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Sequential Teaching as a Strategy in Grade 10 Science Content Delivery: Advantages, Disadvantages, and Influences

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ABSTRACT

The study examined the use of Sequential Teaching as a viable solution to the gap between science content delivery in junior high schools and science teacher education. More specifically, it was conducted to examine the perceived advantages, disadvantages, and influence of sequential teaching to Grade 10 students' performance in science using four groups from varied curricular programs and two groups of teachers. A three-question survey was given to 372 students, 18 science teachers, and 17 teacher advisers using the descriptive-survey research design. The highest percentage among respondents identified "*varied teaching methods"* and "*teaching expertise*" as advantages of sequential teaching while "*follow-up*" and "*adjustment to teaching methods*" as disadvantages. The computed percentage of responses suggests a differing influence level of sequential teaching from respondent groups. Teacher groups identified sequential teaching as a *small disadvantage* while a large number of student respondents identified sequential teaching as a *large advantage* to science performance. Perceived influence of sequential teaching to students' performance in science differ by respondent groups using Kruskal-Wallis test of difference at 5% level of significance, χ^2 (5, N=406)=34.649, p<0.001. Sequential teaching seems to

be influential in the delivery of science content and is recommended for further evaluation in other grade levels.

INTRODUCTION

The relevance of Science to students' lives as evidenced by the problem solving and critical thinking skills students develop and acquire has undoubtedly placed Science as one of the most important subjects in school, giving it high regard as an essential part of life (University of Texas Arlington, 2017; Robinson & Griffiths, 2017; Ngema, 2016). Thus, it is imperative that performance in science is evaluated; in the classroom or in international assessments. According to a report by World Bank (2011), countries that measure student learning and achievement can use the information from these assessments to influence education reform and that there is a strong correlation between higher test scores and higher wages. International assessments have been used as a very significant measure to open facts about how far education in a country performs in terms of reading skills, mathematics, and science (Robinson & Griffiths, 2017). However, looking at results of international assessments in a competitive perspective does not tell the whole story (Pizmony-Levy et al., 2014) as comparing relative standing between nations only tells a little about how instructional practices must be improved and how educational policies must be set (Mislevy, 1995). To be able to understand how nations compare, there is a need to widen the breadth of vision since there is no single achievement index that can totally disclose the full story (Mislevy, 1995). Thus, it is equally important to look into the greatest contributor to students' performance, the teachers.

Teachers play a very significant role in students' achievement (Nhu, Loi, & Thao , 2016). Given the growing demand of policy-making anchored through evidence-based undertakings and the increase of accountability demand along performance standard, effectiveness is accurately measured through students' achievements which is a basis for value-added teacher assessment systems (Zuzovsky, 2013; Blake, 1966; Nbina, 2012). Teachers are the fundamental variable in the framework of teaching and learning (Sultan & Muhammad, 2014). This role is mainly attained through classroom teaching techniques employed, teaching styles used and how the relevance of Science topics in students' daily lives are shown (Movahedzadeh, 2011). The scarcity of qualified science teachers is among the major factors that influence students' poor performance (Majo, 2016). However, comparing the current framework of teacher education training

in the Philippines and what the K to 12 curriculum demands for Science teachers are misaligned. Following the framework of Science teacher education as shown by SEI-DOST and UP-NISMED (2011), a Science teacher who specializes in Biology may be assigned to teach Physics, Chemistry and Earth and Space to students. Also, a non-Physics major teacher may be assigned to teach Physics. To address the gap between the need to assign Science teachers that are trained in each specific Science field for each quarter, several secondary schools started to practice sequential teaching. The flexibility of sequential teaching in consideration to the current circumstances of teachers made it a more favorable solution in delivering content in science. Sequential teaching allows a segmented delivery of content by independent teachers who take care of his own preparations (Jacob, Honey & Jordan, 2002; Jones & Harris, 2012).

Limited to the responses of grade ten students, science teachers, and grade ten teacher advisers, this study was undertaken to investigate the perceived advantages, disadvantages, and influence of sequential teaching to students' performance in science. It is important to note that the science performance being referred in this study was not measured quantitatively, rather, it served as the main point of reference for consideration of respondents' responses to the survey questions. This study sought to get only the advantages, disadvantages and influence that sequential teaching has an effect on students' science performance. The responses were measured using nominal and ordinal scales and were solely dependent upon respondents' perceptions. This study also aims to provide strong evidence that could be used to inform future decisions about whether to use Sequential Teaching and in improving the teaching and learning experience of students in junior high school in the K to 12 curriculum in the Philippines.

FRAMEWORK

Sequential Teaching is the design to assign one instructor or teacher in a classroom at a time (Jones & Harris, 2012). It is considered as a variant of team teaching, a weak one within the notion of team teaching continuum and is thought of as non-team teaching at all due to the absence of collaboration or integration between team members (Yanamandram & Noble, 2006). Sequential Teaching is characterized by the individual planning of each teacher, individual preparation, and lesson recitation. On the other hand, team teaching is where a group of two or more teachers work together to plan, conduct and evaluate the learning activities for the same group of learners (Goetz, 2000). It promotes

collaboration of ideas, teaching methods and sees teaching through the lens of learners (Halverson, 2018). Both Sequential Teaching and team teaching use multiple teachers in the classroom but sequential teaching is more of individual groups of independent teachers who performed the teaching and learning process solely at their respective schedules.

Several studies have been conducted to evaluate the extent of benefits derived from having multiple teachers in the classroom. Studies conducted in particular by Mheehan (1973), Schlaadt, (1969); and Gamsky (1970) have found that although multiple teachers in the classroom do not significantly affect the performance of students, it had seemed to influence students' attitude. However, the actual impacts on students and instructors of using multiple instructors are not well documented (Jones & Harris, 2012).

The figure below presents the framework of this study.

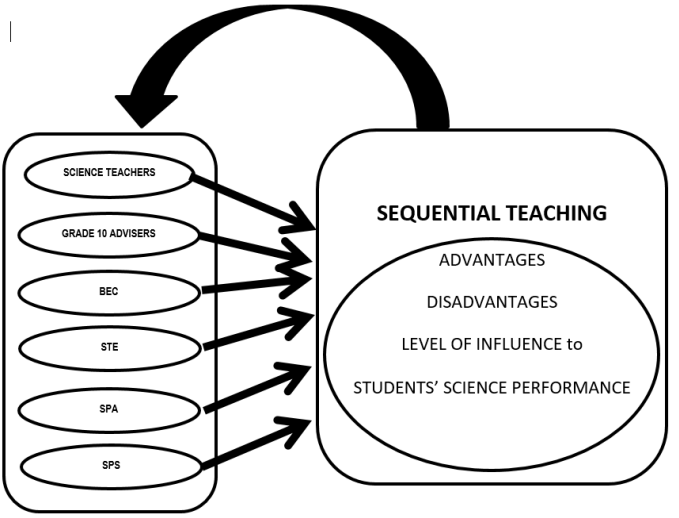

Figure 1. The conceptual framework showing the relationship between variables and the flow of the research.

The variables of interest in this study are Sequential Teaching, perceived advantages, disadvantages, and level of influence of Sequential Teaching on students' performance in Science. The student respondents belong to the four curricular strands in junior high school namely; BEC (Basic Education

Curriculum) where students take all subjects in the K to 12 curriculum for grade 10; STE (a special curricular program in Science, Technology and Engineering) where students are given special add-on Science and Mathematics subjects apart from the core curricular offerings (Department of Education, 2015); SPA (Special Program in the Arts) where students are given add-on arts subjects and special training apart from core curricular offerings; and SPS (Special Program in Sports) where students, apart from their regular K to 12 subjects, undergo a 4-15 hours per week training under trained coaches in sports where they excel (DepEd Region XII, 2018). This study is focused on the goal of finding the perceived advantages, disadvantages and influence of the use of Sequential Teaching in science classes. As Jones and Harris (2012) have shown that there has been not much study being conducted as to the effect of this teaching arrangement to both students and teachers, thus this study is undertaken.

OBJECTIVES OF THE STUDY

Data gathered from four groups of students of varied curricular programs and two teacher groups sought answers to enlighten the school administrators as to students and teachers perception on Sequential Teaching based on quantitative responses to the following: (1) the advantages of sequential teaching according to respondent groups; (2) disadvantages of sequential teaching according to respondent groups; (3) level of influence of sequential teaching to grade 10 students' science performance; and (4) existence of significant difference among perceived influence of sequential teaching in quantitative counts to students' science performance. Data were analyzed to give light to how students and teachers view the effects of this strategy on students' science performance.

METHODOLOGY

Research Design

This study utilized the descriptive-survey research design. A descriptive survey research design allows a researcher to portray account of a characteristic and categorize this characteristic with the purpose of determining the frequency with which the characteristics show. Its strengths as a design lie in enabling the researcher to systematically and accurately describe a particular characteristic, event or phenomena pertaining particular variable/s (Dulock, 1993).

Research Site

The study was conducted at the Baybay National High School (BNHS). BNHS is situated at the center of Baybay City, Leyte Philippines. It is bounded by a local private college, the Franciscan College of the Immaculate Concepcion from the back, the city grandstand at the northern corner with Baybay I Central School annex to the grandstand, a residential area at the left, the city division office at the right side, and a city street at the front. It caters to students from different communities around the city enrolled from grade 7 to grade 10 with an average enrolment of three thousand students per school year. At the time of the conduct of this study, the school is offering four curricula namely; Science & Technology Education (STE), K to 12 Basic Education Curriculum (BEC), Special Program in the arts (SPA) and Special Program in Sports (SPS).

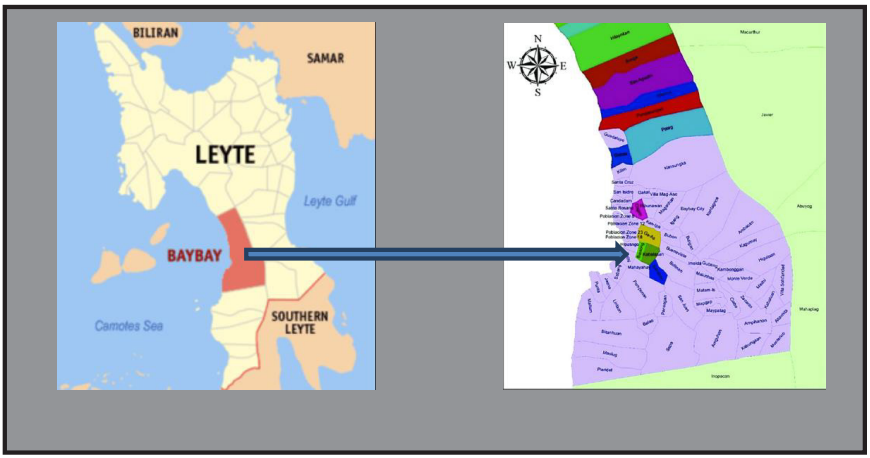

Figure 2. The study site

Participants

The participants of this study were the Science teachers, Grade 10 class advisers and Grade 10 students in the four curricula; STE, K to 12 BEC, SPA, and SPS curriculums of the respondent school.

The researcher used a stratified random sampling technique to all student groups of which 57 students were randomly picked from the STE curriculum, 249 from the BEC, 35 from SPA, and 33 from SPS. All 18 Science teachers and 17 Grade 10 advisers were included in the survey.

Instruments

The survey questionnaires used were adopted from Jones and Harris (2012) from the University of British Columbia who conducted a study on the benefits and drawbacks of using multiple instructors in the classroom. A permission from the authors was sought through email correspondence to adopt the three open-ended questions from their study as the basis for the survey. To provide respondents easier and smooth use of the instrument, responses were provided. These responses were based on the interviews and open ended-questionnaires distributed about the advantages and disadvantages of sequential teaching during the preparation of instruments. Final survey questionnaires were validated and tested for reliability prior to the conduct of the study.

The survey questionnaire was composed of three questions with the first and second questions focused on the advantages and disadvantages of sequential teaching, respectively, all provided with seven possible responses. The third question focused on the respondent's perception of the level of influence of sequential teaching to students' science performance with the following scale; *5 – Large Advantage; 4 – Small Advantage; 3 – Neutral; 2 – Small Disadvantage; and 1 – Large Disadvantage.* Respondents were allowed to make multiple responses to questions one (1) and two (2), but not on question three (3). The researcher also conducted follow-up interviews with respondents to supplement the quantitative data. Since there were unequal number of samples in each independent groups of respondents and normality of data was not established, a Kruskal-Wallis test for the difference was utilized to analyse data for question three. Kruskal-Wallis test is a non-parametric test used as an alternative to one-way ANOVA to understand comparison between two or more independent groups; in this case, the respondent groups, on a dependent variable measured in ordinal scale; in this case, the perceived influence of sequential teaching on students science performance given in a five-point scale (Laerd Statistics, 2016).

RESULTS AND DISCUSSION

Table 1. Frequency distribution of responses on the advantages of sequential teaching

Respondents	n	7	6	5	4	3	2	1
Science Teachers	18	10	9	6	8	0	0	0
Advisers	15	11	13	6	5	0	0	0
K to12 Curriculum	250	88	218	48	58	0	0	0
STE	57	39	55	18	32	0	0	0
SPA	33	5	30	20	6	0	0	0
SPS	33	18	28	12	19	0	0	0
TOTAL	406	171	353	110	128	0	0	0

**n = 406 number of respondents (Multiple responses)*
Legend: *7 – Varied Teaching Methods and Strategies*
6 – Teacher Expertise
5 – Relevance in Teaching-Learning Process
4 – Varied Personalities
3 – No Comment
2 – No Advantage
1 – Others

Table 1 presents the frequency of responses on the advantages of sequential teaching. Mast of the respondents chose *teacher expertise* as the dominant advantage of sequential teaching followed by *varied teaching methods and strategies*. This perception on the advantage of Sequential Teaching is consistent with the conclusions of Traianou (2006) who said that "teacher expertise is *eclectic* in character, drawing on a variety of pedagogical strategies and theories of learning in dealing with the contingent situations faced in the classroom" (Traianou, 2006). Sequential teaching exposes the student to different teaching styles beneficial in a way that, "repertoire of learning styles will thus be enlarged and they will be more likely to flourish in a greater range of settings" (Jacob, Honey & Jordan, 2002).

In the follow-up interviews conducted with the Science department head, it was revealed that with sequential teaching, one Science teacher could gain focus on her own specialization. Thus, teacher expertise is maximized. It has also been observed in the interviews conducted that advisers recognize the difference in teaching methods and strategies employed by different teachers as one of the prime advantages of Sequential teaching.

Table 2. Frequency distribution of responses on the disadvantages of sequential teaching

Respondents	**n**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Science Teachers	18	6	8	7	10	0	0	0
Advisers	15	6	7	7	10	0	0	0
Kto12 Curriculum	250	138	83	48	68	0	0	0
STE	57	42	25	7	7	0	0	0
SPA	33	8	3	2	5	0	0	0
SPS	33	2	12	11	14	0	0	0
TOTAL	406	202	138	82	114	0	0	0

**n = 406 number of respondents (Multiple responses)*
Legend: *7 – Adjustment Teaching Methods and Strategies*
6 – Adjustment to Personality
5 – Maintaining Grades
4 – Follow-up
3 – No Comment
2 – No Disadvantage
1 – Others

Table 2 presents the frequency of responses on the disadvantages of sequential teaching. Majority of responses identified an *adjustment to different teaching methods/strategies* as a dominant disadvantage. Teacher advisers specifically identified *difficulty in making a follow-up to teachers* as a primary disadvantage. In a relevant research, Jones and Harris (2012) claimed that comparing sequentially taught and team-taught classes, students taught using sequential teaching are concerned about the need to adjust teaching style than those in team-taught courses. With the short period of time the students and teacher get to know each other and develop relationship, the quality of the student-teacher relationship in turn impacts on the quality of the learning environment (Jacob, Honey & Jordan, 2002). These results imply the need to closely look into the effects of sequential teaching to students' Science performance. The current use of Sequential teaching among schools in the country must be studied such that its disadvantages may be addressed. The lack of documentation regarding the impact of the use of sequential teaching makes it harder to identify solutions as to how these situations are addressed (Jones & Harris 2012).

In the follow-up interviews conducted, it was noted that although advisers recognize *teaching expertise* as the prime advantage of sequential teaching to

students, making a follow-up to teachers for remediation and completion of requirements is difficult due to the fact that another teacher is assigned to handle the class.

Responses to the level of influence of sequential teaching as identified by respondents are summarized in Table 3.

Table 3. Percentage of responses on the influence of sequential teaching

Respondents	**n**	**5**	**4**	**3**	**2**	**1**	**Total**
Science Teachers	18	22	22	6	28	22	100
Advisers	15	20	13	20	20	0	73
Kto12 Curriculum	250	42	22	26	8	2	100
STE	57	35	28	25	12	0	100
SPA	33	33	39	24	4	0	100
SPS	33	12	18	60	10	0	100
TOTAL	406						
PERCENTAGE		**36.20%**	**23.39%**	**27.58%**	**10.09%**	**1.72%**	

**n = 406 number of respondents (Single response)*
Legend:
5 – Large Advantage;
4 – Small Advantage;
3 – Neutral;
2 – Small Disadvantage; and
1 – Large Disadvantage

Table 3 presents the perceived influence of sequential teaching to the science performance of Grade 10 students. It can be noted that 27% of the teacher advisers abstained from responding to the third question. In the follow-up interviews conducted, a teacher-adviser revealed that they recognized the advantage of sequential teaching to students learning in science but they are more concerned about its disadvantage pertaining to the difficulty of both students, specifically the slow learners, and advisers to follow-up students' respective science teachers that keep on changing from quarter to quarter. These results imply that the perceived influence of sequential teaching to students' performance in science differs depending on respondent groups with the majority of student groups identifying Sequential Teaching as a large advantage to their science performance. Whereas, teachers' groups regard the strategy differently.

The difference of perception on Sequential Teaching implies that although multiple teachers in the classroom do not significantly affect the performance of students, it has seemed to have influenced students' attitude (Gamsky,1970; Schlaadt, 1969). Moreover, Jacob, Honey & Jordan (2002) suggested that "Sequential teaching should be reserved for higher level courses and (particularly) for courses offered at a postgraduate level."

Table 4. Kruskal-Wallis Test for Difference between Group Responses on the Influence of Sequential Teaching to Science Performance

Chi-square	*df*	*p-value*
34.649	*5*	*<0.001**

*Legend: * - significant*

The Kruskal-Wallis test suggests that there was a statistically significant difference in influence score between the different respondent groups, χ^2 (5, N=406)=34.649, p<0.001. To determine which groups are most likely not significantly different from each other, a pairwise comparison was undertaken using Mann-Whitney U test since at the time of analysis of data, some technical circumstance restricted the possibility of using Dunn post hoc test with Bonferroni adjustments to the p-value using SPSS . The table below shows the pairwise analysis between groups.

Table 5: Pairwise comparison using Mann-Whitney U Test

Sample	*Mean Rank*	*Groups*		
Science Teachers	129.50	A		
SPS	143.12	A	B	
Advisers	163.45	A	B	
STE	203.02		B	C
BEC	213.53		B	C
SPA	218.08		B	C

The result shows that the respondent groups significantly differ in their perception of the influence of Sequential Teaching on students' performance in Science. This reveals that even though student groups perceived Sequential Teaching as a large advantage to their Science performance, Science teacher groups and teacher advisers' groups see it otherwise.

There are several limitations to the present study that should be mentioned. First, the generalizability of the study results is limited by the fact that the study was restricted to a sample taken only from one big school in Eastern Visayas. Second, the researcher employed a descriptive research design which limited the exploration of results into frequencies of the characteristics being investigated. Third, due to the uneven number of respondents to the survey, the researcher transformed the data taken into percentages, specifically, Table 3, to give a clearer comparison between teacher and student group responses. Fourth, there is a lack of comparison between other underlying factors that may have affected the responses of respondents like the curriculum where the students belong and gender.

The results were closely analyzed as a whole and were the basis of the interpretations, implications and recommendations of the results of this study that follows.

CONCLUSION

A closer look at the results reveals two significant findings of this study. First, there are advantages and disadvantages that co-exist with the utilization of Sequential Teaching as a content delivery strategy. The results of this study imply the need for all internal and external stakeholders of the Department of Education to come up with a plan or a program to maximize the advantages and minimize the disadvantages of Sequential Teaching. All school heads in the junior high schools should look deep into the results of this study. The identified advantages of Sequential Teaching which largely pointed out *teacher expertise* and *varied teaching methods and strategies* must be maximized.

On the other hand, the identified disadvantages of this content delivery strategy in science such as *difficulty to follow-up* and *adjustment to different teaching methods* must be given an appropriate solution as well. It is necessary that the Department of Education can figure out how to minimize these disadvantages. A consideration of the development of a program to accommodate "follow-up" sessions between Science teachers and students must be ironed out properly. Schools may replicate this study so that students can benefit from expert teachers who can handle quarter content deliveries in Science classrooms.

Second, students and teachers differ in their regard on sequential teaching's influence on students' performance in science. A future study is recommended to explore the factors affecting the difference between teachers and students' regard to the influence of Sequential teaching on students' performance in Science.

Moreover, the results of the study support the suggestion for the Department of Education to do two things. One, sit down with the Commission on Higher Education (CHED) and review the current educational framework of Science teacher education in the country so that significant measures will be undertaken to address the mismatch between Science teachers' education with what the curriculum demands. Two, hire and deploy a complete set of Science teachers who have specialization in the four fields of Science taught in Junior high school to address the need of qualified teachers to teach the four different fields of Science.

Furthermore, a study is recommended using quasi-experimental research design to look into the extent of the effect of Sequential teaching to students' Science performance.

TRANSLATIONAL RESEARCH

The findings of the study may be best translated to various media of communication for information dissemination. An awareness campaign may also be undertaken to inform the public of the results of this study such as social media, mass media (TV, newspaper, and radio).

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