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Students' Engagement in Group-Based Learning in Mathematics

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Abstract

The study explored the students' engagement in the group-based approach and analyzed their perceived advantages and disadvantages in learning mathematics. It employed the descriptive method of research through a researcher-made instrument to collect the learners' perceptions on the statements describing the positive and negative effects of group-based learning on the grounds of their experience. Three groups of respondents were considered as samples in equal numbers, forty each from the classes of STEM (Science, Technology, Engineering and Mathematics) students in the secondary level, Science major students in the tertiary level, and Mathematics major students also in the tertiary level. All of them were exposed to group-based learning in their respective mathematics classes. Data were analyzed using the weighted mean and t-test for independent samples. Statistical results revealed that majority of the respondents believed that there were more merits than drawbacks when they were engaged with a group. Students' from different levels and in diverse fields of interest expressed varied opinions on some issues regarding their experience in working with peers. Based on the learner's perceived beneficial and shortcoming effects of this learning approach, the study offers recommendations which may be considered by the mathematics educators in the design of their instructional plan.

Keywords: Collaborative learning; Cooperative learning; Group-based learning; Instructional plan; Mathematics.

1. Introduction

Over the past years, a significant number of educators in various fields have employed the group-based learning approach to diverse types of learners, from primary through tertiary levels. Consequently, a volume of research on this pedagogical practice began to widely appear in professional publications, mostly focusing on the challenges and issues in its implementation in education. Results of various studies in several countries disclosed that there were more benefits than risks when this learning approach is applied in most disciplines. While the advantages of this are well documented in much research, the implementation of such practice in classrooms remains a challenge that many educators have difficulties achieving [1].

Group work according to literature plays a fundamental role both in cooperative and in collaborative learning methods in education [2]. The words "cooperative" and "collaborative" are sometimes used interchangeably which refers to group-based learning activities in classrooms [3]. Nevertheless, those words because of their characteristics in terms of pre-structure, task structure and content structure can be viewed as different [4]. If all participants do their assigned tasks individually and share their parts to the group as output, cooperation can be achieved; however, if there is a direct interaction among members to produce an outcome and involves negotiations, discussions, and accommodating others' perspective, collaboration is then achieved [5]. Clearly, the common purpose of the two said learning approaches is to provide opportunities to students to engage with each other in selfless learning and to enhance learning by peer interaction [6].

Literature articulates that a staged and sustained approach until the successful achievement of the goal is required in the implementation of a group-based learning [7]. If the wrong type of dynamics in group work is carried out or, maybe the group approach is applied to the wrong type of lesson, the outcome could result to a failure [8]. As such, no significant learning will be obtained, thus, learners are the one who suffer. Situation like this should not be permitted in a learning atmosphere especially for mathematics classes where most students are challenged. Contextualizing this, it stimulates the interest of the researcher to explore on the students' engagement in group-based learning and analyze their perceived benefits and risks and use the findings as inputs for an instructional plan in mathematics.

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2. Research Method

A descriptive method of research was utilized in this study. A review of related studies helped the researcher gather statements based from the learners' past experiences in group-based learning. With these, an instrument was designed which composed of ten (10) statements, five (5) of which described the benefits of group-based learning while the rest expressed the limitations. Statements were assessed by the respondents and their mean response was analyzed as to whether they strongly disagree (1.00-1.75), disagree (1.76-2.50), agree (2.51-3.25) or strongly agree (3.26-4.00) based on their experiences. The positive and negative statements were intentionally mixed together so as not to reveal what statement particularly articulates on the merit or on the shortcoming when learners engage themselves with peers.

The researcher-made survey instrument was administered to one hundred twenty (120) student-respondents, forty (40) from each of the following groups were considered as samples: STEM (Science, Technology, Engineering and Mathematics) students in the secondary level; Science major students in the tertiary level; and Mathematics major students also in the tertiary level. All of them were exposed to group-based learning in their respective mathematics classes. The researcher as the faculty-in-charge supervised the student engagement within the group, offered assistance and intervened when necessary to redirect them to successful completion of the task assigned to them.

The following statistical tools were used in the analysis of data: the weighted mean, to describe the average response of the learners in the given statement pertaining to their engagement in the group; and the t-test for independent samples, to determine whether the computed mean response of the two groups of respondents differ significantly at 0.05 level of significance.

3. Results and Analysis

Table 1 shows that all students agreed on the positive effect of the group-based learning in mathematics, with the exception of only one STEM student. Their mean perceptions reflect that students agreed that group work encourages participation and motivation; promotes constructive learning environment; fosters positive attitude; enhances critical thinking; and helps obtain a deeper understanding of mathematics.

These findings do relate to the results of other studies which revealed that learning in group in mathematics makes students feel more ease, enables them to study better, helps them focus on the topic, which allows them understand better the subject [9]. It likewise builds confidence to them and enhances their understanding of mathematical concepts [10]. The approach motivates the students to learn and provides enjoyment while working jointly in groups [11]. It likewise promotes positive attitude in mathematics to learners [12].

It has been observed that when students engaged in a group, the more capable learners assist the less capable one, which creates in them a constructive learning set-up [13]. When mixed within the group, it gives opportunity to the struggling students to get over their anxieties about the subject [2]. As they worked with peers, it reinforces their mathematical knowledge and enhances the development of their critical thinking and analytical skills [2], [14].

Table 1. Perceptions on the positive and negative effects

Students	Positive Effect				Negative Effect			
	Agree		Disagree		Agree		Disagree	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
STEM	39	97.5	1	2.5	24	60.0	16	40.0
Science	40	100.0	0	0.0	8	20.0	32	80.0

Math	40	100.0	0	0.0	17	42.5	23	57.5

Table 1, on the contrary, presents that the students' responses were divided when asked about the negative effect of group-based learning. Considering their mean response, data shows that twenty percent (20%) of the Science students agreed that it gives pressure to individual. More than forty-two percent (42.5%) of the Math students agreed on same statement and also believed that the said approach holds one to be dependent. Sixty percent (60%) of the STEM students conformed to the opinion of the Math students that group work makes one pressured and dependent and likewise felt that it also dismays one to engage due to low participation of others. On the other hand, the overall mean response of the three groups indicates that they all disagreed that the practice reflects unfair evaluation and consumes too much class time.

Studies similar to this, disclosed that there may be pressure in the group work because of the need to conform to the majority. A member of a group may feel pressure to agree to the group's solution or decision even though that individual is not amenable just to avoid conflict [15]. Other research exposed that the most salient problems in group work is when some members do not adequately contribute to the group and rely too heavily on others [16]. The major reason for students' decision not to participate or may be reduce their engagement was due to lack of contribution of other members of the group [17].

According to research, the process of assessing students working in group is difficult and incoherent because even though students are working collaboratively, they have to be evaluated individually [18]. There were some students who viewed the assessment in group work as unfair having no regard to individual contribution [19]. Moreover, it has also been observed in some studies that a number of teachers experienced challenges in evaluating students' achievements when students worked in group [20]. Some research findings also affirmed that the group-based learning approach requires much greater preparation, not only for teachers, even for students to be able to work independently in groups [18].

Table 2 shows that STEM students, based on their mean response, agreed on the positive (3.21) and negative (2.55) effects of group-based learning. On the other hand, the Science and Math students strongly agreed (3.55 and 3.37, respectively) on its merits while disagreed (2.16 and 2.46, respectively) on its drawbacks. Clearly, these two groups believed that there are more benefits than risks when students are engaged in group-based learning.

Table 2. Perceptions based on mean response

Students	**Positive Effect**		**Negative Effect**	
	Mean	**Description**	**Mean**	**Description**
STEM	3.21	agree	2.55	agree
Science	3.55	strongly agree	2.16	disagree
Math	3.37	strongly agree	2.46	disagree

Although most studies related to this confirmed that this learning approach produced a wide range of positive outcomes, yet this type of learning does not work automatically for all learners [21]. Group-based activities, may lead to unsuccessful implementation, if there is a lack of understanding of the important elements that arbitrate the effectiveness of the said approach [2].

Literature tells that the random selection of group members can be highly unbalanced and thus can likely lead to an ineffective composition of groups [22]. Personal differences can also be a reason that made students' collaboration not successful in many cases [22]. Moreover, its drawbacks may also be attributed to some issues in operation such as diffusing the responsibility, having vague objectives, and allotting shorter time to students to learn individually [23].

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Table 3. Difference in perceptions

Students	Positive Effect		Negative Effect	
	p-value	Interpretation	p-value	Interpretation
STEM & Science	0.000199	significant	0.000157	significant
Science & Math	0.044911	significant	0.003939	significant
Math & STEM	0.079969	not significant	0.341000	not significant

Interpretation: Significant at $p<0.05$.

To determine the difference in students' perceptions, the computation of t-test for independent samples was carried out. Table 3 reflects that the perceptions of the Science students when paired with the STEM and Math students found to be significantly different both for the positive (with p-values of 0.000199 and 0.044911, respectively) and negative (with p-values of 0.000157 and 0.003939, respectively) effects. As reflected earlier in Table 2, this may be attributed to the extreme high response given by the Science students on the benefits, which they strongly agreed (3.55) and their extreme low response on the risks, which they disagreed (2.16) as compared to other groups.

On the contrary, no significant difference was found when the response of the Math students were paired with STEM students, which was seen consistent for the beneficial ($p=0.079969$) and shortcoming ($p=0.341000$) effects of group work. These findings on the varied opinions of the respondents on some issues do relate to similar experiences described in some studies.

Clearly, group-based learning is a pedagogical practice that a particular approach may not fit to all types of learners. The approach must be customized to fit on the types of learners, fields of discipline and learning goals [24]. Managing this type also has its different challenges because of different dynamics employed in the operation [8]. Literature suggests that facilitators of this learning should carefully assess which group approach are typical for students and which activities should be blend together to achieve more effective collaboration [22]. Though it is a widely known learning practice that promotes academic achievement and socialization of learners, yet many educators still struggle in the implementation of this in their classes [20].

4. Conclusion and Recommendation

Overall, majority of the respondents believed that there were more merits than drawbacks when they were engaged in group-based learning in mathematics classes. The varied opinions of the students depend on the levels and fields of interest of the learners. By understanding the pros and cons of group work approach, educators may get most out of the benefits and minimize the occurrence of problems that may hinder the success of achieving the goal. Educators must be mindful of how best to facilitate group activities suitable to the learners' needs.

In engaging students to work in groups, there will always be some pros and cons as learning progresses. The approach may not always work well, but being prepared whenever this happened is essential in managing such type of learning set-up. To minimize the occurrence of some issues during its implementation, the following may be considered by the mathematics educators in the design of their instructional plan: (1) study first the background of the learners as well as their needs; (2) inform the students of the structure of the group work activity, including the selection of group members; (3) build a favorable environment that learners will not feel pressure in accomplishing task; (4) monitor every student so as one will not rely much on others; (5) create a suitable way of assessing individual's contribution; (6) develop a staged and sustained approach in its operation; and (7) make an alternative plan and apply if circumstances required, but consider the best that will blend to the learners' needs.

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