SELF-DIRECTED LEARNING GUIDE FOR AN IMPROVED SCIENCE PROCESS SKILLS OF GRADE 11 LEARNERS

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ABSTRACT

In this generation, many factors affect learning particularly in Science. Thus, this study aimed to enhance students' Science process skills through self-directed learning guide. It also attempted to determine significant difference between the result of pre-assessment and post-assessment tests of students' performance in the Science process skills test. Using a descriptive-developmental method of research, it involved the 70 purposively selected Accountancy, Business, and Management (ABM) Grade 11 students in San Jose National High School, San Pablo City during the Academic Year 2017-2018. Survey questionnaire and science process skills test were utilized to gather the data and these were analyzed using frequencies, percent counts, and Spearman's rho. Results revealed that most of the respondents perceived the attitude in Science as highly positive and they were interested in Science with visual and kinesthetic learning styles. In terms of the perceived level of effectiveness of the self-directed learning guide in Physical Science, learning experience, learning outcome, and user-friendliness, the respondents were all perceived to be very much effective while in effectiveness and efficiency, were perceived to be highly evident. The pre-assessment and post-assessment tests of the students were significantly different which implies that students' science process skills were improved due to the designed learning guide.

Keywords: self-directed learning guide, basic science process skills, integrated science process skills

INTRODUCTION

Developments in science and technology are fundamentally changing the way people live, connect, communicate and transact, with great effects for economic development. 21st century technological revolutions include micro-processors, tele-communications, bio-technology and nano-technology. All of which are the most remarkable breakthroughs that come from the interaction of insights and applications arising nowadays. Hence, investment in quality science education for youth, and continuous skills training for workers and managers should be promoted (Chetty, 2012). The Philippine Government, through implementation of different curricula, has made efforts to ensure that certain concepts and skills are inculcated to the students. For an instance, the K to 12 Basic Education curriculum is designed around the three domains of learning science: understanding and applying scientific knowledge in local setting as well as global context and whenever possible, performing

scientific processes and skills, and developing and demonstrating scientific attitudes and values (K to 12 Basic Education Curriculum, 2016). Apparently, results do not match with the expected output equivalent to 75 percent rating in mean percentage score among students. Considering San Jose NHS-SH alone, a mean percentage score of 51.05 and 56.69 were recorded for the 1st and 2nd semesters in Physical Science. These results were 21.13 percent lower than the expected 75 percent for the whole school year on the average.

The processes and ideas of science are of great importance to everybody's life. Scientific processes and ideas are valuable in developing the abilities to identify components of healthy lifestyle, to take an informed part in social decisions, and to respond positively to changes brought about by science and technology.

It is imperative to emphasize the needs to provide the highest quality of science education for citizenship which are for all students. Education that is sufficiently challenging and interesting will generate high achievement that is apparent through students' creativity, lateral thinking, and persistence. This may in turn, motivate students to follow science-related careers (Kaptan & Timurlenk, 2012).

On the downside, teaching Science is becoming much harder today. Many factors that affect learning which include; poor methodology in Science education, negative attitude towards science subjects among students and lack of resources such as textbooks and well-equipped laboratories must be taken into consideration (King'Aru, 2014).

Science process skills are one of the major goals to be achieved in the field of science education because these skills are utilized not only by scientists but also by everyone, in order to become scientifically literate people. (Gultepe, 2016)

One of the expected results of developed science process skills is to produce self-directed learners. The concept of Self-Directed Learning (SDL) is one that educators have investigated and discussed for many years. It helped learners to be responsible owners and managers of their own learning process.

This study aimed to assess and enhance the science process skills of students through designing a self-directed learning guide fits to the needs of the students to be self-directed and also to evaluate how it will affect the teaching-learning process in Science and their academic performance in the same subject.

OBJECTIVES OF THE STUDY

This study sought to determine the basic and integrated science process skills of Grade 11 students and attempted to develop a self-directed learning guide. Specifically, it attempted to 1) describe the profile of the respondents in terms of attitude in Science, interest in Science, and learning styles as to visual and kinesthetic; 2) determine the pre and post assessment performance grades of the respondents in Physical Science as to the development of basic science process skills in terms of observing, inferring, measuring, communicating, classifying, and predicting; 3) identify the pre and post assessment performance grades of the respondents in Physical Science as to the development of integrated science process skills in terms of controlling variables, defining operationally, formulating hypotheses, interpreting data, experimenting, and formulating models; 4) describe the perceived level of effectiveness of the self-directed learning guide in terms of learning experience, learning outcome, effectiveness and efficiency, and user-friendliness; and 5) determine significant difference between the result of pre-assessment and post-assessment tests of students' performance in the Science Process Skills test.

METHODOLOGY

This study used the descriptive-developmental research design. The science process skills of 70 Grade 11 ABM students who were enrolled in San Jose National High School during the AY 2017-2018 were assessed using a researcher-made questionnaire and from where the data were used as an input in designing a

self-directed learning lesson guide. Its effectiveness was measured using an evaluation questionnaire. The researcher prepared 16 lessons focusing on higher concepts in Chemistry for 1st Quarter of 2nd Semester of AY 2017-2018. Every lesson has learning competency, concepts, and activity found at the end. The said instruments were validated by two English teachers, seven Science teachers including one head teacher and one master teacher coming from different public high schools in the Division of San Pablo. Prior to the gathering of data, the researcher created a questionnaire and learning guide. It was followed by securing necessary permit to conduct the study through the letter of request. A letter to the school principal was submitted and approved. Subsequently, the researcher proceeded to the actual phase of the study. The data that were gathered underwent statistical analysis and interpretation. To determine the performance of the respondents on their science process skills, frequencies and percent counts were used. To test whether a significant relationship exist between the result of pre-assessment and post-assessment tests of students' performance in the Science Process Skills test, the Spearman's rho was used.

RESULTS AND DISCUSSION

1. Profile of the Respondents

1.1 In terms of attitude

Table 1
Respondents' Attitude in Science

Indicators *Science…*	SD	Mean	VI
1.is fun and exciting.	0.57	4.23	HP
2.is useful in everyday life.	0.68	4.47	HP
3.enhanceshigher-order thinking skills (HOTS).	0.73	4.40	HP
4.increases meaningful 5.learning experience.	0.60	4.57	HP
6.improves retention of both knowledge and skills	0.57	4.61	HP
Overall	**0.43**	**4.46**	**HP**

The overall results from the table show that the attitude of students was highly positive towards Science with an overall mean of 4.46. This implies that Science is a very valuable subject for the students. During the 1st Semester of this academic year, respondents took the Earth Science subject in which they were given a lot of performance tasks that allowed them to better understand what Science is and therefore developed a positive attitude towards science.
In the study conducted by Singh, Singh, and Giri (2016), they mentioned that Science and scientific attitude has become a craze not only for teachers and researchers but also for government. They want to enhance the scientific attitude of their student so that students could become competent citizens and realize science is a part of our day to day life.

1.2 In terms of interest in Science

Table 2
Respondents' Interest in Science

Indicators *I give my attention to science because I…*	SD	Mean	VI
1. spend a lot of time studying Science.	0.69	3.56	I
2. value the importance of learning Science.	0.65	4.01	VMI
3. like to study Science better tha other subjects.	0.76	3.33	U
4. always look forward to attend my Science class.	0.73	3.96	I
5. enjoy doing experiments during laboratory.	0.77	4.40	VMI
Overall	**0.51**	**3.85**	**I**

In this table, it was shown that respondents were *uncertain* (M=3.33, SD=0.76) when giving their attention to Science because they like to study other subjects better than Science. On the other hand, they were *very much interested*, (M=4.01, SD=0.65) in valuing the importance of learning Science as well as

enjoying doing experiments during laboratory period, (M=4.40, SD=0.77). Nonetheless, majority of the respondents were *interested*, (M=3.85, SD=0.51) in studying Science. Students nowadays find Science as a difficult subject just like Mathematics. This maybe the reason why the respondents found it *uncertain* to study Science better than other subjects. On the other hand, they valued Science and enjoyed doing the experiments simply because students of today's generation learn more when they experience, do and conceptualize the concepts in Science on their own. This was very evident during the present year's Science Camp wherein most of the participants from Senior High belonged to ABM Grade 11 students. They enjoyed doing the different stations which involved Science concepts and experiments.

1.3 In terms of Learning Styles as to Visual

Table 3
Respondents' Learning Styles as to Visual

Indicators	SD	Mean	VI
1. use Google search engine to learn and to do my researches	0.58	4.56	HE
2. make advance readings and review my notes about the previous lesson	0.71	3.37	VE
3. create a discussion with friends using technologies such as group chat in Facebook in order to be updated with the current issues happening around me	0.99	3.50	VE
4. think of a variety of methods and perspectives in solving different problems	0.71	3.70	VE
5. can express my ideas both in written and oral ways	0.75	3.71	VE
6. can structure my thoughts in a logical and rational way to help others to understand the content of my idea/opinion.	0.70	3.74	VE
7. use appropriate materials in doing my task	0.74	4.21	VE
Overall	**0.47**	**3.38**	**VE**

The indicator pertaining to using Google search engine to learn and to do researches or assignments was *highly evident,* (M=4.56, SD=0.58). Meanwhile, in making advance readings and reviewing their notes about previous lesson this was deemed *very evident* (M=3.37, SD=0.71). Nevertheless, the overall perceived learning styles of the respondents as to visual was *very evident,* (M=3.83, SD=0.47). These results indicate that the use of Internet is very helpful for the students not only when doing assignments and researches but also in being updated about Science innovations and discoveries. With regard to studying in advance or reviewing previous lesson, this suggests that students were not all studious and most of them relied on their teachers.

1.4 In terms of Learning Styles as to Kinesthetic

Table 4
Respondents' Learning Styles as to Kinesthetic

Indicators	SD	Mean	VI
1. make my school projects creatively	0.76	4.17	HE
2. am using different styles of communication to fit in with different cultures.	0.87	3.54	VE
3. sort tasks by priority	0.73	4.01	VE
Overall	**0.61**	**3.91**	**VE**

Looking closely at the results, the indicator citing that they are making their school projects creatively was assessed to be *highly evident*, (M=4.17, SD=0.76). The data revealed that the overall perceived learning styles of the respondents as to kinesthetic was *very evident*, (M=3.91, SD=0.61).

When doing projects and performance tasks that were creative is a must. It can be said that students of this generation were more creative and innovative in presenting their output in different ways like video-making, explosion box portfolio, paper folds, and puppet show instead of merely reporting. Jeannin (2013) mentioned in her thesis that today's classrooms are becoming more and more diverse wherein teachers meet students of different ages, backgrounds, cultures, and learning styles. And

in order to better suit to the current needs of the students, teachers seek to better understand their students' expectations.

2.2 Basic Science Process Skills (Post-assessment)

Table 6
Post-assessment Performance in Basic Science Process Skills

Grade	Observing		Inferring		Measuring		Communicating		Classifying		Predicting	
	f	%	f	%	f	%	f	%	f	%	f	%
90-100 (O)	2	2.9	19	27.1	21	30	2	2.9	6	8.6	18	25.7
85-89 (VS)	26	37.1	46	65.7	39	55.7	40	57.1	53	75.7	48	68.6
80-84 (S)	42	60	5	7.1	10	14.2	27	38.6	11	15.7	4	5.7
75-79 (F)	0	0	0	0	0	0	1	1.4	0	0	0	0
Below 75 (DNME)	0	0	0	0	0	0	0	0	0	0	0	0

This table shows that all of the six BSPS were developed having no grade below 75. Most of the respondents belong to *very satisfactory* or a grade of 85 to 89.

The results show that the use of SDLG helped the students to further enhance their BSPS since the topics covered were in line with such. One specific example would be stoichiometry where students got a high score in *Measuring*, 21 respondents or 30 percent belonged to *outstanding* or a grade of 90-100. On the other hand, one respondent or 1.4 percent belonged to *fairly,* a grade ranging from 75-79 in *Communicating*. As observed in the learning guide, there were a lot of activities intended for the respondents to explain their answers and since Science uses English as the language of instruction, they struggled to express their ideas.

3. Performance of the Students in Physical Science as to Integrated Science Process Skills (ISPS)

3.3 Integrated Science Process Skills (Pre-assessment)

Table 7
Pre-assessment Performance in Integrated Science Process Skills

Grade	Controlling variables		Defining Operationally		Formulating hypotheses		Interpreting Data		Experimenting		Formulating Models	
	f	%	f	%	f	%	f	%	f	%	f	%
90-100 (O)	0	0	0	0	6	8.6	1	1.4	3	4.3	6	8.6
85-89 (VS)	4	5.7	5	7.1	10	14.2	11	15.7	8	11.4	15	21.4
80-84 (S)	12	17.1	11	15.7	26	37.1	28	40	16	22.9	29	41.4
75-79 (F)	28	40	17	24.3	14	20	24	34.3	16	22.9	12	17.1
Below 75 (DNME)	26	37.1	37	52.9	14	20	6	8.6	27	38.5	8	11.4

This shows that 28 or 40 percent of the respondents got a grade of 75 to 79 which means *fairly* in *Controlling variables* while 37 or 52.9 percent got a grade of below 75 which means *did*

not meet expectations in *Defining operationally*. In terms of *Experimenting*, 27 or 38.5 percent of the respondents also belonged to *did not meet expectations*. Having these results, it was quite alarming to know that senior high school students have not yet fully developed the ISPS needed for higher level concepts and theories in Physical Science.

This implies that there was a need for an urgent plan and solutions in order to address this kind of problem. Guidance and expertise of the teacher were highly needed because attainment of this learning would not be possible if students will not be given the opportunity to develop these skills.

3.4 Integrated Science Process Skills (Post-assessment)

Table 8
Post-assessment Performance in Integrated Science Process Skills

Grade	Controlling variables		Defining operationally		Formulating Hypotheses		Interpreting data		Experimenting		Formulating Models	
	f	%	f	%	f	%	f	%	f	%	f	%
90-100 (O)	0	0	1	1.4	4	5.7	1	1.4	5	7.1	18	25.7
85-89 (VS)	28	40	30	42.9	47	67.1	42	60	44	62.9	45	64.3
80-84 (S)	35	50	35	50	17	24.3	25	35.7	21	30	7	10
75-79 (F)	7	10	4	5.7	2	2.9	2	2.9	0	0	0	0
Below 75 (DNME)	0	0	0	0	0	0	0	0	0	0	0	0

After using the SDLG, it showed that there was an improvement in the ISPS of the respondents. However, there were still some respondents who got a grade ranging from *75 to 79* or *fairly* specifically in controlling variables, defining operationally, formulating hypotheses, and interpreting data. Of all the six integrated science process skills, it was only in *Controlling variables* where the students did not get a grade of 90-100.

Results then supported the findings of Derilo (2019) who also conducted a study regarding SPS. The results of the study revealed that the students have a low level of integrated science process skills. He found out that students' integrated SPS was found not significantly related to their performance Meanwhile, interpreting data requires focus, good analysis and higher order thinking skills to come up with proper interpretation which seems to be difficult for the respondents since students just rely on the internet and other source of information without even thinking whether it's true or not. The result implies that the topics covered in the SDLG were much applicable in the basic science process skills, thus the improvement of integrated science skills were not that much developed.

4. Effectiveness of Self-Directed Learning Guide (SDLG)

4.1 In terms of Learning Experience

As generated from the indicator learning guide can be mastered by both slow and fast learners, it showed respondents' perception of *much effective* (M=3.99, SD=0.91).

During the pre-test which served as an initial assessment, low points of basic and integrated science process skills were identified. Alignment of the activities, interests, and capabilities of the students were also considered in the revision of the SDLG. This may be the reason why the respondents perceived the SDLG to be effective.

Table 9
Effectiveness of the SDLG design as to Learning Experience

Indicators	SD	Mean	VI
1. The learning guide is appropriate and suited to students' reading vocabulary and comprehensio	0.49	4.70	VME
2. The task given for each topic is adaptable to the students' needs, interests, and abilities	0.65	4.31	VME
3. The learning activity can be used for individual and cooperative learning (ICL) instruction	0.66	4.36	VME
4. The learning guide can be mastered by both slow and fast learners.	0.91	3.99	ME
5. The learning guide is competency-based an is aligned with the activities of the lesson	0.56	4.66	VME
Overall	**0.48**	**4.40**	**VME**

4.2 In terms of Learning Outcome

Table 10
Effectiveness of the SDLG Design as to Learning O

Indicators	SD	Mean	VI
1. I found the learning guide intellectually challenging and stimulating.	0.71	4.41	VME
2. I have learned something that I consider valuable.	0.67	4.31	VME
3. My interest in the subject has increased as a consequence of using this learning guide.	0.66	4.10	VME
4. The content of learning guide met my expectations.	0.73	4.30	VME
5. The learning guide provide a sense of accomplishment because it can be mastered and can be evaluated properly.	0.70	4.26	VME
Overall	**0.69**	**4.28**	**VME**

Respondents found the learning guide intellectually challenging and stimulating as shown by their perception of *very much effective*, (M=4.41, SD=0.71). Moreover, the lowest mean was on indicator stating that their interest in the subject has increased was still perceived as *very much effective*, (M=4.10, SD=0.66).

This shows that the use of SDLG when it comes to learning outcome was *very much effective*, (M=4.28, SD=0.69). This means that students take full responsibility for their learning with least guidance from the teacher and were also given a chance to learn at their own pace but still achieving the desired learning outcomes.

4.3 In terms of Effectiveness and Efficiency

Table 11
Effectiveness of the SDLG Design as to Effectiveness and Efficiency

Indicators	SD	Mean	VI
The learning guide…			
1. helps the students to acquire and develop science skills, scientific literacy attitudes and values needed in solving everyday problems	0.61	4.46	HE
2. reinforces the type of learning sought by the teacher, the school and the present curriculum	0.63	4.26	HE
3. provides sufficient repetition of concept and ideas through examples; illustrations, questions and summaries to enhance the students' understanding of the lesson	0.65	4.46	HE
4. offers activities that can be accomplished in the time allotment indicated	0.73	4.23	HE
5. allows students to explore ideas through independent inquiry	0.67	4.44	HE
Overall	**0.48**	**4.37**	**HE**

Generally, the respondents' perceived the level of effectiveness of the SDLG design as to effectiveness and efficiency as *highly Evident*, (M=4.37, SD=0.48).

On this, SDLG was effective and efficient when the students used it as they dealt with the lessons and activities as observed by the facilitator. Efficiency was manifested when the students were able to comply when the teacher checked the worksheets. Effectiveness was gauged by the high resulting scores garnered by the learners.

4.4 In terms of User-friendliness

Table 12

Effectiveness of the SDLG Design as to User-friendliness

Indicators *The learning guide…*	SD	Mean	VI
1. is student-friendly and adapts to the needs of the learners	0.70	4.34	VME
2. is made with quality	0.67	4.44	VME
3. is visually appealing to me and most likely to students	0.74	4.36	VME
4. provides materials with graphics an illustration to attract attention and clarify concepts	0.57	4.61	VME
5. helps learners cope with their lessons in Physical Science.	0.44	4.80	VME
Overall	**0.45**	**4,51**	**VME**

As a whole, the respondents perceived the learning guide as *very much effective*, (M=4.51, SD=0.45) in terms of user-friendliness. It can be inferred then that the teacher-researcher provided a list of learning portals that gave students more opportunity to be saturated with additional concepts, samples, and insights regarding the given topics found in the learning guide.

5. Test of Difference between the students' performance in Physical Science

The table clearly shows that the pre-assessment and post-assessment of BSPS as indicated by the t-value of -18.25 had significant difference likewise with the result of the pre-assessment and post-assessment of ISPS having the t-value of -17.85. These values were supported by the p values.

Table 13

Test of Difference between the Pre-assessment and Post-assessment Scores as to the Students' Science Process Skills

Science Process Skills	Paired Differences					t	Sig. (2-tailed)
	Mean	SD	SEM	95% CI of the Difference			
				Lower	Upper		
Basic Science Process Skills	-11.62	5.33	.637	-12.89	-10.35	-18.25	.000
Integrated Science Process Skills	-13.64	6.39	.764	-15.16	-12.11	-17.85	.000

Based on the results, there was a significant difference, between the results of the pre-assessment and post-assessment tests of students in their science process skills because the self-directed learning guide contained activities that helped to enhance the science process skills and trained the students to be self-directed learners. This supported Tekkol & Demirel (2018) on that people who can direct their own learning have acquired ways of reaching information, can think at higher levels and organize their own learning. In short, they are individuals who have mastered how to learn.

CONCLUSIONS

In the light of the aforementioned findings, the following conclusions are drawn:

1. Basic Science Process Skills of the students such as inferring, measuring, communicating, classifying, and predicting are all *very satisfactory*.
2. Integrated Science Process Skills of the students have *very satisfactory* in formulating hypothesis, interpreting data, experimenting, and formulating models.
3. The perceived level of effectiveness of the SDLG in Physical Science as to learning experience, learning outcome, and user-friendliness are all perceived to be *very much effective*.
4. There is a significant difference between the results of pre-assessment and post-assessment tests of students' in the Science

Process Skills test. Therefore, the null hypotheses posited in the study are not sustained.

RECOMMENDATIONS

Based on the findings of the study and the conclusion drawn, the following are recommended:

1. Students may be encouraged and aided to improve their skills to higher levels through varied intervention programs most especially the Integrated Science Process Skills.
2. As the study revealed that the Self-directed learning guide is effective as an aid to improve the science process skills of the students, the teachers may be encouraged to utilize this learning guide or develop their own to assist the students especially when the learning materials are not available.
3. Since the study revealed that students' interest in Science is in "interest" level, school support may be encouraged through innovations and up-to-date activities which will help to capture the interest of the students.
4. For the future researchers, studies concentrating on Basic Science Process Skills may be conducted to further strengthen the Science Process Skills of the students.

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