Differential effects of seating arrangements and sociometric relationship on students' attitude towards mathematics

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ABSTRACT

Although quite a few studies conducted the effect of seating arrangement and peer factor to students' attitude toward a specific course such as math, several educators believe that it is crucial for learning performance. Different seating arrangements provide students dynamic educational experiences and peer-relationship creates impact on students' academic achievement. Looking through these possibilities, it is an important decision to consider since both factors possibly play a significant role in the optimization of students' performance. Quasi-experimental design was conducted to investigate the effect. Specifically, a Likert scale pre-test/post-test between-group design was employed to the three groups: one control group and two experimental groups. Also, sociometry assessment was formulated through Glasser's Choice Theory where people rely their choices based on five primary needs: survival, love and belonging, power, freedom, and fun. Rearranging the seating arrangements, experimental groups were rigorously analyzed based on two assumptions: (1) the mean score of the student's ATM versus the mean score of the sociometry; and (2) mutual relationship that indicates good motivation (Ariani, 2017). Analysis of covariance (ANCOVA) was performed to assess the effects of the treatment. Students experiencing either sociometry-based traditional or horseshoe seating arrangement reported more positive attitude towards math than did students experiencing mere traditional seating arrangement. The result from this study is deemed beneficial to the educators and students to optimize learning environment.

Keywords*: attitude towards math; choice theory; quasi-experimental research design; sociometry; seating arrangement.*

INTRODUCTION

As years go by, classroom management and teachers' pedagogical approaches change, so does the classroom seating design. Seating arrangement is meaningful to the classroom setting, and is essential to students' behavior with regards to performance (Haghighi & Jusan, 2012). Based on the observations of the researchers in most classroom settings, the students on the front seats perform better compared to those who seat on the back. Assumptions were made that seating location may drive as a significant factor on the academic performance of students (Ngware, Ciera, Musyoka, & Oketch, 2013; Meeks et al., 2013; and Haghighi & Jusan, 2012).

Aside from the effects of seating arrangements on student's performance, peer support is another factor to consider (Estell & Perdue, 2013). Peer relationships drive students to participate in school activities, and those students who are more motivated are more likely to have the higher academic achievement (Juvonen, Espinoza, & Knifsend, 2012; Bullock, 2017). Therefore, social support from peers will

influence students' academic motivation. In other words, interpersonal relationships or social relationships will encourage the academic performance of students (Ariani, 2017).

Although quite a few studies conducted the effect of seating arrangement and peer factor to students' attitude toward a specific course such as math, despite the fact that seating arrangement and peer-relationship may sound uncommon, several educators have confidence that it's crucial for learning. Altering seating arrangements and peer-relationship, which plays a great factor in the academic achievement of students, provide a different educational experience. It is an important decision to consider since both factors possibly play a significant role to enhance students' performance.

In this context, the researchers aim investigate the differential effects of seating arrangement and sociometric relationship on students' attitude towards math. Understanding how seating arrangement and peer relationship being applied to every classroom unlocks the possibility to identify a teaching-learning process that is favorable and more conducive to learning. Harvey and Kenyon (2013) once stated, that there is a need of campuses to (re)consider the purpose and roles of seating styles within the 21st century classrooms.

METHOD

The theoretical foundations of this study have rooted in the knowledge of William Glasser's (1998) Choice Theory. According to his theory, the behavior is a choice constructed by a particular individual which is based on his or her emotions and needs and is therefore not purposeful or controlled by external situations. In other words, every individual has the power to decide how and what he or she will behave to specific desires of the social and physical environment that may influence his or her well-being. There were five primary needs discussed by Glasser (1998). These were (1) survival, (2) love and belonging, (3) power, (4) freedom, and (5) fun. These basic needs guide all human behavior and constitute the source of all internal motivation. If teachers see the importance of these needs, they can create and transform their classroom into places where students desire to learn, produce high-quality work, and behave responsibly (Gabriel and Matthews, 2011). The Sociometry of Jacob Levy Moreno (1993) express how people are related to each other. Measurement of interconnections can be useful not only in the assessment or evaluation of behavior within groups but also for interventions to bring about positive change and for determining the extent of change.

In this study, the researchers utilized a quasi-experimental design specifically between-group design, where pre-test/post-test design were being employed. Creswell (2012) stated that quasi-experimental design include assignment, but not random assignment of participants to groups. This is because the experimenter cannot artificially create groups for the experiment. This might happen because of the availability of the participants or because the setting prohibits forming artificial groups. Between-group quasi-experimental design, he added, is the most frequently used to compare two or more groups.

Cook and Campbell (1979) added that quasi-experiments involve administering a treatment like true experiments. Unlike true experiments, though, participants are not randomly assigned to treatment. Consequently, when evaluating the effects of many real-world treatments, using quasi-experimental designs is often the researcher's best option. This design is so useful for assessing the effects of real-life treatments.

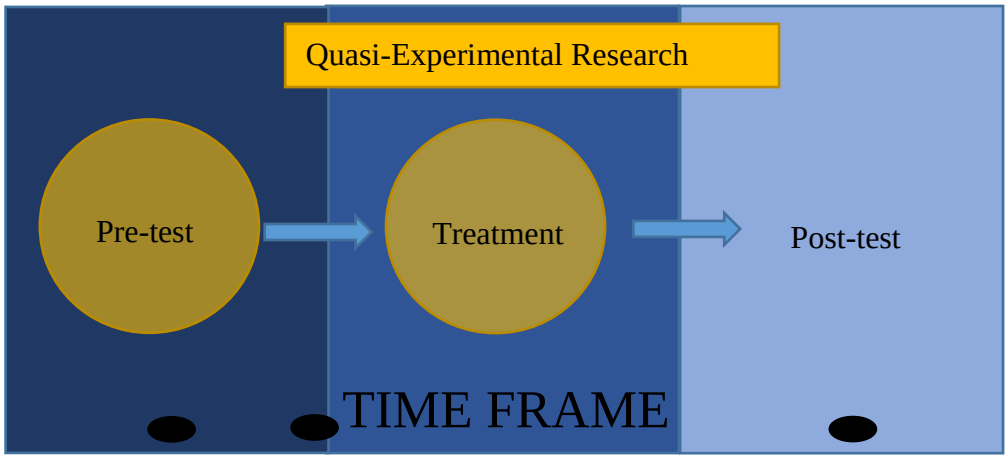

Figure 1. The quasi-experimental research- pretest-posttest design as used in this study

Table 1 shows the corresponding treatments of each group. Group A- the control group, is the typical seating arrangement of the students which is the traditional type of seating arrangement. Group B is the first experimental group in which sociometric based traditional seating arrangement is used as the treatment. Group C is the second experimental group in which sociometric-based horseshoe type of seating arrangement is used as the treatment. The researchers used this design because of the restrictions in creating artificial groups for the experiment, instead used existing groups. Since it is very prone to potential threats, the researchers put importance on considering those variables that may co-vary to the dependent variable. Therefore, those variables have been controlled and observed.

Table 1. The treatment setup of the study

		Treatment			
Group	Pretest	Traditional	Horseshoe	Sociometry	Post-test
A-Control Group					
B-Experimental Group	●	●		●	●
C-Experimental Group	●		●	●	●

The quasi-experimental research participants consists of 3 groups to compare with. The researchers aim to gather accurate results where extraneous variables are controlled (Cook and Campbell, 1979), hence, samples are deemed homogeneous since they are all grade 11 students. 112 students were involved in the study, 32 students on control group (Group A), 40 students on experimental group with traditional seating arrangement (Group B), and 40 students for the last experimental group with horseshoe type of seating arrangement (Group C). Both experimental groups are treated with Sociometry assessment.

Researcher's primary source of data has adopted with modification from Tahar, Ismail, Zamani, and Adnan (2010) that was used during the administration of pre-test/post-test. The result was used for comparison during analysis. Also, another source of data is a research-made test Sociometry to assess the relationship between the students which were then analyzed visually to create a seating arrangement for the treatment groups. Rearranging the seating arrangements, experimental groups were rigorously analysed based on two assumptions: (1) the mean score of the student's ATM versus the mean score of the sociometry; and (2) mutual relationship that indicates good motivation (Ariani, 2017).

After collecting the means and the sociometry results of the pre-test, we implemented the treatment to the experimental groups for 15 days (3 school weeks). 15 days are prone to extraneous variables that are

needed to be controlled. During the monitoring process, we closely follow the process to ensure that the experiment is in order and expect accurate results. We constantly remind the teacher to have his normal routine in the class to avoid bias and disclosure about the experiment to retain the validity of the results.

Post-test was administered after 15 days of treatment. Data have gathered the results in pre-test as well as in post-test. The results undergo analyzation by comparison of pre-test/post-test and post-test to post-test in each group. The researchers utilized distinctive measurable instruments to analyze data and infer accurate results based on the given data.

RESULTS AND DISCUSSION

Quasi-experimental study was conducted to investigate the differential effects of seating arrangements and sociometric relationship on student's attitude towards math. Two instruments were used in this research: (1) Likert scale that measures the students' attitude towards math was administered as a pretest and posttest; (2) Sociometry that measures relationships of students in a classroom was administered only as a pretest that would be the basis for the seating arrangement plan. Data collected were analyzed using the Statistical Package for the Social Sciences (SPSS) to establish cause and effect relationships between the students' attitude towards math of a mere traditional seating arrangement, sociometric-based traditional seating arrangement, and sociometric-based horseshoe seating arrangement. Each of the statistical tests required to investigate the three research questions and alpha confidence of 0.05 was established.

Likert Scale. To assess the effect of sociometric-based seating arrangements on the student's attitude towards mathematics, the analysis of covariance is used. ANCOVA, using the pretest mean scores as a covariate, determined whether the adjusted posttest mean scores between the three populations grouping: (a) two experimental group of sociometric-based seating arrangements, and (b) a control group of a mere traditional seating arrangement, were significantly different (F-Probability at the confidence level of .05). The data were analyzed using the following independent variables:

Group A (Control Group)
- Grade 11 Senior High STEM Students
- N = 32
- Mere Traditional Seating Arrangement

Group B (Experimental Group I)
- Grade 11 Senior High STEM Students
- N = 40
- Sociometric-based Traditional Seating Arrangement

Group C (Experimental Group II)
- Grade 11 Senior High School STEM Students
- N = 40
- Sociometric-based Horseshoe Seating Arrangement

The ATM Likert scale was processed with a 0.868 Cronbach's alpha test of reliability. The tool consists of 21-item questionnaires on a five-point scale. The scale ranged from 5 points for "Strongly Disagree" to 1 point for "Strongly Agree." The point scale was reversed on items 1, 2, 7, 9, 18, 19, 20, and 21 which were written in negative terms. Data were analyzed to an overall ATM mean scores.

Sociometry. A Sociometry tool was used to measure the relationships existing in each group, which a criterion "List ten classmates whom you can freely express your ideas, with whom you are comfortable,

and through whom you can get motivated to learn math" is used. Using GeoGebra, for the sake of visualizing the sociogram, the researchers manipulate the seating location of each student. The basis for indicating where to sit and whom to sit with are: (1) the mean score of the students' ATM versus the ATM mean score of the group; and (2) peer (mutual) relationship indicates good motivation (Ariani, 2017), hence performance. This instrument was only administered during the pretest of each group. Figure 2 shows the actual seating arrangement plan of experimental group B after the pretest was taken, while Figure 3 shows the actual seating arrangement plan for experimental group C after the pretest was taken.

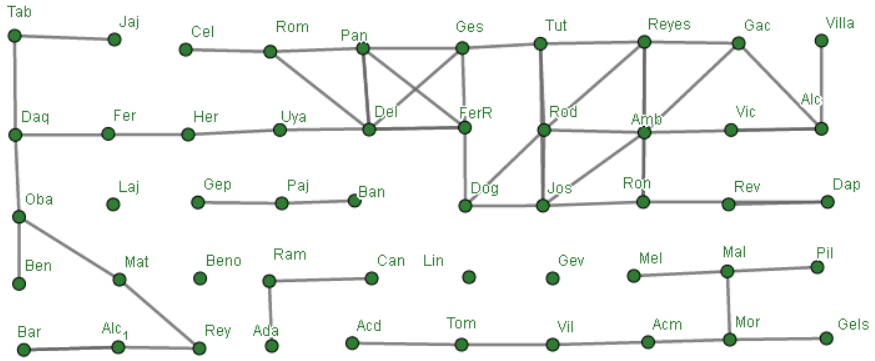

Figure 2. Sociometric-based seating arrangement experimental group B

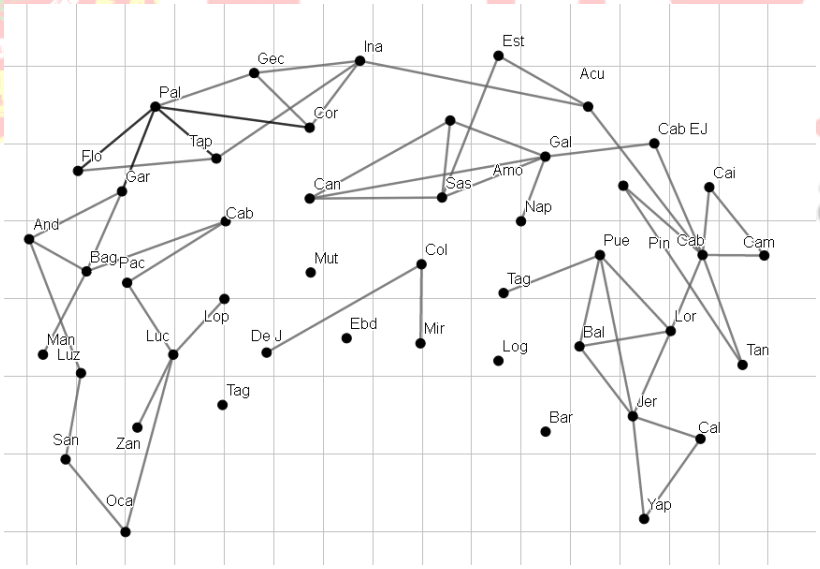

Figure 3. Sociometric-based seating arrangement experimental group C

ANCOVA was implemented to assess the effect of sociometric-based seating arrangements on the student's attitude towards mathematics. Table 1 revealed that (1) the sociometric-based seating arrangements had significant main effect on the students' attitude, $F(2, 105) = 180.04$, $p = .001$, partial eta squared $\eta^2 = .83$. The covariate, pretest on the math attitude scale, was significantly related to the students' math attitude during posttest, $F(1, 105) = 539.79$, $p < .001$, partial eta squared $\eta^2 = .83$. (2) There was also a significant effect of either sociometry-based seating arrangements on the students'

attitude towards math, after controlling for the effect of pretest scores in attitude scale, $F(2, 105) = 7.06$, $p < .01$, partial eta squared $\eta^2 = .12$.

Specifically, (3) planned contrasts revealed that sociometric-based traditional seating arrangement (*adjusted M* = 2.37) had significantly higher positive effect on students' attitude toward math, than did traditional seating arrangement, (*adjusted M* = 2.16), $t(105) = 2.09$, $p < .05$, effect size $r = .20$. Similarly, sociometric-based horseshoe seating arrangement (*adjusted M* = 2.28) had significantly higher positive effect on attitude than did the latter, $t(105) = 3.76$, $p = .001$, effect size $r = .34$. In summary, students experiencing either sociometry-based traditional or horseshoe seating arrangement reported more positive attitude towards math than did students experiencing mere traditional seating arrangement. Similar positive effect on the students' attitude towards math, when compared with a mere traditional seating arrangement.

Table 1. One-way ANCOVA of the effect of seating arrangements on the students' attitude towards mathematics

Group	*N*	*Adj M*	*SE*	*F*	*P*
Traditional (control)	32	2.16	0.04		
Traditional + sociometry	40	2.37	0.38	180.04	.000
Horseshoe + sociometry	40	2.28	0.37		

Note: Adj M = adjusted mean computed after controlling for the covariate's effect; SE = standard error for the mean

CONCLUSION AND RECOMMENDATION

Sociometry is a tool to measure ones' relatedness to the group. Some use it to know the interrelationship occurring within the group. It is at most useful if you apply the results of the Sociometry which unlocks the full potential not only for the individual but the group performance.

The result shows that there is a significant effect of the application of Sociometry in different seating arrangement on students' attitude towards math. This research agrees with Ariani (2017) which stated that peer relationships motivate students and students who are more highly motivated will have the higher academic achievement (Juvonen, Espinoza, & Knifsend, 2012; Bullock, 2017), thus, affects the students' attitude towards the specific course.

The results also reveal that there is a significant positive effect of the sociometric-based seating arrangements on attitude towards math. This implies that the Sociometry tool helped the students to make better choices since they were arranged according to the results of the Sociometry given to them.

For researchers, Time-series quasi-experimental design is highly recommended because these research wanted to investigate a change of attitude in which long-term of observation is required. In arranging students, a well-developed algorithm is encouraged in applying the Sociometry results to a classroom seating arrangement setting considering age, gender, Sociometry versus Likert scale results, and location preference. For teachers, it's highly recommended to do action research using this design to arrange students in the classroom and test whether it conveys the same result.

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