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Using Peer Mentoring-Buddy System as an Intervention Strategy to Enhance Science Research Skills

Hazel R. Balan

Gingoog City Comprehensive National High School, Gingoog City, Misamis Oriental, Philippines
Corresponding author: Hazel R. Balan, email: msciedhrb@yahoo.com

Abstract

Students have difficulties in conducting science research. In an attempt to enhance students' interests and skills in conducting science investigatory projects, this study designed and used the peer mentoring-buddy system as an intervention strategy to address the identified needs of students concerning their research skills. This paper also determined the effectiveness of the system and examined if there is a significant difference in the perceptions of both genders. This study also determined the percentage of project completion among students provided with the peer-mentoring. The descriptive action research design was used. The validated Students' Needs Assessment Survey Instrument was distributed to a total of randomly selected 45 junior high school students (28 female and 17 male) of Gingoog City Comprehensive National High School, Philippines. The researcher developed and implemented the peer mentoring-buddy system from June 2013 to February 2014 to address the identified research needs. The system was evaluated in the month of March using the validated Peer Mentoring Survey Questionnaire. The weighted mean, percentage, and t-test were the statistical tools used. Results of the study revealed that using the system was very effective in addressing the high level of student needs regarding their research skills. The female students have better perception regarding the effectiveness of the system than male students ($p<0.05$). Despite the differences in the perceptions of both genders, the system was found to be very effective since all proponents finished their studies and some projects won in the science fair competitions at regional and national level.

Keywords: competitions, effectiveness, perceptions, projects, studies

Introduction

One of the engagements that students do to explore and explain science concepts is through science investigatory projects. These hands-on and minds-on activities provide students with practical experience in applying the scientific method that helps stimulate their interest in scientific inquiry. The conduct of investigatory projects is regarded as an inquiry-based learning of the scientific method (Jugar, 2013). As Novak (2002) stressed, a better understanding of the scientific concepts means to engage actively in meaningful learning, to seek how new concepts can relate to prior knowledge, and use new conceptual understanding to explain experiences encountered.

Through the Bureau of Science Education (BSE), the Department of Education (DepEd) spearheads the annual conduct of Science and Technology Fair (STF) celebration through Science Investigatory Project (SIP) competition from the particular local school setting to the national level. The STF aims to promote science and technology consciousness among young students through actual conduct, exhibit, oral presentation and defense of science investigatory research projects. Ultimately, it seeks to identify the most creative or innovative work. The activity also selects the best science researchers who will represent the country in the Intel International Science and Engineering Fair (Department of Education, 2012).

Gingoog City Comprehensive National High School (GCCNHS) offers a science class under the Science, Technology and Engineering Program (STEP). As such, the students are required to engage in science investigatory projects. Students have the opportunity to expose themselves to the rudiments of conducting science research, writing research reports, and preparing for congress in science fair competitions (Department of Education, 2010).

However, the study of Balan (2013) revealed that both third-year students and fourth-year students of GCCNHS under the STEP need sufficient research skills, resources, and positive attitude towards the conduct of science investigatory projects. The preceding, therefore, presents that most of the students have difficulties in doing science investigatory project.

Peer mentoring or buddy system is shown to support effective learning (Bojuwoye et al., 2014). The approach uses older students to teach their younger counterparts. A more qualified student plays as the peer mentor to the new student (Bozeman & Feeney, 2007). This system has achieved remarkable results in schools and has a positive effect on both parties (Grossman & Tierney, 1998). Peer mentoring model adds value to existing support in high schools (Brady et al., 2014).

Mentoring is an intervention that has been proven highly efficient and has become popular in recent years (Crosby, 2003; Karcher et al., 2005). In the study of Rhodes (2001), mentoring relationships have a positive influence on a broad range of outcomes that include improvements in peer relationships, academic achievements, and self-concept. The results of mentoring include lower recidivism rates among juvenile delinquents and reductions in substance abuse (Davidson et al., 1998). Furthermore, mentoring has been shown to help students achieve better grades, establish attainable goals, and enhance their self-esteem when partnered with caring and supportive mentors (Clasen & Clasen, 1997; Flaxman, 1988; Johnson, 2007; Smink, 1990).

In the Philippines, the study of Saygo (2005) at Pangasinan State University-Bayambang Campus showed that the students encountered moderate difficulty regarding research skills, economic resources, and time management. They also encountered difficulty concerning human resources. Thus, more information and activities for the students will broaden their knowledge regarding conducting an investigatory project. In an action research conducted at Pedro Guevara Memorial National High School, Santa Cruz, Laguna, results revealed that the use of science investigatory projects enhanced students' performance in research (Tobias, 2006). However, Tan (2012) of National Institute for Science and Mathematics Education Development (NISMED), University of the Philippines presented some deficiencies in conducting students' science investigations.

In an attempt to enhance students' interests and skills in conducting science investigatory projects, this study designed and used the peer mentoring-buddy system as an intervention strategy to address the identified needs of students concerning their research skills.

This paper also determined the effectiveness of the system and examined if there is a significant difference in the perceptions of both genders. Moreover, the study determined the percentage of project completion among students provided with the peer-mentoring. The effectiveness and success of the mentoring-buddy system would serve as the basis for school's continuous improvement plan to strengthen the implementation of STEP. The outcome of this study can provide a mechanism to enhance the research skills of students doing investigatory projects in other grade levels.

Materials and Methods

Research design

The study used the descriptive action research design. The needs of the students concerning their research skills of conducting science investigatory projects were identified, and the mentoring-buddy system intervention strategy was used to address these needs. The descriptive design also determined the perceptions of students regarding the effectiveness of the peer mentoring-buddy system used in this study.

Respondents of the study

The respondents of the study were 45 junior high school students (28 female and 17 male) enrolled at GCCNHS during the school year 2013-2014. Among the respondents, 36 were Grade 10 students under the STEP, five students from Grade 8 and four from Grade 7.

Sampling design

Simple random sampling was used in selecting the respondents from the target group. Students who were tasked to conduct science investigatory projects for science fair competitions were the target group. The course required these students to complete the projects. The sample size was determined using the Sloven's formula (Olatunde & Joshua, 2012) with 95% level of confidence.

Intervention

The researcher designed and used the peer mentoring-buddy system as an intervention strategy to address the identified needs of students concerning their research skills in conducting science investigatory projects. Peer mentors were students who have some experiences in doing science investigatory projects and have joined science fair competitions at least at the regional level. The peer mentors received training to achieve the required knowledge and skills in conducting science research projects. Ten mentors were selected for the study. Both mentors and mentees answered the survey questionnaire.

The mentees or buddies had several mentors that guide them throughout the conduct and completion of the study. The mentors were responsible for the checking and improvement of the manuscript before submission for final corrections and approval of the teacher or project adviser. The mentees also shared ideas and helped other mentees or buddies.

The mentors required the mentees to meet them at least 30 minutes daily or three hours every week after school hours or any time convenient to them. The mentees had to fill in the logbook and mentoring slip for the mentors to monitor the progress of the study. Figure 1 is the flow diagram of the mentoring-buddy system.

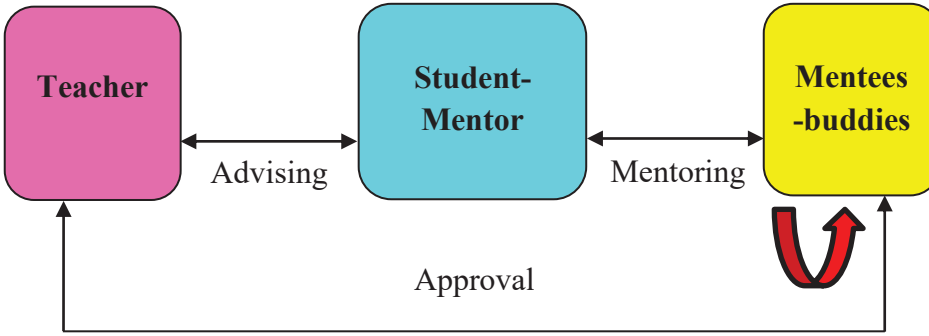

Figure 1. Flow diagram of the mentoring-buddy system.

Research instruments

Two survey instruments were developed for the study. The first instrument was the Students' Needs Assessment Survey (SNAS) and the other was the Peer Mentoring Survey Questionnaire. The results of the pre-assessment or analysis conducted with some students, a science teacher, and a research project adviser were the bases in framing the items in the instruments. The survey questionnaires consisted of 10 Likert-type items.

The science education program specialist, science department head, science research paper adviser, research expert and Math teacher validated the instruments. They examined the appropriateness of the questionnaires by using an expert judgment form. The students also verified the clarity of the terms.

The researcher subsequently conducted the pilot test using the test-retest method on a sample of 20 students of GCCNHS to establish the reliability of the instruments. The calculated Cronbach's alpha values of 0.82 for SNAS and 0.84 for peer mentoring survey questionnaire are closer to 1.0 which suggest that the items in the instruments are reliable. Fraenkel and Wallen (1996) suggested that reliability should be at least 0.70 and preferably higher as a useful rule of thumb for research purposes.

Data gathering procedures

The permission from the Science Area Department Head and School principal to carry out the study in the school was obtained. Before the distribution of the survey questionnaires, the nature and purpose of the study were discussed with the students. The researcher also informed the students that they could raise questions in case of uncertainties and misconceptions. The respondents accomplished the survey questionnaires on a four-point Likert scale. The respondents were reminded to check their answer for each item to keep off from missing data. The accomplished questionnaires were retrieved and sorted in a different envelope for each class.

Scoring and quantification of data

The four-point scale with the range below was the basis for the score of each response (Sclove, 2001):

A. Students' Needs Assessment Survey (SNAS)

Scale	Mean Range	Verbal Description	Interpretation
4	3.50 - 4.00	Very much a need	Very high
3	2.50 - 3.49	Moderately a need	High
2	1.50 - 2.49	Slightly a need	Low
1	1.00 - 1.49	Not a need	Very low

B. Peer Mentoring Survey Questionnaire

Scale	Mean Range	Verbal Description	Interpretation
4	3.50 - 4.00	Strongly Agree	Very effective
3	2.50 - 3.49	Agree	Moderately effective
2	1.50 - 2.49	Disagree	Less effective
1	1.00 - 1.49	Strongly Disagree	Not effective

Statistical treatments

The data were compiled, sorted out, organized and tabulated for statistical treatments to facilitate the presentation, analysis, and interpretation. The statistics used includes the weighted mean, t-test, and percentage.

Results and Discussion

Table 1 revealed the level of students' needs concerning their research skills of conducting science investigatory projects. The level of needs was very high in all the indicators assessed, and the responses of the students were similar. The result implies that the respondents perceived that their research skills are indispensable in doing research work.

Table 1. The level of student's needs concerning the research skills of conducting science investigatory projects.

Indicators	Weighted mean	Verbal Description	Interpretation
As a student investigator			
1. I should know how to identify problems for the study.	3.86	Very much a need	Very high
2. I should know how to formulate objectives and hypotheses.	3.75	Very much a need	Very high
3. I should know how to identify independent and dependent variables.	3.89	Very much a need	Very high
4. I should know how to state background of the study.	3.83	Very much a need	Very high
5. I should know how to relate significance/importance of the study.	3.78	Very much a need	Very high
6. I should know how to design appropriate method/procedure for the study.	3.83	Very much a need	Very high
7. I should know the appropriate parameter/variables in collecting data.	3.92	Very much a need	Very high
8. I should know the correct ways of collecting data with accuracy and use of precise instruments.	3.75	Very much a need	Very high
9. I should know how to present data in tables/graphics.	3.72	Very much a need	Very high
10. I should know how to analyze data and to draw out conclusion.	3.86	Very much a need	Very high
Overall Weighted Mean	**3.82**	**Very much a need**	**Very high**
Coefficient of variation (CV)	**1.74%**		

The highest weighted mean obtained was on the use of appropriate parameters or variables in collecting data by fourth-year students. As noted, they have difficulty in finding appropriate parameters and standard measurements. For instance, the students manifested the difficulty in a study on the formulation and evaluation of the effectiveness of soap from a certain plant extract. They have much difficulty to test how effective the soap is, which may include physical, chemical and microbiological tests.

Identifying the independent and dependent variables followed next regarding their level of needs as seen in the value of weighted mean obtained. Formulating problems for the study, analyzing data, and drawing out conclusion were among the top three as to the level of needs regarding their research skills.

Nevertheless, students do not have much difficulty in presenting data in tables or graphics as this indicator obtained the lowest weighted mean. The overall finding of this study regarding the level of students' needs in research confirms the study of Tan (2012) of UP NISMED, Philippines.

Figure 2 presents the peer mentoring-buddy system design. The Gantt chart shows the peer mentoring intervention process. The mentoring started with planning with mentors and preparation of all materials needed. Needs assessment and orientation with student mentors and mentees took place at the first meeting in the month of June. The roles and tasks were assigned to the mentors and mentees. The implementation proper of the peer-mentoring system started in the month of June until February. The evaluation of the system that aimed to assess the effectiveness of the peer mentoring-buddy system in doing science investigatory projects was conducted in the month of March.

Phase	Months of Implementation (2013-2014)										
	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar
1. Planning and Preparation											
- Mentors											
2. Getting Started											
- Needs Assessment - Orientation											
3. Implementation											
a. Identifying Problems											
b. Formulating Hypothesis											
c. Identifying Variables											
d. Research Design											
e. Research Plan											
f. Letter and Forms											
g. Writing Introduction											
h. Writing Objectives, Significance, Scope											
i. Writing RRL											
j. Experimentation											
k. Data Processing											
l. Results											
m. Discussion											
n. Conclusion											
o. Recommendation											
p. References Cited											
q. Finalization of Manuscript											
r. Research Congress											
4. Evaluation											

Figure 2. Gantt chart of the implementation process of peer mentoring-buddy system.

Table 2 presents the results about the effectiveness of the mentoring-buddy system. Overall findings showed that female students strongly agreed that the system is very effective in enhancing science research skills while the male students admitted that the system is moderately effective.

Table 2. Students' responses on the level of effectiveness of the mentoring-buddy system.

Dimensions	Weighted mean (Female)	Verbal Description	Interpretation	Weighted mean (Male)	Verbal Description	Interpretation
Mentoring-buddy system						
1. stimulates your interest in doing science investigatory project.	3.84	Strongly Agree	Very effective	3.47	Agree	Moderately effective
2. provides you clearer idea and understanding in the conduct of science investigatory project.	3.84	Strongly Agree	Very effective	3.76	Strongly Agree	Very effective
3. enhances your skills in conducting science investigatory project.	3.73	Strongly Agree	Very effective	3.29	Agree	Moderately effective
4. motivates you to finish your science investigatory project.	3.84	Strongly Agree	Very effective	3.17	Agree	Moderately effective
5. helps you complete the project on time.	3.84	Strongly Agree	Very effective	3.29	Agree	Moderately effective
6. provides you support and help in solving problems in the conduct of the project.	3.94	Strongly Agree	Very effective	3.47	Agree	Moderately effective
7. helps you establish good rapport and working relationship.	3.84	Strongly Agree	Very effective	3.29	Agree	Moderately effective
8. is a method for having a successful science project.	3.89	Strongly Agree	Very effective	3.52	Strongly Agree	Very effective
9. boosts your self-esteem and confidence to conduct science projects.	3.63	Strongly Agree	Very effective	3.11	Agree	Moderately effective
10. helps you display creativity, resourcefulness and inventiveness.	3.42	Agree	Moderately effective	3.11	Agree	Moderately effective
Mean	**3.78**	**Strongly Agree**	**Very effective**	**3.35**	**Agree**	**Moderately effective**
CV	**4.04%**			**6.17%**		

The perceptions of the students across gender regarding the effectiveness of the system differed in some dimensions. Female students strongly agreed that nine of the ten dimensions of the system were very effective and their responses are comparable. On the other hand, the male students strongly agreed that only two dimensions were very effective while the others were considered moderately effective. Their responses are also comparable.

Female students believed that mentoring-buddy system is very effective in providing support and help to students in solving a problem. This dimension obtained the highest weighted mean. Similarly, female students also strongly agreed that mentoring-buddy system is very effective in stimulating students' interest in doing science investigatory projects. They also strongly agreed that the system was very effective in enhancing the skills of conducting science investigatory project, and in motivating them to finish the projects on time. The mentoring buddy system was also very effective among female students in helping them establish good rapport and working relationship as well as in boosting their self-esteem and confidence. On the other hand, the results regarding the effectiveness of these dimensions were different with the male students who only considered them moderately effective.

Nevertheless, there was also a similarity in the perceptions of the students across gender regarding the effectiveness of the system in two dimensions. Both female and male students strongly agreed that mentoring-buddy system is very effective in providing students clearer idea and understanding in the conduct of science investigatory projects with the male respondents giving this dimension the highest mean. In both genders, the system was very effective in having a successful science project.

However, in both genders, the system was only moderately effective in helping students display their creativity, resourcefulness, and inventiveness with the male students giving this dimension the lowest mean. This result is in conformity with the actual observation in the classroom setting that female students were more assertive to ask help and assistance from mentors-buddies than male students who were hesitant to approach and to work well with mentors. Taking into account the gender in a mentoring relationship, boys tend to strive more than

girls for autonomy during adolescence (Bogat & Liang, 2005). On this ground, mentors personally extended assistance and guidance to help male students finish their projects. The ability of the mentors to reach out to their mentees also plays a crucial role in this situation. Hence, the training received by mentors is critical to achieving the goal of peer-mentoring (Freire, 1997). The overall findings of this study regarding the effectiveness of the mentoring-buddy system are consistent with other studies (Clasen & Clasen, 1997; Flaxman, 1998; Johnson, 2007; Smink, 1990). These studies showed that mentoring had been shown to help the students establish attainable goals. Mentoring also has enhanced the self-esteem of the students when partnered with caring and supportive mentors. The results also support the statement of Lund (2002) that the principal purpose of the mentoring relationship is to pass on knowledge, share experience, and provide a background for more sound judgment. The implementation of mentoring programs as potentially successful approaches to address the needs of at-risk middle school students was also shown in the study of Lampley and Johnson (2010).

The t-test revealed a significant difference in the perceptions of male and female students regarding the effectiveness of peer mentoring-buddy system (Table 3). The perceptions of the female students about the effectiveness of the mentoring-buddy system in doing science investigatory project are better than the male students. The results are similar to the study of Stark and Gray (1999). In this study, the respondents performed well on tasks with context drawn from biology and on written tasks assessing science skills. The results also showed that through the mentoring-buddy system, 100% of the proponents were able to finish successfully their science research projects (Table 4). In the study of Tenenbaum et al. (2014), results showed that the mentorship model for secondary students supports the development of mentee and the mentor as well and offers a unique opportunity to integrate research in science, technology, and mathematics (STEM) internship. The model has contributed to personal, educational, and professional growth for near-peer mentors and increased the interest and engagement of STEM students.

Table 3. Test of difference between male and female respondents' perceptions on peer-mentoring buddy system.

Groups	Mean	Variance	Computed Value	Critical value at 0.05
Female (n=28)	38.53	4.26	4.759	2.0167
Male (n=17)	33.88	20		

*Significant at 0.05
df = 43

Table 4. Percentage of completion in the conduct of science investigatory projects.

Number of Projects		Percentage of Completion
Proposed	Completed	
26	26	100 %

Conclusion and Recommendations

The peer mentoring-buddy system was very effective in addressing the students' very high need concerning their research skills of conducting science investigatory projects. The system was very effective as an intervention strategy to enhance the research skills of students despite differences in perceptions of both genders. Students' better perceptions on the effectiveness of mentoring-buddy system contribute much in improving knowledge and enhancing science research skills. The use of mentoring-buddy system helped all proponents finished their work and won some projects in the science fair competitions at regional and national level. The peer mentoring-buddy system is strongly recommended for use in other grade levels in science program as well as in other subjects. There should also be more mentors to address the needs and number of mentees.

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