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Development, Validation, and Utilization of Quantitative Data Analysis Worksheets for Inquiries, Investigations, and Immersion (III)

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Abstract *– Inquiries, Investigations and Immersion (III) is one of the subjects in Senior High School that aims to strengthen further the skills of the students in problem-solving and critical thinking through conducting researches in any type they want (whether qualitative, quantitative, or mixed). In this study, the researcher developed worksheets for quantitative data analysis and pilot tested it to fifty Grade 12 students in a certain integrated high school. Results showed that the utilization of developed and validated quantitative data analysis worksheets improves the performance of students in the experimental group as compared to the control group. Also, a significant difference on the gain scores of control and experimental groups was seen in which the gain score in the experimental group is equivalent to four times the gain score of the control group. Hence, the study concluded that the use of worksheets in teaching quantitative data analysis ensure advancement of learning.*

Keywords *– Inquiries, Investigations and Immersion (III), Worksheets, Quantitative Data Analysis*

INTRODUCTION

Research is a precise and systematic process of gathering evidence for new discovery, skills, values to address a particular issue (Bocar, 2013). Across the globe, difficulties of conducting research among higher education institutions have been noted. These include foreign language problems, data analysis difficulties, gaps in publishing research, time management, collaboration and difficulties in resources (Yalçin &Altun, 2017). Same problems are also experienced by graduate students (Akyürek and Afacan, 2018) specifically in methods; planning; research problems, data collection tools, and data analysis. Similar scenario has been experienced by the undergraduate students who experienced difficulties in terms of time allotment to accomplish the research; research resources; intrinsic motivation of individuals or willingness of institutions to be part of the setting or share information; proximity of research location; knowledge about statistics to assess and analyze research data (Tan, 2007). Given the scenario in the academicians, graduate students and undergraduate students, high school students experience frustrations in terms of doing research. As found out by Torrendon (2017) conflicts in time management is one of the high school students' difficulties experienced in doing research. Torrendon (2017) also found that having not enough knowledge is one of the factors affecting difficulties. Despite emphasizing research in Senior High School curriculum, many students are still encountering problems that may consist of writing and organization, providing a thesis statement, and supporting it with relevant and adequate information (Cabral, 2019).

In the Senior High School program implementation under the Enhanced Basic Education Curriculum, the subject Inquiries, Investigations, and Immersion highlights the development of problem-solving and critical thinking skills through conducting research. In this subject, students are prepared to focus on concerns in their respective fields, conceptualize vividly the statement of research problems, read related studies, understand ways to collect data, find answers to the research questions, report their findings, and share their research (Curriculum Guide, Inquiries, Investigations and Immersion, 2013). In one of its competencies, learners are expected to analyse and interpret data. In analysing the data, knowledge of appropriate quantitative or qualitative data analysis procedure is very important.

Quantitative research relies on measuring variables using a system of numbers. It also involves analysing measurements using varieties of statistical models and reporting associations and correlations among variables of concern (Research Methods, 2018). In the most basic terms, it is collection and analysis of data that is well-organized and numerically represented.

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Accuracy and reliability are the central goals of this research methods with the use of statistical analysis (Goertzen, 2017) and quantitative research relies heavily on sample data (Lutabingwa, J & Auriacombe, 2007). Using this sample, with the help of appropriate sampling technique, a researcher can provide generalization about the population being studied.

Instructional written materials play a very significant role as teachers' mediators to an effective teaching practice. According to Lee (2014), worksheet is one of the most frequently used materials in teaching. Several studies proved the effectiveness of worksheets in teaching. Megahati and Susanti (2014) found that student's worksheet based on mastery learning was found effective since it could increase learning outcomes of the students in each activity.

Meanwhile, according to Yildirim et al. (2011), materials such as worksheets provide opportunities to the students since they are given step-by-step explanations on the things that they are supposed to do and learn. In the worksheets also, students are given responsibility of their own learning. For this reason, worksheets are prominent in helping students to obtain necessary skills such as experimental mechanism, data recording, data interpretation, and conceptualization

In this study, the development, validation and utilization of quantitative data analysis worksheets were tackled and realized. As supplemental learning tools, worksheet is expected to enhance capability of the students in identifying appropriate quantitative research treatments as well as giving proper interpretation of the data being gathered by the students in their quantitative research. This research undergone three phases: phase I focuses on the development of worksheets as supplemental tools for the students; phase II highlights the validation of the developed worksheets based on a certain criterion; and phase III which is the utilization of the validated worksheets to the students.

OBJECTIVES OF THE STUDY

The following questions are set to address the problems about difficulties in research:

1. What is the performance of the students in research before the implementation of supplemental worksheets?
2.What is the performance in research of the students in experimental group after the implementation of supplemental worksheets and the performance of control group after the conventional way of teaching?
3.What is the gain score of the students in control and experimental group?
4.Is there a significant difference between the performances of both control and experimental groups in pre-test?
5.Is there a significant difference between the performances of both control and experimental groups in post-test?
6.Is there a significant difference between the pre-test and posttest scores of control group?
7.Is there a significant difference between the pre-test and posttest scores of experimental groups?
8.Is there a significant difference between the gain scores of both control and experimental groups?

Based on the presented research questions, the hypothesis in a null form enunciates that the utilization of supplemental worksheets for quantitative data analysis is not effective for teaching inquiries, investigations, and immersion subject.

MATERIALS AND METHODS

Participants

The participants of the study were the 50 Grade 12 students of one integrated school in Laguna who are enrolled in the subject Inquiries, Investigations and Immersion during the School Year 2019-2020. Students were randomly chosen based on the number of section and number of students per section.

Sources of Data

Scores of the participants in two separate examinations in research were considered as the primary data of the study. One before the actual exposure to supplemental worksheets while the other one after the actual exposure to supplemental worksheets.

Data Gathering Methods

Pre-test and post-test validated examinations were given to the participants. Pre-test was given to both control and experimental groups prior to the start of the discussion. Then, participants were subjected to 20-hour discussions using the prepared lessons of the teacher as prescribed in the curriculum guide of the DepEd. During the experimentation, only the participants from the experimental group were given supplemental worksheets after each discussion while no treatment was received by the control group. After the 20-hour sessions, both groups were given post-test exams and results were analyzed using mean and t-test. After the experimentation, selected participants from the experimental group were interviewed and be asked to provide their experiences about the utilization of

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worksheets. Statistical Treatments such as mean, standard deviation, t-test for independent samples and correlated samples were used to analyze the data gathered from the respondents. Participants of the study were informed about the objectives of the study in both control and experimental groups. Participants in the experimental group were informed also that they are allowed to refuse or withdraw participation in the study even in between of the experimentation. Participants were also informed that all data gathered would be used for the purpose of the research alone and any information that the participants give would be treated with utmost confidentiality. In fairness for the control group, once the study is done, all worksheets given to the members of the experimental group were given also to the members of the control group.

RESULTS AND DISCUSSION

This study was participated by twenty-five (25) students from control group and twenty-five (25) students from experimental group. Students from experimental group used quantitative data analysis worksheets making research as requirement of the subject. However, control group did not use the quantitative data analysis worksheets, teacher guided the students in making the research output.

Performance of the students (both control and experimental groups) in research before the implementation of supplemental worksheets

The table shows that the performance of the students from control and experimental group before the implementation of the supplemental worksheets was in satisfactory level. This means that students already have prior knowledge in making research before the implementation of the treatment.

Table 1. Performance of the Students (both control and experimental groups) in Research Before the Implementation of Supplemental Worksheets

Group	Mean	SD	VI
Control	23.56	9.58	S
Experimental	24.12	7.46	S

Performance of the students (both control and experimental groups) in research after the implementation of supplemental worksheets

It can be gleaned from the table that the performance of the students from control and experimental group after the implementation of the supplemental worksheets increased. Performance of the students from the control group remain in the satisfactory level even though increased was noted. However, performance of the students from experimental group rises on the very satisfactory level after the treatment.

Table 2. Performance of the students (both control and experimental groups) in research after the implementation of supplemental worksheets

Group	Mean	SD	VI
Control	26.88	10.15	S
Experimental	36.28	5.83	VS

Gain score of the students in control and experimental group

It can be noted from the table that the gain score of control and experimental group differ after the implementation of supplemental worksheets. Students from control group accumulated 6.64% increased. Meanwhile, from the experimental group, the performance rises on 24.32%. The increase on gain score from control and experimental group highlighted the effectivity of the applied supplemental worksheets in research in terms of students' performance. The result of the study is parallel to what Hoai & Hoa (2020) found that the use of supplementary materials in teaching English among high school students. The findings of their study demonstrated that the use of variety of supplemental materials uplifts students' learning outputs.

Table 3. Gain score of the students in control and experimental group

Group	Mean	SD	% Increase
Control	3.32	10.24	6.64%
Experimental	12.16	6.45	24.32%

Significant difference between the performances of both control and experimental groups in pre-test

The table shows that before the application of treatment students perform the same. This is proven by the p-value of 0.819 which is not significant. Therefore, there is no significant difference between the initial performance of students in both control and experimental group. This means that the initial performance of both groups do not differ significantly.

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Table 4. Significant difference between the performances of both control and experimental groups in pre-test

Group	t-value	p-value	Interpret-ation
Control Experimental	0.231	0.819	NS

Significant difference between the performances of both control and experimental groups in post-test

After the application of the treatment, it was found that students from experimental group performed better than the control group. The control group performed satisfactory level while the experimental group performed very satisfactorily. This further explains that the use of quantitative analysis worksheets is a great help for the students to perform well in research. As explained by Mawardi, Rusiani, & Yani, (2020) the use of student worksheet-based guided inquiry increases higher order thinking skills of students. In the study, the use of worksheets improves ability of the students in the higher order thinking skills.

Table 5. Significant difference between the performances of both control and experimental groups in pre-test

Group	t-value	p-value	Interpret-ation
Control Experimental	4.016	0.0003	S

Significant difference between the pre-test and posttest scores of control group

The mean scores of the control group are on the same level of performance which is satisfactory. This means that with the use of traditional teaching students has little improvement and shows no significant difference on the students' initial performance. This is shown by the p-value of 0.118 indicant no significant difference between the pre-test and posttest scores of the control group.

Table 6. Significant difference between the pre-test and posttest scores of control group

Test	t-value	p-value	Interpret-ation
Pre Post	-1.621	.118	NS

Significant difference between the pre-test and posttest scores of experimental groups

The mean scores of the experimental group increase from satisfactory to very satisfactory level. This means that with the use of worksheets students show positive improvement and thus, there is significant difference on the students' initial performance. This is shown by the p-value of <0.001 indicating significant difference between the pre-test and posttest scores of the control group.

Table 7. Significant difference between the pre-test and posttest scores of experimental groups

Test	t-value	p-value	Interpret-ation
Pre Post	-9.422	<0.001	S

Significant difference between the gain scores of both control and experimental groups

It can be gleaned from the table that greater gain score was garnered on the application of worksheets. This is proven by the p-value of 0.0007 which means that there is significant difference between the gain scores of control and experimental group. The result conforms to what Muskita, Subali, & Djukri. (2020) found that the use of worksheets in teaching ensures improvement on the learning of the students. Based on the result of their study, a significant difference was found on the control and experimental groups in which the experimental group had significantly higher difference in the critical and creative thinking than in the conventional group.

Table 8. Significant difference between the gain scores of both control and experimental groups

Group	t-value	p-value	Interpre-tation
Control Experimental	3.652	<0.001	S

CONCLUSION AND RECOMMENDATION

As supported by literatures, there is no doubt that the utilization of supplemental materials contributes a lot to the performance of the students. In the same way, presence of this supplementary materials increases the learning achievement of the students. In the context of research subject, students need to be guided not only for appreciation but also to acquire or improve competencies in research. Since, it was found out in this

pilot study, the implementation of quantitative data analysis worksheets was able to increase the performance of the students in research, further studies on the effectiveness are highly encouraged using wider range of respondents. Likewise, possible adoption of the developed materials is recommended.

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