mathematical performance test, the MANOVA with repeated measures indicated that there was interaction between group learning and test time. The multivariate tests show a significant main effect of time in affecting the students' mathematical performance post-test score and the interaction effects of group learning by time were also significant at 0.05 level. Thus, these findings imply that group learning intervention had significant impact in improving students' mathematics performance.

To examine the gender differences in mathematical performance in the experimental group

To examine the gender differences in mathematical performance in the experimental group, pre- and post-test mean scores were also analyzed using independent-samples t-test.

Table 6 shows the pre-test mean scores for experimental group male students was 25.87 (SD=4.23) and that of female students was 24.79 (SD=4.03). The results reveal that the difference between pre-test mean scores of male and female students [t(42)=0.86, p>0.05] was not significant at 0.05 alpha level. This suggests that performance of both male and female students in the experimental group was equivalent at the start of this study.

Table 6. *Independent-samples t-test comparing means of mathematical performance pre-test scores between male and female students*

Gender	n	Mean	SD	t	df	Sig(2-tailed)
Male	20	25.87	4.23	0.86	42	0.39
Female	24	24.79	4.03			

Table 7 indicates that the difference of post-test means on mathematical performance scores of male students (46.00 with a standard deviation of 2.48) and that of the female students (48.12 with a standard deviation of 2.24) was found to be significant [t (42) = -2.97, p < 0.05] in favor of the female students. The results showed that the female students in the experimental group had significantly higher MPT scores than their male counterparts in the experimental group.

Table 7. *Independent-samples t-test comparing means of mathematical performance post-test scores between male and female students*

Gender	n	Mean	SD	t	df	Sig(2-tailed)
Male	20	46.00	2.48	-2.97	42	0.00
Female	24	48.12	2.24			

Results on gender differences indicate that, prior to the treatment, both male and female students were equal in their performance in the experimental group. The comparison of pre-test mean scores of both male and female students reflected that there were no significant differences between them, and both male and female participants were equivalent with respect to mathematical performance before treatment. After the treatment, female students performed significantly better than male students. The results reveal that both male and female students showed significant improvement in their performance with female students achieving significantly better results than male students in the experimental group.

Discussion

This research study aimed at identifying the effects of group learning on students' performance in mathematics along with an examination of any gender-related differences in terms of mathematical performance in co-educational schools. Findings from this study indicated a significant effect of group learning in mathematical performance and a significant difference in performance of male and female students. It was found that a total of 98.69 % experimental students' attitudes toward group learning were positive. The findings indicated that most of the students expressed enjoyment working in groups. Students preferred to learn mathematics by sharing knowledge during group work and it made them feel happy. Hence, there was a significant effect of group learning on mathematical performance, and a significant effect on gender differences in mathematical performance.

The results revealed that the students who worked in groups improved their mathematical performance in comparison to the conventional students. The post-

test results indicated that group learning provided students with the opportunity to determine their algebraic expression, geometric theorem and trigonometric ration confidently. Group learning enables students to acquire the appropriate procedural problem solving techniques; therefore, they were able to solve their problem easier than the students in the control group. Students in the experimental group worked cooperatively to obtain shared group goals. The finding of this study showed that group learning enhanced students' mathematical performance as shown by the studies of Johnson and Johnson (1994), Web (1984), Kagan (1994), Davidson (1990) and Slavin (1995). The findings of this study are also consistent with the studies by Effandi (2003), Martin (2005), Barbato (2000), Faizah (1999), Lee (1999), Zakaria et al. (2010), Ozsoy and Yildiz (2004), Yee (1995) and Vaughan (2002). Zakaria et al. (2010) in their study concluded that student-centered approaches such as group leaning improved mathematics achievement, and teachers in schools who teach mathematics need to be aware of the benefits and importance of group learning thus changing the practice of teacher-centered teaching to student-centered teaching. This finding is also consistent with the research by Joiner (1999) and Kolawole (2007) while with regards to gender differences it is in contrast to the findings by Kolawole (2007) who found male students performed better than female students in group learning. Findings of our study, however, are in contrast to the findings by Mwerinde and Ebert (1995) who found that their conventional group did better than the experimental group. Baseline assessments showed that the experimental group is more mathematically experienced but the conventional group achieved higher grades. However, the composition of cooperative groups in the experimental group was not properly structured; hence, this may yield contradictory results with students from the control group scoring higher grades. In addition, Webb (1984) found male and female students showed equal achievement and similar interaction in cooperative groups with equal numbers of male and female students. Webb concluded that female students directed most of their interaction to male students in majority-female groups and showed lower mathematics achievement than male students while in majority-male groups, male students tended to ignore female students and showed somewhat higher mathematics achievement than female students.

Conclusions

This study showed that group learning had significant effects on students' mathematical performance, and a significant difference in performance of male and female students. Prior to the treatment, it was found that both the experimental and control group students were equivalent with low overall scores of MPT. After the treatment, experimental students showed significant improvement in their overall post-test scores of MPT in comparison to conventional students. The results suggest that the increase of the post-test scores for experimental students was due to the significant effects of group learning treatment. As such, this study concluded that

group learning is more effective in teaching mathematics in co-educational schools. The findings revealed that providing students with the opportunity to experience Learning Together in groups encourages them to support each other to gain academic achievement and interpersonal competencies. The findings also disclosed that overall mathematical performance of both male and female students was significant while the female students outperformed the male students. Also, based on the experimental male and female students' overall performance, this study came to the conclusion that group learning can make a significant impact on the performance of female students without negatively affecting the performance of male students. Thus it is important that female students are provided with every opportunity to do extremely well at mathematics in the group learning environment in co-educational schools. Therefore, group learning may be an approach that can be professionally incorporated to develop female students' performance, and secondary teachers should think seriously about integrating group learning approaches in their mathematics teaching, while education authorities should include aspects of group learning into the syllabuses of teacher training in Bangladesh.

Based on the conclusion, this study lends a few recommendations as follows:

1. This study was conducted on a sample of 88 students. Further study on this problem could be done on a larger sample to determine the validity of the findings of the present study.

2. Studies may be undertaken to show the comparison of male and female students' mathematical performance between rural and urban, government and non-government schools.

3. The present study was limited to the area of mathematics only. Further study could be conducted in the areas of English, Bangla, science, physics, chemistry, history, geography and any other areas of education.

References

Akinbobola, A. O. (2006). Effects of cooperative learning and competitive learning strategies on academic performance of students in Physics. *Journal of Research in Education*, 3(1), 1-5.

Barbato, R. (2000). *Policy implications of cooperative learning on the achievement and attitudes of secondary school mathematics students*. PhD thesis. Fordham University, New York.

Berg, K., & Latin, R. (1994). *Essential of modern research methods.* Englewood Cliffs,
    NJ: Prentice-Hall, Inc.

Board of Intermediate and Secondary Education (BISE).(2005). *Board summary of the secondary school certificate examination-2005* (Rajshahi). Dhaka: Ministry of Education.

Bottge, B.A. (2001). Reconceptualizing mathematics problems solving for low-achieving students. *Remedial and Special Learners,* 22(2), 102-112.

Campbell, D.T., & Stanley, J.C. (1963). *Experimental and quasi-experimental design for research.* Chicago: Rand McNally College Publishing Company.

Carroll, A. (2002). At-risk and not at-risk adolescent girls in single-sex and mixed-sex school settings: an examination of their goals and reputations. *Westminster Studies in Education,* 25, 147-162.

Davidson, N. (1990). *Cooperative learning in mathematics: a handbook for teachers*. CA: Addison-Wesley Publishing Company.

Deutsch, M. (1949). A theory of Co-operation and Competition. *Human Relations,* 2, 129-152.

Effandi , Z. (2003). *The effects of cooperative learning on students in a matriculation mathematics class*. PhD thesis. Universiti Kebangsaan Malaysia, Bangi.

Faizah, M. G. (1999). *Kesan Pembelajaran koperatif menggunakan alat ujian pencapaian dalam matematik.* Projek Penyelidikan Sarjana Pendidikan. Universiti Kebangsaan Malaysia.

Johnson, D.W., & Johnson, R.T. (2004). *Assessing students in group*. California: CORWIN PRESS.

Johnson, D.W., & Johnson, R.T. (1994). *Learning together and alone*. London: Allyn and Bacon.

Joiner, K. (1999). *Training and evaluating reform in calculus: a social, technological, psychological, instructional and curricular perspective on educational reform*. PhD thesis. Curtin University of Technology.

Kagan, S. (1994). *Cooperative learning.* CA: Kagan Publishers.

Kolawole, E. (2007). Effects of competitive and cooperative learning strategies on academic performance of Nigerian students in mathematics. *Educational Research and Review*, 3, 33-37.

Leedy, P. D., & Ormrod, J.E. (2001). *Practical research planning and design.* New Jersey: Merrill Prentice Hall.

Lee, G.E. (1999). *Pembelajaran koperatif dan kesannya ke atas pencapaian kemahiran penyelesaian masalah matematik teras tingkatan 4 di sebuah sekolah di Daerah Kota Setar*. Kedah, Malaysia Projek.

Martin, R.L. (2005). *Effects of cooperative and individual integrated learning system on attitudes and achievement in mathematics*. PhD thesis, Florida International University, Florida.

McMillan, J.H., & Schumachar, S. (1984). *Research in education: a conceptual introduction.* Boston: Little, Brown and Company.

Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., & Chrostowski, S.J. (2004). *TIMSS 2003 international mathematics report: findings from IES's trend in international mathematics and science study at the fourth and eighth grades*. Chestnut Hills, MA: Boston College.

Mwerinde, P., & Ebert, C. (1995). *An examination of the relationship between the problem-solving behaviour and achievements of students in cooperative learning groups.* Paper presented at the annual meeting of the North American chapter of the international group for the psychology of mathematics education, Columbus, Ohio. ERIC Document Reproduction. Service No. ED 389572.

Ozsoy, N., & Yildiz, N. (2004). The effect of learning together technique of cooperative learning method on student achievement in mathematics teaching 7th class of primary school. *Turkish Online Journal of Educational Technology*, 3, 49-54.

Rimmerman, H. (2004). *Resources in cooperative learning.* San Clemente, CA: Kagan Publishing.

Samad, M.A. (2005). *Ganit shikkha-o-prashikkhon.* Dhaka: Samad Publication and Research.

Sax, L. (2005). *Why gender matters: what parents and teachers need to know about the emerging science of sex differences.* New York: Doubleday.

Slavin, R.E. (1995). *Cooperative learning.* London: Allyn and Bacon.

Vaughan, W. (2002).Effects of cooperative learning on achievement and attitude among students of color. *Journal of Educational Research*, 95, 359-364.

Webb, N. (1984). Sex differences in interaction and achievement in cooperative small groups. *Journal of Educational Psychology,* 76, 33-44.

Yee, C.T. (1995). *Kesan pembelajaran koperatif terhadap pencapaian matematik dari segi akademik dan kemahiran penyelesaian masalah di kalangan pelajar tingkatan empat di sebuah sekolah di Malaysia.* Tesis Sarjana, Universiti Sains Malaysia.

Zakaria, E., Chin, L.C., & Yosoff, D.M. (2010). The effects of cooperative learning on students' mathematics achievement and attitudes towards mathematics. *Journal of Social Science,* 6(2), 272-275.

Anowar Hossain
Institute for Mathematical Research (INSPEM),
Universiti Putra Malaysia;
43400 UPM Serdang, Selangor, Malaysia;
anowar_24434@yahoo.com

Rohani Ahmad Tarmizi
Institute for Mathematical Research (INSPEM),
Universiti Putra Malaysia;
43400 UPM Serdang, Selangor, Malaysia;
rohaniat@gmail.com

Zahara Aziz
Faculty of Education,
Universiti Kebangsaan Malaysia;
43600 UKM Bangi, Selangor, Malaysia;
zaharaukm@yahoo.com

Norazah Nordin
Faculty of Education,
Universiti Kebangsaan Malaysia;
43600 UKM Bangi, Selangor, Malaysia;
norazah13140@yahoo.com

Učinci grupnoga rada i rodnih razlika kod matematičkih dostignuća

Sažetak

Ovo istraživanje imalo je za cilj proučiti učinke grupnoga rada i rodnih razlika na matematička dostignuća u rodno mješovitim školama. U istraživanju je sudjelovalo ukupno 88 učenika devetog razreda iz Natorea u Bangladešu. Koristila se metoda polueksperimentalne istovjetne kontrolne grupe s testom prije i poslije. Eksperimentalna grupa (n=44) bila je podvrgnuta grupnom radu, dok je kontrolna grupa (n=44) bila podvrgnuta konvencionalnim načinima učenja u trajanju od 15 tjedana. Nezavisni t-test i MANOVA analiza s ponovljenim mjerenjima korišteni su za obrađivanje podataka. Rezultati pokazuju značajne učinke grupnoga rada i značajne rodne razlike u matematičkim dostignućima. Nalazi otkrivaju da je eksperimentalna grupa učenika nadmašila kontrolnu grupu učenika, a učenici i učenice u eksperimentalnoj grupi poboljšali su svoja matematička dostignuća s tim da su učenice imale bolje rezultate od učenika nakon uvođenja grupnoga rada. Zaključak ovog istraživanja je da grupni rad poboljšava matematička dostignuća za učenice, dok učenici ne profitiraju toliko kao učenice. Iz toga slijedi da bi grupni rad mogao biti pristup koji se može profesionalno uključiti da bi se poboljšali dosezi učenica u Bangladešu.

Ključne riječi: *grupno učenje; matematički dosezi; matematika; rod; rodno-mješovite škole; učenici devetog razreda.*

Uvod

Grupni rad u podučavanju/učenju matematike sve se više koristi u današnjem svijetu znanosti i tehnologije, a tema rodnih razlika u dostignućima privlačila je pozornost nastavnika posljednjih nekoliko godina. Mnoga istraživanja proučavala su utjecaj grupnog rada u različitim disciplinama poput engleskog, matematike, fizike, kemije, povijesti, geografije i drugih područja obrazovanja, dok je samo nekoliko njih proučavalo rodne razlike u dostignućima koja su rezultat grupnog rada. Istraživači

poput Carrolla (2002) i Saxa (2005) ustanovili su postojanje rodnih razlika u učenju i utvrdili da u rodno mješovitim razredima učenice imaju bolje rezultate u matematici s korištenjem konkretnih predmeta i pomagala, dok učenici imaju bolje rezultate u računanju koje je podučavano koristeći se pločom. Trend u matematici i znanosti na međunarodnoj razini (TIMSS) 2003 procjenjuje postignuća učenika četvrtih i osmih razreda i ukazuje na rodne razlike u matematičkim dostignućima. Prema Mullis i dr. (2004) rodne razlike naklonjene učenicima ustanovljene su kod učenica četvrtih razreda iz tri zemlje (Armenija, Moldova i Filipini) s malim prednostima od 11 do 12 bodova u njihovu korist. Iako opsegom male, te rodne razlike su prvi slučajevi u povijesti ženske prednosti u matematičkim postignućima u četvrtim razredima u cijeloj međunarodnoj organizaciji za evaluaciju obrazovnih postignuća. Rodne razlike koje idu u prilog dječaka ustanovljene su u šest zemalja koje su sudjelovale. Prednost muškaraca (od 6 do 11 bodova) bila je relativno slična u opsegu prednosti kod žena. U osmome razredu nailazimo na dvije pojave vezane uz rodne razlike kod matematičkih postignuća. Prvi put u povijesti IEA uočene su rodne razlike koje idu u prilog učenicama. Među zemljama sudionicama u kojima se pojavila rodna razlika u korist učenica isti je broj zemalja u kojima se pojavila rodna razlika u korist učenika. Druga pojava uočena je među tri zemlje (Bahrein, Jordan i Tunis) u kojima su rodne razlike bile najveće u dvije zemlje (Bahrain i Jordan), i to u korist učenica. Takve rodne razlike ukazuju na to da učenice u tim zemljama, kada imaju jednaku mogućnost učenja, postižu puno bolje rezultate u matematici nego učenici. S obzirom na razlike u demonstriranim mogućnostima i interesu za matematiku te u postignućima na standardiziranim testovima kod učenica, znanstvenici su istraživali moguće uzroke tih razlika. Moguće je da su razlike uzrokovane demografskim profilom učenica i učenika, razlikama u iskustvu u istim razredima te interesom za matematička zanimanja. Rodne razlike i matematička postignuća kod grupnog rada bili su tema istraživanja Kolawolea (2007). Kolawole je zaključio da učenici imaju bolje rezultate od učenica, dok je Joiner (1999) pokazao da učenice imaju bolje rezultate u grupnome radu, a da učenici pokazuju bolje rezultate u tradicionalnim načinima poučavanja.

Kako bi se usporedila dostignuća učenika i učenica u matematici s obzirom na učinke grupnoga rada, pokrenuli smo istraživanje u rodno mješovitim srednjim školama u Bangladešu. Certifikat srednje škole (SSC) je prvi veći ispit koji u Bangladešu ima značajnu težinu za učenike i njihove roditelje. Rezultat SSC-a je značajan za uspjeh pojedinca i za život u zajednici. Postotak učenika koji prođu SSC u mnogim ruralnim srednjim školama u 2000., 2001., 2003., 2004., i 2005. bio je manji od 20% (Board of Intermediate and Secondary Education, 2005). Ti rezultati odraz su loše kvalitete srednjoškolskog obrazovanja, posebno kada većina učenika ne prolazi matematiku. Kao grupa, djeca iz tih ruralnih škola dolaze iz podčinjenih obitelji i obitelji s niskim primanjima. Samad (2005) je ustanovio da u matematičkim postignućima srednjoškolaca u Bangladešu postoji presudna potreba za popravljanjem i učvršćivanjem znanja matematike posredstvom različitih načina poučavanja. To je zahtijevalo nešto kreativnosti i

poduzetništva nastavnika i upravo je to ono područje koje pati. Prema tome, da bi se minimalizirala frekvencija neprolaska na SSC ispitima, nastavnici bi trebali proznaći načine kojima bi poboljšali učenje učenika. Slaba postignuća među učenicima mogu se pripisati nedostatku suvislog, eksplicitnog, situacijskog, društvenog učenja, te učenja orijentiranog na učenika u razredima. Bottge (2001) je identificirao te oblike učenja (suvisle, eksplicitne, situacijske, društvene i učenicima orijentirane situacije) kao ključne za učenje matematike, a posebno za učenike sa smanjenim mogućnostima. Grupni rad izvrsno je dokumentiran kao suvisao, eksplicitni, situacijski, društveni i učenički orijentirani odnos u kojem učenici s visokim ili niskim mogućnostima rade zajedno na rješavanju problema, sa zajedničkim ciljevima. Osnovna je ideologija grupnog rada da su članovi grupe povezani tako da uvide da sami ne mogu uspjeti, već da moraju svi raditi. Oni će si aktivno međusobno pomagati kako bi osigurali izvršenje zadaće i dostignuće grupnog cilja (Deutsch, 1949). To postižu dajući pomoć i podršku, dijeleći resurse i potičući vlastiti trud. Rezultat toga je da članovi grupe koji surađuju imaju puno bolje rezultate od učenika koji rade samostalno ili koji se natječu jedni s drugima (Johnson i Johnson, 2004). Prema Akinbobola (2006), grupno je učenje prilikom kojeg učenici različitih razina mogućnosti rade zajedno u malim grupama kako bi postigli cilj. Johnson i Johnson (1994) definirali su učenje u grupi kao način poučavanja prilikom kojeg učenici u malim grupama poput timova za učenje rade i surađuju jedni s drugima da bi riješili zajednički problem ili obavili zadatak koji im je nastavnik postavio. Grupno je učenje način učenja koji je istovremeno i fleksibilan i učinkovit, tj. učenici uče misliti, raditi i razvijati osjećaje prema zadatku. Postoje mnoge strategije za grupni rad poput modela Učiti zajedno (*Eng*. Learning Together), odsjek postignuća timova učenika (STAD), turniri timova-igara (TGT), ubrzano timsko podučavanje (TAI), suradničko integrirano čitanje i pisanje (TGT), slagalica, grupno istraživanje (GI) itd., ali autori ovog istraživanja usredotočili su se na Johnsonov i Johnsonov (1994) model *Učiti zajedno* jer upravo je njihov pristup za razvoj grupnog učenja utemeljen na pet osnovnih principa koji su široko primjenjivi u bilo kojoj situaciji grupnog učenja.

Model Učiti zajedno sastoji se od pet osnovnih elemenata kao što su pozitivna uzajamna ovisnost, odgovornost pojedinca, poticajna interakcija licem-u-lice, međuljudske vještine i vještine rada u maloj grupi, i analiza grupe. Prema Johnson i Johnson (1994) za uspješnu implementaciju grupnog učenja u matematici potrebno je pet elemenata:

1. Pozitivna uzajamna ovisnost: svi članovi grupe neće imati uspjeha ako svatko osobno nema uspjeha.
2. Odgovornost pojedinca: svatko je odgovoran za doprinos svog dijela u grupi.
3. Poticajna interakcija licem-u-lice: članovi grupe svoje uloge obogaćuju pohvalom, podržavanjem i poticanjem svakog člana kako bi se postigao zajednički cilj.
4. Međuljudske vještine i vještine rada u maloj grupi: članovi grupe trebali bi biti upoznati s vještinama donošenja odluka, rukovođenja grupom, i izgradnjom povjerenja u slučaju konfliktne situacije, kako bi se uspjeh grupe održao.

5. Analiza grupe: članovi grupe trebali bi biti upoznati s postupkom podrške. Svaki član grupe trebao bi prepoznati trud drugoga člana u radu grupe kako bi se dostigao zajednički cilj grupe.

Vaughan (2002) je podržao Johnsonov i Johnsonov model *Učiti zajedno*, strategije grupnoga rada koja je ključna za kultiviranje pojedinačnog i akademskog uspjeha. Rimmerman (2004) je rad Johnsona i Johnsona nazvao modernim razdobljem u grupnome radu. Njihov model grupnog učenja poznat pod nazivom *Učiti zajedno* može se primijeniti na bilo koju disciplinu i bilo koji razred. Učenici uče sadržaj strategijom grupnog učenja u kojoj dolazi do interakcije učenika, razmjene informacija i znanja, i u kojoj učenici rade kao tim da bi dostigli ciljeve učenja. Johnson i Johnson (1994) podržavaju tezu da male grupe u grupnom radu promiču postignuća učenika u matematici u devetom i desetom razredu. Istraživanja u ostalim razredima u matematici imala su slične ishode kao što napominju Web (1984), Davidson (1990), Kagan (1994) i Slavin (1995). Njihovi su rezultati pokazali da su oni učenici koji su učili u grupi imali bolja matematička postignuća nego konvencionalna grupa u istom okruženju.

Effandi (2003), Zakaria i dr. (2010) također su spomenuli rezultate istraživanja provedenog u Maleziji po kojem je grupno učenje poboljšalo matematička dostignuća i promicalo pozitivne stavove prema matematici za razliku od tradicionalnog načina poučavanja matematike. Učinkovitost grupnog učenja pokazuje brzi rast u matematičkim dostignućima i stavovima prema matematici, što su pokazala mnoga istraživanja (Barbato, 2000; Faizah, 1999; Kolawole, 2007; Lee, 1999; Martin, 2005; Ozsoy i Yildiz, 2004; Yee, 1995; Vaughan, 2002). Svrha ovoga istraživanja bila je identificirati učinke grupnog učenja i istražiti rodne razlike u matematičkim dostignućima u rodno mješovitim školama iz Natorea u Bangladešu. Točnije, ciljevi istraživanja bili su sljedeći:

1. Identificirati učinke grupnoga rada na matematička dostignuća učenika u rodno mješovitim školama.
2. Ispitati postoje li rodne razlike kod matematičkih dostignuća u eksperimentalnoj grupi.

Metode

Oblikovanje istraživanja

Da bi se identificirali učinci grupnog učenja u usporedbi s konvencionalnim učenjem, studija je podrazumijevala polueksperimentalno oblikovanje testom "Istovjetna kontrolna grupa s predtestom i posttestom" (Berg i Latin, 1994; Campbell i Stanley, 1963; McMillan i Schumacher, 1984). Ista kontrolna grupa odnosi se na elemente kod kojih ni jedno svojstvo između dvije grupe nema različitu očekivanu vrijednost. Prije eksperimentalnog tretmana dvije bi grupe trebale biti slične u svakom pogledu. Inicijalno opažanje (npr. predtest) može potvrditi da su dvije grupe slične barem u pogledu zavisnih varijabli koje se istražuju. Ako se nad jednom grupom

izvede eksperimentalni tretman, razlike u grupama mogu se pronaći s obzirom na zavisnu varijablu i tada se istraživanjem dolazi do zaključka da su razlike u naknadnom tretmanu rezultat tog tretmana (Leedy i Ormrod, 2001). U ovome istraživanju uzorak se sastoji od ukupno 88 redovnih učenika iz dvije rodno mješovite škole iz Natorea u Bangladešu. Preliminarni predtest proveden je na učeničkim matematičkim dostignućima u kontrolnoj (n=44) i eksperimentalnoj grupi (n=44), a rezultati su pokazali da su obje grupe istovjetne u pogledu matematičkih dostignuća prije tretmana, te da su započeli na jednak način prije nego je dana strategija tretmana (Tablice 3 i 6).

Nakon izvedenog predtesta, eksperimentalna je grupa podvrgnuta skupnom načinu učenja, dok se kontrolna grupa i dalje koristila konvencionalnim metodama učenja. Grupni način učenja utemeljen je na Johnson i Johnson modelu *Učiti zajedno* (1994). Učenje u grupi i konvencionalno poučavanje izveo je isti nastavnik tijekom jednog školskog sata, a postupak se ponavljao tijekom 15 nastavnih tjedana. Posttest učeničkih matematičkih dostignuća proveden je s obje grupe, eksperimentalnom i kontrolnom. Tablica 1 grafički prikazuje polueksperimentalno oblikovanje ovog istraživanja. „A" predstavlja eksperimentalnu grupu, dok „B" predstavlja kontrolnu grupu. „O_1" predstavlja predtest, dok je posttest prikazan kao „O_2" za eksperimentalnu i kontrolnu grupu. Tretman učenja u grupi predstavljen je kao X.

Tablica 1.

Sudionici

Za glavno istraživanje odabrane su dvije rodno mješovite srednje škole iz Natorea, u kojima se u istom razredu poučavaju i djevojke i dječaci, a koje je odabrao ravnatelj obrazovnog okruga Narodne Republike Bangladeš. Škole smještene u ruralnim područjima Natorea su srednja škola Kachugari Fakir Bari i srednja škola Poal Shura Patpara. Uzorak su činili učenici 9. razreda. U istraživanju je sudjelovalo ukupno 88 redovnih učenika (44 učenika za eksperimentalnu grupu i 44 učenika za kontrolnu grupu) iz dvije rodno mješovite srednje škole. Distribucija uzorka, utemeljena na grupi i rodu, prikazana je u Tablici 2.

Tablica 2.

Podaci u Tablici 2 prikazuju da je od ukupnog uzorka od 88 sudionika, u obje grupe, kontrolnoj i eksperimentalnoj, sudjelovalo po 44 učenika. U pogledu roda sudionike eksperimentalne grupe koja se sastojala od 44 učenika činilo je 20 (45,45%) učenika i 24 (54,55%) učenice. Kontrolna grupa sastojala se od 23 (52,27%) učenika i 21 (47,73%) učenice.

Obje škole u kojima je provedeno testiranje obuhvatile su dvije sekcije. Sekcija-I predstavljena je kao eksperimentalna grupa, a Sekcija-II kao kontrolna grupa 9. razreda u nastavi matematike, prema napucima ravnatelja testiranih škola. Objema grupama bilo je rečeno da su odabrani kao sudionici eksperimenta sa svrhom istraživanja

učinaka učenja u grupi, te da bi se napravila usporedba razine matematičkih dostignuća između učenika i učenica. Odabrano je dvoje nastavnika (po jedan iz svake škole), s više od dvanaest godina iskustva u poučavanju matematike. Oba nastavnika poučavala su dva razreda u obje škole.

Instrumenti

Instrument korišten u ovoj studiji je test učeničkih dostignuća u matematici (mathematical performance test (MPT)). Srednjoškolska algebra i srednjoškolska geometrija, obavezni matematički udžbenici pod pokroviteljstvom Vlade Narodne Republike Bangladeš. Istraživač je samostalno izradio test matematičkih dostignuća koristeći se poglavljima Algebarskih izraza, koja su se sastojala od nastavnih jedinca 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7 i 3.8; geometrijskog teorema iz nastavne jedinica 2, 3 i 11; trigonometrijske proporcije jedinica 12.1 i 12.2 u skladu sa savjetima iznesenim u Udruzi nastavnika srednjih škola koji poučavaju algebru i geometriju u ruralnim srednjim školama. Matematičko dostignuće za ovo je istraživanje ishod koji su učenici postigli nakon procesa poučavanja. U ovome je istraživanju matematičko učenje mjereno uporabom MPT instrumenta. Matematičko dostignuće, mjerenje učenja matematike, rezultiralo je značajno višim rezultatima ostvarenima na posttestu s obzirom na rezultat koji su učenici ostvarili na predtestu.

Test matematičkih dostignuća (MPT) podijeljen je na dva dijela (A i B). Dio A ispituje demografske podatke ispitanika, točnije rod i serijski broj, a dio B je test matematičkih dostignuća (MPT). Prije pravog istraživanja provedeno je pilot-istraživanje da bi se testirala pouzdanost instrumenta. Pilot-testiranje provedeno je na uzorku od 40 srednjoškolaca srednje škole Krishi Karigari ML u Natoreu. Srednju školu Krishi Karigari ML odabrao je ravnatelj Obrazovnog okruga pri Vladi Narodne Republike Bangladeš. Sekcija-I i Sekcija-II predstavljaju eksperimentalnu i kontrolnu grupu. Svaka mala rodno heterogena grupa sastojala se od četvero učenika niskih i visokih mogućnosti u eksperimentalnoj grupi. Obje grupe, eksperimentalnu i kontrolnu, vodio je isti nastavnik s više od dvanaest godina nastavničkog iskustva u poučavanju matematike. Obje su grupe, eksperimentalna i kontrolna, prošle matematičke instrukcije u trajanju od pedeset i pet minuta tijekom četiri tjedna. Svi učenici pisali su predtest i posttest. To osigurava pouzdanost instrumenta u kontekstu Bangladeša.

Sadržajna valjanost instrumenta *Test matematičkih dostignuća* (MPT) utvrđena je konsenzusom stručnjaka relevantnog područja. Instrument istraživanja sadržajno su potvrdili ravnatelj Obrazovnog okruga pri Vladi Narodne Republike Bangladeš; profesor Instituta obrazovanja i istraživanja Sveučilišta u Dhaki, izvanredni profesor matematike i bivši nadzornik za provedbu ispita Upravnog odbora predmetnog i srednjoškolskog obrazovanja u Rajshahiji; profesor i bivši školski inspektor Upravnog odbora predmetnog i srednjoškolskog obrazovanja u Rajshahiji; i jedan stručnjak iz područja matematičkog obrazovanja Fakulteta obrazovnih znanosti Sveučilišta Kebangsaan iz Malezije.

Eksperimentalna grupa

Na početku tretmana proveden je MPT predtest s eksperimentalnom grupom. Učenici su informirani da će biti podvrgnuti grupnom učenju u razdoblju od 2. veljače do 15. svibnja 2008. godine. Eksperimentalni nastavnici kojima je dodijeljen zadatak implementacije grupnog učenja prošli su odgovarajuću obuku. Tretmanu je prethodilo temeljito upoznavanje učenika s principima grupnog učenja. Svim sudionicima eksperimentalne grupe dani su detaljni opisi grupnog učenja. Opisi grupnog učenja uključivali su uvod u grupno učenje prema modelu *Učiti zajedno*, proces primjene tog modela s ciljem poboljšanja matematičkih dostignuća posredstvom učeničke suradnje unutar okruženja grupnog učenja, postavljanje suradničkih grupa i vježbanje socijalnih vještina. Nastavnici su s učenicima razgovarali o vrijednosti uporabe modela *Učiti zajedno* u nastavi matematike. Predstavljali su te koncepte s obzirom na to kako učenici mogu postati suradljivi u okruženju grupnog učenja, zašto bi učili kako učiti u grupi i na koji bi način to mogli iskoristiti za poboljšanje svojih matematičkih dostignuća. Nakon razgovora o modelu *Učiti zajedno*, učenici su podijeljeni u grupe s obzirom na svoje mogućnosti. Podijeljeni su na jako sposobne i manje sposobne, ovisno o rezultatima postignutim na MPT predtestu matematičkih sposobnosti. Rezultat vrijednosti srednjeg člana (median) je bio kriterij za razvrstavanje učenika u određenu grupu. Rezultati iznad mediana označeni su kao jako sposobni, a ispod mediana kao manje sposobni. Svaka grupa sastavljena je od nasumce izabrana dva jako sposobna i dva manje sposobna učenika. Učenike se ohrabrivalo da međusobno dijele znanje i zajednički, u grupi, rješavaju dodijeljene matematičke zadatke. Učenicima je rečeno da razviju svoj način raspodjele zadataka među članovima grupe. Nakon tretmana grupnog učenja, na posljednjem satu eksperimenta iz matematike od učenika se tražilo da završe MPT posttest.

Kontrolna grupa

Za kontrolnu grupu najprije je proveden MPT predtest, a potom je nastavnik u kontrolnoj grupi nastavio s uobičajenim izvođenjem nastave matematike i učenici nisu bili izloženi skupnom učenju. Nakon što je nastavnik objasnio gradivo, učenici su individualno vježbali koristeći se udžbenicima i bilješkama s nastave. Prilikom poteškoća u rješavanju zadataka učenici su za pomoć pitali nastavnika. Nastavnik je intervenirao prema potrebi, pomažući učenicima u rješavanju problema. Ponekad bi nastavnici objasnili i informirali učenike o postupcima potrebnim za rješavanje problema. Na kraju svakog susreta nastavnici bi ponovili lekciju toga dana s cijelim razredom. Od učenika se tražilo da završe MPT posttest 15. svibnja 2008. godine.

Prikupljanje i analiza podataka

Istraživanje je provedeno u razdoblju od 2. veljače do 15. svibnja 2008. godine. Učenici u obje grupe, kontrolnoj i eksperimentalnoj, pisali su MPT predtest 2. veljače 2008. godine. Svi podaci su zabilježeni i pohranjeni najprije na papiru, a kasnije na

računalu u SPSS datoteci. MTP posttest održan je 15. svibnja 2008. godine i podaci su pohranjeni u SPSS datoteku. Istraživač je uspio natrag dobiti 100% distribuiranog instrumenta.

Za analizu i prikupljanje podataka korištene su deskriptivna i inferencijalna statistika. Deskriptivna statistika poput frekvencije, srednje vrijednosti i standardne devijacije korištena je za dobivanje ukupnih demografskih informacija subjekata istraživanja. Inferencijalna statistika provedena je za testiranje hipoteza. Specifični upotrijebljeni inferencijalni statistički postupci bili su t-test nezavisnog uzorka i MANOVA s ponavljanim mjerenjima.

Rezultati

Istraživanje je provedeno s ciljem utvrđivanja učinaka grupnog učenja i rodnih razlika na matematička dostignuća učenika u rodno mješovitim srednjim školama iz Natoreu u Bangladešu. Rezultati istraživanja prikazani su na temelju prije istaknutih ciljeva kako slijedi:

Identificirati učinke grupnog učenja na matematička dostignuća učenika u rodno mješovitom školama

Identificirati učinke grupnog učenja uspoređujući matematička dostignuća eksperimentalne i kontrolne grupe, analizirajući srednju vrijednost rezultata predtesta i posttesta uporabom t-testa nezavisnog uzorka.

Kao što je prikazano u Tablici 3, srednja vrijednost rezultata predtesta za eksperimentalnu grupu bila je 25,28 (SD=4,11), a kontrolnu grupu 24,88 (SD=3,65). Rezultat otkriva da razlike između srednje vrijednosti rezultata predtesta eksperimentalne i kontrolne grupe [t (86) = 0,47, p > 0,05] nije značajna na alfa razini od 0,05. To sugerira da su dostignuća obje grupe jednakovrijedna na početku istraživanja.

Tablica 3.

Rezultati u Tablici 4 pokazuju da su srednje vrijednosti rezultata posttestova učenika eksperimentalne grupe bili 47,15 (SD = 2,56), a za učenike kontrolne grupe 34,65 (SD = 2,05). Ustanovljeno je da su učenici koji su sudjelovali u grupnom učenju postigli bolje rezultate od učenika koji su pratili konvencionalnu metodu poučavanja. T-test je pokazao značajnu razliku [t (86) = 25,22, p < 0,05] u korist eksperimentalne grupe, što je otkrilo da su dostignuća učenika u eksperimentalnoj grupi značajno bolja od dostignuća učenika koji su radili po konvencionalnoj metodi. Stoga navedeni rezultati sugeriraju da je integracija grupnog učenja u rodno mješovite škole pokazala pozitivan učinak u poboljšanju matematičkih dostignuća učenika.

Tablica 4.

Rezultati koji se odnose na matematička dostignuća upućuju na to da su u fazi predtretmana obje grupe, eksperimentalna i kontrolna, bile jednake po svojim dostignućima, s niskom ukupnom srednjom vrijednošću rezultata dostignuća na

predtestu. Rezultati pokazuju da je došlo do povećanja srednje vrijednosti rezultata na MPT posttestu u eksperimentalnoj grupi nakon tretmana. Tako se može zaključiti da strategija uporabe grupnog učenja izgleda ima značajan i pozitivan učinak na matematička dostignuća učenika., dok za kontrolnu grupu možemo ustanoviti minimalan napredak u njihovim sveukupnim srednjim vrijednostima rezultata posttesta matematičkih dostignuća.

Učinci grupnog učenja na matematička dostignuća na temelju ponavljanih mjerenja testiranja dostignuća tijekom petnaest tjedana

Multivarijantna analiza varijance (MANOVA) s ponavljanjem mjerenja korištena je za istraživanje glavnog učinka grupnog učenja i različitih test-vremena, kao i njihove interakcije. Multivarijantna analiza varijance prikazuje glavni učinak i učinak interakcije na varijable identificirane s razinom značajnosti od 0,05. Tablica 5 predstavlja ukupan rezultat testa multivarijance.

Tablica 5.

Multivarijantni testovi ukazuju na značajan glavni učinak vremena, Wilks' Lambda = 0,070, F = (1,86) = 1148,971, p = 0,000, η2 = 0,930; značajan interaktivni učinak grupnog učenja u određenom vremenu, Wilks' Lambda = 0,339, F (1, 86) = 168,019, p = 0,000, η2 = 0,661. Promatrana vrijednost za sve faktore bila je 1.000. Postojala je razlika među matematičkim dostignućima prije i nakon izlaganja skupnom učenju prema izmjerenim i pokazanim rezultatima predtesta i posttesta matematičkih dostignuća učenika. MANOVA s ponavljanim mjerenjima pokazala je da postoji interakcijka između grupnog učenja i testnog vremena. Multivarijantni test prikazuje značajan glavni utjecaj vremena na rezultat postesta matematičkih dostignuća učenika, a značajni su i učinci interakcije kod grupnog učenja u vremenu na razini 0,05. Dakle, navedeno implicira da je ubacivanje grupnog učenja imalo značajan utjecaj na unapređivanje matematičkih dostignuća učenika.

Istražiti rodne razlike u matematičkim dostignućima u eksperimentalnoj grupi

Da bismo istražili postojanje rodnih razlika u matematičkim dostignućima eksperimentalne grupe, srednje vrijednosti predtesta i posttesta također su analizirane uporabom t-testa nezavisnog uzorka.

Tablica 6 prikazuje da je srednja vrijednost predtesta za eksperimentalnu grupu učenika bila 25,87 (SD = 4,23), a učenica 24,79 (SD = 4,03). Rezultati otkrivaju da razlika između srednjih vrijednosti predtesta učenika i učenica [t (42) = 0,86, p > 0,05] nije značajna na alfa razini od 0,05. To sugerira jednakost dostignuća učenika i učenica na početku ovog istraživanja.

Tablica 6.

Tablica 6 ukazuje na to da su srednje vrijednosti rezultata posttesta učenika na matematička dostignuća 46,00, sa standardnom devijacijom od 2,48, i učenica 48,12, sa standardnom devijacijom od 2,24 značajne [t (42) = -2,97, p < 0,05] u korist učenica. Rezultati su pokazali da učenice u eksperimentalnoj grupi postižu značajno više rezultate MPT-a od svojih muških kolega.

Tablica 7.

Rezultati rodnih razlika ukazuju na to da su prije tretmana učenici i učenice eksperimentalne grupe imali jednaka matematička dostignuća. Usporedba srednjih vrijednosti rezultata pretesta oba roda odražavala je nepostojanje značajnih razlika među njima. Oba su roda bila jednaka s obzirom na matematička dostignuća prije tretmana. Nakon tretmana učenice su ostvarile značajno bolju izvedbu od učenika. Rezultati otkrivaju značajno poboljšanje izvedbe učenika i učenica, dok je kod učenica eksperimentalne grupe zabilježen značajno bolji uspjeh u odnosu na njihove kolege u istoj grupi.

Rasprava

Istraživanje je imalo za cilj identificirati učinke grupnoga rada na postignuća učenika u matematici te ispitati postoje li rodne razlike kod matematičkih dostignuća u rodno mješovitim školama. Rezultati istraživanja ukazuju na značajan učinak grupnoga rada na matematička dostignuća, te na značajnu razliku u dostignućima između učenika i učenica. Ukupno 98,69% učenika u eksperimentalnoj grupi imalo je pozitivan stav prema grupnom učenju. Rezultati također pokazuju da je većina učenika izrazila veliko zadovoljstvo radom u grupama. Učenici preferiraju učenje matematike razmjenom znanja u grupi. Osjećaju se sretnima kada rade u grupi. Prema tome, postoji značajan učinak grupnog učenja na matematička dostignuća i značajan učinak na rodne razlike u matematičkim dostignućima.

Rezultati su pokazali da su učenici koji su radili u grupi unaprijedili svoja matematička dostignuća u usporedbi s učenicima koji su bili u grupi u kojoj se upotrebljavala konvencionalna metoda rada. Rezultati posttesta pokazuju da je grupno učenje dalo učenicima više mogućnosti da s pouzdanjem odrede svoje izraze u algebri, geometrijskom teoremu i trigonometriji. Grupno učenje omogućuje učenicima da usvoje odgovarajuće procedure kod rješavanja problema, a to znači da su mogli riješiti svoj problem za razliku od učenika u kontrolnoj grupi. Učenici u eksperimentalnoj grupi surađivali su kako bi dostigli zadane ciljeve grupe. Rezultat ovog istraživanja pokazao je da grupno učenje unapređuje matematička postignuća učenika kao što su pokazala istraživanja Johnsona i Johnsona (1994), Weba (1984), Kagana (1994), Davidsona (1990) i Slavina (1995). Rezultati ovog istraživanja u skladu su s onima koja su proveli Martin (2005), Barbato (2000), Faizah (1999), Lee (1999), Zakaria i dr. (2010), Ozsoy i Yildiz (2004), Yee (1995) i Vaughan (2002). Zakaria i dr. su u svom istraživanju zaključili da je pristup orijentiran na učenika kao što je grupno

učenje poboljšao njihova postignuća u matematici, a nastavnici koji podučavaju matematiku u školama moraju biti osviješteni o dobrobiti i važnosti grupnog učenja tako da napuste praksu orijentiranu na učenje i zamijene je za podučavanje usmjereno učeniku. Navedeni rezultati također su u skladu s rezultatima istraživanja koje su proveli Joiner (1999) i Kolawole (2007), dok s obzirom na rodne razlike odudaraju od rezultata dobivenih od Kolawole (2007), u kojem je otkriveno da su učenici imali bolje rezultate od učenica kod grupnog učenja. Rezultati našeg istraživanja razlikuju se od rezultata istraživanja Mwerinde i Ebert (1995). Mwerinde i Ebert otkrili su da je konvencionalna grupa imala bolje rezultate od eksperimentalne grupe. Osnovna procjena pokazala je da je eksperimentalna grupa imala više matematičkog iskustva, ali je konvencionalna grupa imala bolje ocjene. Međutim, sastav suradničkih grupa u eksperimentalnoj grupi nije uvijek bio primjereno strukturiran; slijedom toga moguće je da je upravo to dovelo do kontradiktornih rezultata u kojima su učenici u kontrolnoj grupi dobili veće ocjene. Osim toga, Webb (1984) je otkrio da su učenici i učenice imali ista postignuća i sličnu interakciju u suradničkim grupama s istim brojem muških i ženskih učenika. Webb je zaključio da su učenice usmjeravale većinu svoje interakcije prema učenicima u većinom ženskim grupama i da su imali manja dostignuća od učenika, dok su u dominantno muškim grupama učenici uglavnom zanemarivali učenice i pokazali nešto veća dostignuća od učenica.

Zaključci

Ovo istraživanje pokazalo je da učenje u grupi ima značajne učinke na matematička dostignuća učenika i značajne razlike u dostignućima između učenika i učenica. Prije postupka ustanovili smo da su i eksperimentalna i kontrolna grupa bile jednake s obzirom na uspjeh na MPT, koji je bio prilično nizak. Nakon postupka, eksperimentalna je grupa pokazala značajno poboljšanje u cjelokupnim rezultatima MPT posttesta u odnosu na konvencionalnu grupu učenika. Rezultati upućuju na to da je rast na rezultatima testa za eksperimentalnu grupu učenika rezultat značajnih učinaka postupka grupnoga učenja. Ovim smo istraživanjem mogli zaključiti da je grupno učenje učinkovitije za podučavanje matematike u rodno mješovitim školama. Rezultati su otkrili da učenju metodom *Učiti zajedno* u grupama treba dati podršku kako bi se dostigla postignuća u učenju i razvile međuljudske kompetencije. Rezultati su također otkrili da je cjelokupno postignuće za učenike i učenice u matematici značajno, kao i da su učenice nadmašile učenike. Nadalje, na osnovi postignuća učenika i učenica eksperimentalne grupe, ovim smo istraživanjem zaključili da grupno učenje može imati značajan utjecaj na postignuća učenica bez negativnog učinka na postignuće učenika. Prema tome, važno je učenicama pružiti sve prilike kako bi bile dobre u matematici koristeći se grupnim učenjem u rodno mješovitim školama. Grupno učenje mogao bi biti pristup koji može razviti postignuća učenica, a nastavnici bi ozbiljno trebali razmisliti o uvođenju grupnog učenja u podučavanje matematike, dok bi obrazovne vlasti trebale uvrstiti aspekte grupnog učenja u kurikule za obrazovanje nastavnika u Bangladešu.

Na osnovi zaključaka iz istraživanja donosimo i nekoliko preporuka:

Istraživanje je provedeno na uzorku od 88 učenika. Daljnja istraživanja mogla bi biti rađena na većim uzorcima kako bi se odredila valjanost rezultata ovog istraživanja.

Mogla bi se provesti druga istraživanja kako bi se pokazale razlike kod učenika i učenica u matematičkim postignućima u odnosu na ruralna i urbana središta, javne i privatne škole.

Ovo istraživanje bilo je ograničeno na područje matematike. Daljnja istraživanja mogla bi uključiti područja poput engleskog, bangla, prirodnih znanosti, fizike, kemije, povijesti, geografije i bilo kojeg drugog područje obrazovanja.