International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Science Learning Activity Packets (SciLAPs) on the Assessment of Learning Performance

Rex S. Galos, MEd*

Dr. Vicente F. Gustilo Memorial National High School, Cabahug St., Brgy. Zone 2, Cadiz City, Negros Occidental 6121, Philippines

A B S T R A C T

The main purpose of the study was to determine the effectiveness of Science Learning Activity Packets (SciLAPs) as an approach to instruction. The study involved Grade 10 students of a National High School in Northern Negros Occidental who were selected through purposive sampling. The study adopted a quasi-experimental design that utilized an experimental group with 21 students and a control group having 19 students. The researcher developed the SciLAPs and made three SciLAPs integrated lessons that underwent peer and expert evaluation following the criteria set forth by Carter V. Good and Douglas B. Scates. The 25-item multiple-choice test administered as the Pretest and Posttest of this study was validated utilizing the Likert Scale Rating Scale set forth by Allan S. Cohen and James A. Wollack. The independent samples t-test was utilized to determine the difference in the learning performance of the two groups and a paired sample t-test was employed to determine the difference in the participants' pretest and post-test scores. Results of the study revealed that the experimental group has a higher mean score than the control group in the post-test conducted and the students who successfully completed the tasks in the SciLAPs have shown positive results in their post-test that are significantly above compared to those students who did not go through the activity packets. Therefore, it was concluded that using SciLAPs as an approach to instructions is effective to improve the learning performance of the students in Science 10.

Keywords: science learning activity pockets, assessment, learning performance, SciLAP/s, teaching and learning, instructional approach

1. Introduction

Background of the Study

Science education under the K to 12 Basic Education Curriculum, aims to develop scientific literacy among learners that will transform them into well-informed and participative citizens. This literacy will also enable them to make sound judgments and decision-making regarding applications of scientific knowledge that may have social, health, or environmental impacts. Generally, the K to 12 science curriculum is learner-centered, emphasizing the use of evidence in constructing explanations.

However, despite the effort exerted by teachers such as the use of varied approaches based on sound educational pedagogy for the acquisition of the three domains of learning science, the Department of Education (DepEd) reported that the National Achievement Test (NAT) mean percentage score (MPS) for high school, for the academic year 2012-2013 was only 51.41 % or 23.59 % away from the target and the Mean Percentage Score (MPS) in science was only 41.35 % (Cruz, 2017).

In addition, the quarterly consolidated reports on MPS submitted by the subject teachers in the science department of the national high school where the researcher is currently teaching showed that 59 out of 99 or 59.60 % of all class sections from Grade 7 to Grade 10 had an MPS lower than 70 % during the first quarter, 58.59 % during the second quarter, and 61.62 % during the third quarter of the school year 2018-2019. The above data indicate that more students are performing poorly in science. Such results call for science teachers to reflect on their teaching, enrich their instructional methodologies and enhance their pedagogical approaches in order to improve the student's mastery level in any competency and help them perform better in their performance assessment.

* *Galos, Rex S.*. Tel.: +0344326304; Mobile phone: +639605905292.
E-mail address: rex.galos@deped.gov.ph

Meanwhile, according to Staples (2018), the current type of learners we have belong to Generation Z. She posited that this generation wants to choose what to learn and how they want to learn it in a way that feels right for them. Not to mention, today's learners are dealing with things practically rather than theoretically and are not easily convinced. Generation Z students are much more pragmatic and skeptical than generations before (Kalkhurst, 2018).

As a science teacher, the researcher deemed it necessary to use learning activity packets (LAPs) as a possible solution to the above-mentioned issue. This is a method of communicating between a student and/or a small group of students and the instructor where the content of a particular topic or activity is explained through the use of self-directed learning activity packets (Marzahi, 2001). With science learning activity packets (SciLAPs), students find explicit directions to complete a specific science activity and what activities they should perform to acquire the knowledge and abilities expected them. Barnhill (1998, p. 30) observed that the packet approach "inspire(s) students to excel and shed their ingrained notions about education, motivating them..." (Barnhill, 1998, p. 30 as cited in Basho, 2005). With SciLAPs, students will be responsible for accomplishing a task in a specific amount of time. This instructional method promotes students to take the initiative to complete an activity and be able to utilize digital technology to learn more outside the class and continue working oncompleting the tasks designed in each packet. It also encourages them to work collaboratively with peers and may consult a resource person, as needed. If students experience difficulties, the instructor is available as a resource. When not serving as a resource, the instructor continually monitors student progress. Moreover, using of SciLAPs in the teaching and learning process is brain-engaging that encourages students to actively perform in class that strengthens scientific literacy. By allowing the students to complete the tasks in SciLAPs is applicable to real life situations especially on jobs that require self-direction that will make them informed and participative citizens.

Though various studies have backed up the effectiveness of the utilization of SciLAPs, the researcher wanted to find out its effectiveness as a means of improving the academic performance of Grade 10 students, in a National High School in Northern Negros Occidental. It is in this light that this study was conducted.

2. State of the Problem

The study aims to determine the effectiveness of Science Learning Activity Packets (SciLAPs) as an approach to instruction in the learning performance of the Grade 10 students. Specifically, this research aims to answer the following questions:

1. What is the learning performance of the two groups of participants in the pretest?
   1.1 Control Group
   1.2 Experimental Group
2. What is the learning performance of the two groups of participants in the posttest?
   2.1 Control Group
   2.2 Experimental Group
3. Is there a significant difference between the pretest scores of the control and experimental group?
4. Is there a significant difference between the posttest scores of the control and experimental group?
5. Is there a significant difference between the pretest and posttest scores of the control and experimental group?

Hypotheses

The following null hypothesis will be tested at 0.05 level of significance.

1. There is no significant difference between the pretest result of the control and experimental group.
2. There is no significant difference between the posttest result of the control and experimental group.
3. There is no significant difference between the pretest and posttest results of the control and experimental group.

3. Review of Related Literature

This chapter presents the conceptual and research literature which the researcher reviewed in order to have a background of the study. Likewise, related concepts and studies that have significant bearings to the study conducted are also presented in this section.

It has been a fact that the search for better ways of educating students at all levels has been one of long standing. As the increase of technology quadrupled every year and our society is pacing so fast, changes also come ever more rapidly in the field of education. The current vocabulary alone evidences the extent of recent innovations; team teaching, modular scheduling, large group instruction (LGI), computer-assisted instruction, problem-based learning, programmed instruction, blended learning and flipped classroom. The focus of much of this effort is an attempt to solve the question central to teachers throughout the history of education and how to provide individualized instruction that allows for the differences in students that exist in any classroom (Timmerman, 1972). Recent technology and the increased awareness by the society on the value of the individual have created renewed interest and encouraged the development of effective programs for individualization. Manatt and Meeks (1971) summarized the extent of these developments as follows: (1) an awareness of and skill in specifying educational objectives; (2) acceptance of the notion of self-instruction, self-initiation, and self-direction in learning; (3) refinement of testing techniques that permits assessment in terms of specific goals; (4) acceptance of differentiated responsibilities that permit instructional roles other than that of teacher; (5) development of improved management skills that allow for proper record keeping and classroom management; and (6) awareness of the use of feedback data about the student as a contingency for motivation.

They continue: (p. viii), “With the teacher's role changing to that of diagnostician, a selector of human and material resources and a tutor, self-instructional materials become a key ingredient in individualization".

The effectiveness of Science Learning Activity Packets (SciLAPs) as an approach to instruction is the primary focus of this review of the literature and related research. The role of self-instructional materials in individualizing instruction was also discussed to emphasize the nature of SciLAPs as a tool for learning. The review was divided into the following sections: (1) Self-Instructional Materials, with particular attention to (2) Learning Activity Packages, (3) Approaches to Teaching Science in High School, and (4) The Current Generation of Learners. Researches related to this study were also included in this section.

Self-Instructional Materials

The phrase "self-instructional materials" is most commonly associated with "programmed instruction," though the two are not interchangeable. "Programmed instruction (PI) involved breaking the content down into small pieces of information called frames. A PI textbook might contain several thousand frames of information. Students would read a frame, then answer a question about the frame. Then they would check their answer (get "feedback") and proceed to the next frame." (Programmed Instruction, 2001-05. HTML, retrieved 16:22, 16 August 2007 (MEST)). In like manner, programmed instruction is a method of presenting the new subject matter to students in a graded sequence of controlled steps. Students work through the programmed material by themselves at their own speed and after each step tests their comprehension by answering an examination question or filling in a diagram. They are then immediately shown the correct answer or given additional information (Infoplease, 2017). Computers and other types of teaching machines are often used to present the material, although books may also be used. Computer-assisted instruction, which both tests students' abilities and marks their progress, may supplement classroom activity or help students to develop ideas and skills independently.

According to Farooq (2013), the main focus of PI is to bring desirable change in the cognitive domain of the learner's behavior. He stated that the structure of the teaching method is that the selected content is analyzed and broken into smaller elements. Each element is independent and complete in itself. He also presented the three types of this teaching strategy known as follows: (1) Linear Programming that is being used for teaching all subjects. In a programmed teaching strategy, progressive chain elements are presented. The last step is at the mastery level. It is based on five fundamental principles which include small steps, active responding, immediate confirmation, self-paced, and student testing; (2) Branched Programming which is generally used in mechanical fields; and (3) Mathematics in which Retrogressive chain of elements is presented. The first step is the master level while the last step is the simplest element.

Farooq (2013) continues that PI has its own advantages. As a teaching strategy, PIs main emphasis is on individual differences and students' involvement; there is no fixed time interval for learning where students may learn at their own pace; learning by doing maxim of teaching is followed to involve learners in the learning process; students are exposed only to correct responses, therefore, possibility to commit errors in reduced; and immediate confirmation of the results provides reinforcement to the learners and encourages the learners to proceed further. That is feedback being is provided to wrong answers, so that the learner is able to develop mastery over the content. This feedback also known as "reinforcement" requires immediate knowledge of results which is another characteristic of programmed instruction where knowledge of results is part of the reinforcement theory (Skinnerian psychology) developed by (Skinner, 1954).

On the contrary, PI as a teaching strategy also posed disadvantages. These include the difficulty of developing an instructional program; only cognitive objectives can be achieved, due to tight schedule of time table, students cannot be left to learn at their own pace and it is true that it would be very difficult to learn the content the subject matter in a limited period of time, there is no chance for students' creativity, their responses are highly structured; development of a program is not economical in terms of cost and time; in the absence of the teacher, students may spoil the disciplinary tone of the class, or they will be helpless when any problem arises; and it cannot be applied at a primary level of education or at higher education.

For the above reasons, several authors suggested that the program should have a thorough knowledge of the content and technique of content analysis. Levett-Jones (2005) added that this strategy should be used as a supplementary device for remedial teaching in the classroom, should be used in distance education or continuing education programs where no rigid time table is applied, and if no at a primary level or higher level of education, this strategy may be useful at the secondary level of education where many new subjects are introduced in the curriculum and they create problems in learning.

Finally, if a PI is applied in classroom teaching, the teacher should be present in the class. According to Farooq (2013), the teacher can maintain discipline in the class and help in eradicating the difficulties of the learners. A personal touch of the teacher can be more fruitful and effective in student's learning.

In programmed instruction, an entirely new concept of responsibility enters the learning situation. The burden of responsibility for student learning is on the program and the instructional technology used—not solely on the student. If the student doesn't learn, something is wrong with the program and it must be revised until it teaches practically everybody.

Learning Activity Packages

Learning Activity Packages, also known as LAP, are a comparative development in programmed instruction. A LAP is a "modular instructional unit designed to facilitate the individualization of instruction" (Manatt & Meeks, 1971, p. 174). A specific advantage of the LAP is that it allows the student a wide variety of choices in how he will achieve the behavioral objectives, thus allowing for differences in past achievement and in style of learning (Marzahi, 2001 as cited in Citeseerx, 2015).

As in all self-instructional materials, LAPs attempt to account for differences in student's learning rate, past achievement, interest, and aptitude. It does not require everyone to go through every activity. LAP forces the teacher to organize the learning experience into a logical and consistent approach; he can then readily prepare performance criteria because there are clearly defined goals.

According to (Timmerman, 1972), LAP has five essential elements which include concepts; behavioral objectives; multi-dimensional learning materials and activities; pre-, self- and post-evaluation; and quest or self-initiated learning. The components are highly structured but not at the expense of individualization. For the most part, the teacher becomes an integral/ but not an essential part of learning.

There are three major procedures for evaluation in a LAP (Jones, 1968, pp. 178-183). The first procedure is known as exemption where students may decide, after reading the behavioral objectives, that he already knows the material. If he passes the test, he may proceed to the next LAP. The second is the student self-assessment. It is where answers to these self-tests are readily available. And the third procedure for evaluation in a LAP is the teacher test. This evaluation must be parallel in content, form, and type of question to the student-self-assessment test.

Jones (1968) also lists several factors involved in a LAP. One is the provision for small group work and for student/instructor contact. He also added that "Many other elements may be included within the covers of a LAP: visual aids, a complete bibliography, worksheets, an achievement record, and a large dose of motivational drawings, anecdotes, and cartoons. The insertion of these items is limited only by the imagination of the writer and the availability of time to think them up and write them down." In this regards, quest opportunities may be one of three types: (1) apply knowledge gained and skills developed in some kind of activity which the student finds particularly interesting, (2) develop further the theoretical competencies in some area of interest, or (3) organize some type of activity which he designs himself.

The importance of behavioral objectives is again emphasized. Mager (1968) states that the existence (or lack of) clearly-stated objectives may cause an approach (or an avoidance) response. A positive response causes a rise in stimulation, self-esteem, and confidence. He approves of the LAP because the student may choose the extent and rate of his progress, may clearly see the objectives and goals and can follow, through evaluation, his own progress.

Little research has been conducted using the strictly printed LAP. Meeks (1971) noted this absence in the background information for the study of the effectiveness of LAPs compared to that of the lecture. He grouped 144 experienced teachers into two groups, one receiving instruction through LAPs and the other by attending lectures. The group using the LAPs achieved a significantly higher level (.10 level of significance), than did the control group. There was no significant difference in time spent, but the experimental group indicated they preferred the LAPs to the conventional lecture.

Approaches to Teaching Science in High School

Criticism of science education programs has become increasingly widespread in recent years, as students at all levels decry the lack of individualization, the alleged uselessness of required science education, and the lack of instruction which will have life-long benefits. Students who are 14-19 years of age is distracted by many outside activities and if they are not interested in science, this will be a challenge for the teacher. Many secondary science teachers have been aware of these problems and have acted accordingly. The teachers also knew that if the students are interested in the future of the subject, they will need quality tools to enable the students to learn. Among the proposed and implemented solutions have been (Tips for Teaching Science to High School, Grades 9-12, 2019): providing good reference materials as well as lab equipment; utilize developing math skills and problem-solving; engage students by asking questions; build confidence through experimentation; make science class fun, relevant, and challenging; alleviate boredom through activity; encourage skills through the science notebook; encourage independent investigation; and develop the mind further through vocabulary.

More research, development, and teacher education are needed on how to increase students' engagement in learning science. Priorities include classroom organization, a changed approach to written work, and an increased focus on the task that is part of the core of learning science. There should be a strong emphasis on 'assessment for learning' (Kaptan & Timurlenk, 2012).

Research suggests that a strong influence on student's attitudes towards science is on how the teacher as the role model and the perceived subject attractiveness by the students. Nteere, Kwaria and Kirimi (2017) presented that "the Physics teachers who could not show the significance of Physics in relation to day to day life situation, were not fully able to make students grasp the concepts of application of Physics. Results also clearly indicated that the majority of the students claimed that Physics involved calculations hence perceived Physics difficult. In essence, part of the explanation for student attitudes toward school science may be a shortage of well-qualified science teachers capable of providing a positive experience.

Science is unique among school subjects that its curriculum aims to create future scientists rather than a future citizen. This produces a foundation curriculum whose coherence only becomes clear for those who stay the distance and with it the value and meaning of the subject. Moreover, it is dominated by an assessment system whose predominant demand is a low-level cognitive recall. Such a system promotes "performance learning," which is extrinsically motivated, rather than "mastery learning," which concentrates on the student, to the detriment of student engagement (Shulman, 1986). Those who drop by the wayside are left with a few disjointed pieces of knowledge whose salience is difficult to comprehend.

Shulman (1986) added that "there is now a significant body of knowledge about teaching and learning science. It has been developed through scholarship and empirical studies conducted in many countries around the world. All teachers know that what is taught by teachers is not the same as what is learned by pupils. As in all acts of communication, learners have to make sense of what they hear, see and read in terms of what they already know. Teachers can make this easier or more difficult for pupils by the way that messages are put together, and the way that pupils' questions are elicited and answered."

Interaction between teachers and students is essential for teaching to be effective in promoting learning. One-way delivery from a teacher does not work for the vast majority of pupils. Assessment for learning (a developed form of formative assessment) is a key element of this interaction. A comprehensive review of the research literature has shown that there is very clear evidence that formative assessment leads to significant improvements in students' test scores, i.e. their attainment as measured by summative assessment (Black & William, 1998). In the past, science teachers, in particular, have been discouraged from adopting this approach to assessment. These developments have involved four main changes according to Kaptan and Timurlenk (2012). These changes include: (1) the first has been in classroom dialogue. If teachers are to communicate effectively with students, they must set up activities and questions that help students to formulate and express their own ideas and then listen to what students say. On the basis of this assessment, teachers must fashion the next steps, challenging students and leading them towards ideas that will be more fruitful. Such two-way interaction can happen several times during a lesson as learning progresses. A crucial aspect of such dialogue-based teaching is to give students a voice, and help them realize that their teacher wants to know what they think so that they will feel free to express even half-formed or confused ideas; (2) a second change requires interactive feedback on written work. Teachers have to annotate students' work with comments designed to guide them in making improvements, and then provide opportunities for them to use this guide. Students then come to see their work as a step in improving their learning. Existing practices emphasize marks so that pupils see the exercise merely as a test; (3) a third change is to involve students in working in small groups to assess each other's work. The point here is not to trust students with generating marks, but to help them help each other so that they are better able to understand the aims of their work and the criteria by which its quality may be judged. Self-assessment is essential if students are to carry on being effective learners in their adult lives, and (4) the fourth change makes use of the formal tests that teachers regularly apply to add extra value to learning. Students may learn from trying to design test questions or from marking test papers in groups so that they can be more objective and realistic in appraising their own performance and in understanding how tests are marked. Working in this way has led students to become more active participants in their learning and to become more motivated to take it seriously.

Education is viewed as a planned series of dynamic behavioral interactions between teacher and child. The starting point is the kind of behavior one might wish the child to evidence in a free society. Learning, on the other hand, is not described in the usual sugar-coated terms, but rather is presented as a struggle to be resolved—and in the resolution comes the realization—the personal triumph of the learner. By skillfully blending concepts advanced by Maslow, Skinner, Bruner, and Socrates into meaningful and workable formulas, a flexible framework is offered to those sensitive enough to grasp it.

It is suggested that true learning is only accomplished by carefully transferring decisions formerly made by teachers to the learner. The use of programmed instruction to teach science education motor skills have been limited but with encouraging results. Locke (1971, p. 57) surveyed seven studies that used programmed instruction, six of which used a programmed textbook. He concluded: "Motor skills can be programmed and that programmed instruction of motor skills may be at least as effective as conventional methods of instruction. In no case was the conventional method superior".

However, Locke (1971, p. 59) raises some speculation that has application to all programmed instruction: "It does not seem out of order to speculate that many statistically significant differences favoring programmed instruction might be attributed less to the superiority of programming, and more to the inferiority of the traditional verbal-based instruction used as a control condition. Such traditional methods are not inherently inferior but teachers rarely prepare traditional instruction with the same thorough attention to pedagogical detail that goes into the construction of a programmed text".

The use of programmed modes of instruction will permit each student to determine for himself how much repetition he needs. Learning activity packets or LAPs, on the other hand, permit the student to isolate himself from the surrounding environment, permitting greater concentration. Therefore the use of SciLAPs serves the dual purpose of providing material whose content is valuable to the student, and of introducing the student to a format that is of the importance of self-directed learning.

The Current Generation of Learners

Generation refers to all the people of about the same age within a society or within a particular family, or the usual period of time from a person's birth to the birth of his or her children (Generation, 2019). People in this "birth cohort" exhibit similar characteristics, preferences, and values over their lifetimes (The Center for Generational Kinetics, 2019). They believed, that generations are powerful clues showing where to begin connecting with and influencing people of different ages and what shapes generations, as they continue, are based on the three key trends which include parenting, technology, and economics. Currently, the generation of learners in both public and private high schools belong to Generation Z or Gen Z. Generally, this generation includes those who were born from 1995 until 2012. Although precise years vary according to the source, Gen Z gained its mark of having the largest population in the generational cohort of all time.

In order to understand the emerging generations and their learning habits, teachers must understand the characteristics or the type of learners they have. According to Fell (2019), the five characteristics of today's learners are defined as social, mobile, global, digital, and visual. She explained that today's learners are social because learning takes place outside the classroom, but the essential engagement and practice are still conducted at school, by the all-important facilitator, rather than the teacher. The learners are mobile in terms of the jobs they will have and the homes they will live in that is through the technology with which they interact. Also, she added that today's learners are global, for they are the most globally connected and influenced generation in history and are not limited to the local, but are global as never before. Fell (2019) continues stating that the current learners are digital. She emphasized in her discussions that "as much as today's learners need literacy, they also need to learn digital skills in order to thrive in this changing world. Because it is not just pen and paper for them but iPads and screens on which they will learn, which are designed to not just display the written but the visual". Lastly, the learners we have today are visual. She explained further that, "in an era of information overload, messages have increasingly become image-based and signs, logos, and brands communicate across the language barriers with color and picture rather than with words and phrases. Visuals are also the way in which the brain processes information best. It can retain visual symbols and images rather than just written content. Their analysis of learning styles has shown dominance in the visual and hands-on learning styles, above the auditory delivery form, which has traditionally dominated the classroom."

Gen Zs were born with technology. Kalkhurst (2018) stressed that these Gen Z learners don't see technology as a tool, they see it as a regular part of life and will never know what life was like without the internet. He also added, that today's learners are dealing with things practically rather than theoretical considerations and are not easily convinced making them more pragmatic and skeptical than generations before.

Different from its characteristics and values, this young generation of learners may approach learning differently. It is quite known that in order for the delivery of learning to be effective, the teacher has to know how the learning style of a learner. Staples (2018), presented that by giving the Gen Z the freedom to learn on their own while guiding them on the type of skills required may create a more supportive learning journey that Gen Z desires. She also stressed that to get Gen Z workers excited about being active participants in a learning culture, L&D will want to focus on engagement tactics and show the connection to career advancement. Lastly, she pointed out that while Gen Z understands that learning new skills will be critical to their economic relevance (and employment), they may overlook the importance of skills like communication and collaboration that will be key to making good on the promise of lifelong learning.

In this study, utilizing science learning activity packets or SciLAPs as an approach to instruction can be an effective means to improve the learner's performance in Science. SciLAP is a kind of self-instructional material or programmed instructions. Research indicates that using this as a strategy is effective at the secondary level of education where many new subjects are introduced in the curriculum that creates a problem in learning (Levett-Jones, 2005). Using SciLAPs as an intervention is considerably modular in approach. The instructional unit was designed to facilitate the individualization of instruction (Manatt & Meeks, 1971) but it can also be structured to include elements such as worksheets, links to online resources, visual aids, and infographics. These elements could facilitate self-paced learning and at the same time could provide opportunities for small group work that encourages collaboration among peers, teachers, and other resources which fit the type of learners we have in this generation. Moreover, the teacher-researcher would also act as a resource person and provides feedback or assistance during the completion of the task required in each packet. This ensures the interaction between teachers and students which is very essential for teaching to be effective in promoting learning (Black & William, 1998). Lastly, with the sets of structured drills and activities for self-paced learning, SciLAPs can be an effective intervention among Gen Z learners who prefers to have the freedom to learn on their own while guiding them on the type of skills required (Staples, 2018).

4. Materials and Methods

Research Design

This study utilized the quasi-experimental design because of the absence of the randomization of samples. Quasi-experimental is a research design that involves an experimental approach but where random assignment for treatment and comparison groups has not been used (Robson, 1998). This design was employed proving or disproving the study hypotheses mathematically supported with statistical analysis. Moreover, the teacher-researcher utilized two groups in conducting the experiment. One group, marked as the experimental group received the treatment and the other group that received no treatment was referred to as the control group. The treatments were conducted on both groups over the same period of time and undergone exactly the same tests.

Pretest and Post-test were employed in the design of this study. A systematic observation was also conducted during the entire duration of the experiment. The measurable data that the teacher-researcher has collected, consolidated and organized were utilized in formulating facts that uncovered the learning performance of the subject-respondents. Generally, this study has enabled the teacher-researcher to quantify the problem by way of generating numerical data, transforming it into usable statistics, and generalized results from a larger sample population.

Participants

The study was conducted at a National High School in the Northern Negros Occidental during the fourth quarter of School Year 2018-2019 where the subject-respondents were Grade 10 students in Science. Among the five sections that the teacher-researcher was holding, two sections with the lowest mean percentage scores (MPS) in their third quarter examinations were chosen as the sample frame. From these two sections, one section was selected as the experimental group and the other section as the controlled group by way of a draw lot.

On the other hand, the distribution of samples for each group was done through purposive sampling. According to Tongco (2007), the purposive sampling technique is a type of non-probability sampling that is most effective when one needs to study a certain cultural domain with knowledgeable experts within. She added, that purposive sampling may also be used with both qualitative and quantitative research techniques. In the study conducted, the students with grades below 78 in the third quarter and have attended Science 10 classes for at least three consecutive meetings were selected for the purpose. As a result, 21 students were identified and distributed in the experimental group and 19 students for the controlled group. No member of one group has been part of the other group. Thus, the grouping of the participants was considered to be unrelated or unpaired also known as independent groups.

Instrument

In this study, a teacher-made multiple-choice type of test composed of 25 items was utilized in the conduct of pretest and posttest. This research instrument developed by the teacher-researcher was validated by the Assistant School Principal in charge of Curriculum and Instruction and two Master Teachers with more than 15 years of experience in teaching Science. Based on a Likert Scale Rating Scale set forth by Allan S. Cohen and James A. Wollack, the reliability statistics for this instrument results in a Cronbach's Alpha of .877 interpreted as optimal. Testing its reliability, the same instrument was administered to thirty students from other sections with almost the same profile. The students' scores in the 25-item test were statistically treated using the Kuder-Richardson Formula 20 resulting in a KR-20 of 0.87 was obtained showing optimal reliability.

Meanwhile, the teacher-researcher has developed SciLAPs integrated lessons that were used in the study. Prior to the conduct of the study, the instrument was subjected to face and content validity by the same group of validators. According to McBurney (1994, p. 123), face validity is an idea that a test should appear superficially to test what it is supposed to test. He also defines content validity as the notion that a test should sample the range of behavior represented by the theoretical concept being tested. As the instrument undergoes peer and expert evaluation, the criteria developed for evaluating the survey questionnaire set forth by Carter V. Good and Douglas B. Scates was utilized. With the obtained average score of 4.44, the result indicates that SciLAPs integrated lessons that were utilized in the conduct of the study were generally agreeable. In addition, this instrument has qualified from the testing validity which predetermined the goal was to reach an expert's consensus of 65% on each item (Powell, 2003).

Moreover, the content of the SciLAPs includes topics on "Chemical Equations" and "the Law of Conservation of Mass". The learning competency carried out in this study was focused on the learners to be able to "apply the principles of conservation of mass to chemical reactions (S10MT-IVe-g-23)". This competency was chunked into three specific objectives and was sorted based on progression as shown in the table below:

Table 1. Daily task learning objectives

Day	Objectives
1	The learners should be able to distinguish between reactants and products.
2	The learners should be able to write chemical equations
3	The learners should be able to perform activities that illustrate the law of conservation of mass.

The same objectives can be found in the SciLAPs integrated lessons that were delivered to the two groups, the control group, and the experimental group.

Data Gathering

After seeking approval from the Office of the Schools Division Superintendent and Office of the School Principal, the teacher-researcher has conducted the entire study in twelve days which includes validity and reliability testing of the instruments. Presented in the table below, were the activities conducted in the study:

Table 2. GANNT Chart of Activities

Activity	Week 1					Week 2					Week 3	
Approval of the OSDS and OSP												
Seek parents' consent												
Preparation of the Research Instruments												
Instrument Validation, Reliability Testing												
Statistical Treatment and Analysis												
Make Revisions if needed												
Conduct of pretest												
Conduct of experiment												
Conduct of posttest												
Gathering and Consolidating of Results												
Statistical Treatment and Analysis												

Meanwhile, the experimental group received the treatment by which teaching was carried out using SciLAPs. The control group, on the other hand, received no treatment in which teaching was conducted by way of the teaching methods similar to the approach found in the DepEd's Teacher's Guide and Learners' Materials. The treatments were carried out by the teacher-researcher during the three-day experimental period.

Prior to the experimentation, a pretest was administered among all subject-participants. A posttest, however, was administered after the entire lesson were delivered. The scores of both the pretest and posttest were collected, tallied, coded, and statistically treated. In particular, the scores that were obtained by the students in the pretest and posttest were categorized and assigned with descriptions. The following scoring interpretation shows the score range and its corresponding description:

Score Range	Description
1.0 - 5.0	Very Low
6.0 - 10.0	Low
11.0 - 15.0	Average
16.0 - 20.0	High
21.0 - 25.0	Very High

Statistical Treatment/Data Analysis

In this study, the frequency and percentage were used as the frequency of respondents across groups was determined. The learning performance of the control and experimental groups based in the pretest and posttest were determined by acquiring the mean and its respective standard deviations.

The independent samples t-test, however, was utilized in determining the difference in the learning performance of the control and experimental groups. However, a paired sample t-test was utilized to determine the difference in participants' pretest and posttest. The t-test results compared the students' pretest and posttest scores with each particular group.

Ethical Considerations

The teacher-researcher followed the five basic principles of research ethics in the conduct of this study according to Lund Research Ltd. (2012). The principles were stated as follows: (1) those minimized the risk of harm or discomfort of the participants; (2) obtained informed consent from the participants by making sure that they understood that they took part in research and what the research required them; (3) protected the anonymity and confidentiality of participants by removing identifiers; (4) avoided deceptive practices by making this study known to the participants or subjects; and lastly, (5) providing participants with the right to withdraw from the research process at any time.

4. Results and Discussions

This part of the study comprised two sections – first, is the results that deal with the presentation, analysis, and interpretation of data in connection with the specific problems of the study and second, the discussion that advances the implications and the importance of the investigation.

Results.

This chapter is the presentation and analysis of the data in the study. Charts and tables are presented to supplement in the discussion of the results.

Table 3. *Frequency Table of Respondents across Groups*

Group	*Frequency*	*Percentage*
Experimental	21	52.5
Control	19	47.5

Table 3 presents the distribution of the 40 student-respondents across groups. There are 21 (52.5%) students in the Experimental and 19 (47.5%) students in the Control group.

I. Learning Performance of Control and Experimental Group in the Pre-test and Post-test

Table 4. *Table of Pre-Test and Post-Test Mean Scores across Groups*

Test	*Group*	*Mean*	*Standard Deviation*
Pre-test	Experimental	2.48	1.209
	Control	2.84	1.214
Post-Test	Experimental	19	2.214
	Control	13.84	2.522

Table 4 present's students' pre-test and post-test mean scores across the experimental and control group.

For the pre-test, the mean score of the experimental group is 2.48 with a standard deviation of 1.209 while the control group has a mean score of 2.84 with a standard deviation of 1.214. Furthermore, the control group has a higher mean score than the experimental group in the pre-test conducted.

For the post-test, the mean score of the experimental group is 19 with a standard deviation of 2.214 while the control group has a mean score of 13.84 with a standard deviation of 2.522. Furthermore, the experimental group has a higher mean score than the control group in the post-test conducted.

II. Differences in the Learning Performance of the Control and Experimental Group

Table 5. *t-Test Results Comparing Students' Pre-Test Scores across Control and Experimental Groups*

Group	*n*	*Mean*	*SD*	*Test Statistic*	*t-Tabulated*	*df*	*P-value*	*Decision*
Control	19	2.84	1.214	-.954	2.024	38	.346	Do not Reject
Experimental	21	2.48	1.209					

Table 5 presents the test results comparing the pre-test scores across control and experimental groups. An independent-samples t-test was conducted to compare the scores. From the table, there is evidence to conclude that the hypothesis stating that "there is no significant difference in the pre-test scores across control *(M = 2.84, SD= 1.214)* and experimental *(M= 2.48, SD= 1.209)* groups" can be *retained; (t (38) = -.954, p= .346)* at significance level alpha set to .05. These results suggest that before the experiment, pre-test scores differ among students across different groups.

Table 6. *t-Test Results Comparing Students' Post-Test Scores across Control and Experimental Groups*

Group	*n*	*Mean*	*SD*	*Test Statistic*	*t-Tabulated*	*df*	*P-value*	*Decision*
Control	19	13.84	2.522	6.888	2.024	38	.000	Reject
Experimental	21	19.00	2.212					

Table 6 presents the test results comparing the post-test scores across the control and experimental groups. An independent-samples t-test was conducted to compare the scores. From the table, there is evidence to conclude that the hypothesis stating that "there is no significant difference in the post-test scores across control *(M = 13.84, SD= 2.522)* and experimental *(M= 19.00, SD= 2.212)* groups" can be *rejected; (t (38) = 6.888, p= .000)* at significance level alpha set to .05. These results suggest that before the experiment, post-test scores differ among students across different groups.

III. Differences in Students' Pre- and Post-test

Table 7. *t-Test Results Comparing Students' Pre-Test and Post-Test Scores Within Control Group*

Pair	*Mean*	*SD*	*Test Statistic*	*t-Tabulated*	*df*	*P-value*	*Decision*
Pre-test and Post-test	-11.000	1.732	-27.683	2.1009	18	.000	Reject

Table 7 presents the test results comparing the pre-test and post-test scores in the control group. A paired-samples t-test was conducted to compare the scores. From the table, there is evidence to conclude that the hypothesis stating that "there is no significant difference in the pre-test *(M=2.84, SD=1.214)* and post-test *(M=13.84, SD= 2.522)* scores in the control group" can be *rejected; (t (18) = -27.683, p= .000)* at significance level alpha set to .05. These results suggest that within the control group, pretest and posttest scores differ significantly.

Table 8. *t-Test Results Comparing Students' Pre-Test and Post-Test Scores Within Experimental Group*

Pair	*Mean*	*SD*	*Test Statistic*	*t-Tabulated*	*df*	*P-value*	*Decision*
Pre-test and Post-test	-16.524	1.463	-52.733	2.1009	18	.000	Reject

Table 8 presents the test results comparing the pre-test and post-test scores in the experimental group. A paired-samples t-test was conducted to compare the scores. From the table, there is evidence to conclude that the hypothesis stating that "there is no significant difference in the pre-test *(M= 2.48, SD=1.209)* and post-test *(M=19, SD=2.214)* scores in the experimental group" can be *rejected; (t (18) = -52.733, p= .000)* at significance level alpha set to .05. These results suggest that within the experimental group, pre-test and post-test scores differ significantly.

Discussions

As the main objective of this study was to determine the effectiveness of Science Learning Activity Packets (SciLAPs) as an approach to instruction in the learning performance of Grade 10 students, pretest and posttest were conducted. To fulfill its purpose, it is important to understand how approaches or delivery of instructions may affect the learning performance of the student.

It is apparent that the purposively selected Grade 10 students, especially in this particular setting, considered all aspects of SciLAPs as essential and necessary for improving their learning performance. Therefore, results from the pretest and posttest may not generalize the effectiveness of SciLAPs to the whole Grade 10 students where the study was conducted.

Although the course of the developed intervention was very short (one-week period), it appears that with three lesson objectives in the developed SciLAPs, the results show that the students have improved their learning performance. To include, students who have completed the tasks required in each learning packet results in a positive impact on the mastery and understanding of the lessons that were delivered. This supports that the chunking of information in the form of learning packets of a meaningful unit (Miller, 1956), was effective. And in addition to that, the learning activities have developed student's mastery of problem-solving that encouraged the student to perform drills which, according to Thorndike's S-R bond theory, helps in increasing the efficiency and durability of learning. The above features were in line with Detaramani and Chan's(1999) findings onthe impacts of self-study centers. The findings revealed that students consider the major roles of self-access centers an independent means to help them learn. Therefore, some time is needed to be spent making sure students understand how activities help them learn, in other words, teaching-learning strategies (Wachob, 2019).

Research on science learning activity packets could continue in several directions. First is motivation, as one of the aspects of motivation may be affected by weak reading comprehension and poor skills in mathematical operations. As observed, some students in this study were less motivated to complete the tasks in the learning packets because of having difficulty in reading comprehension and pauses for help when performing computations. Second, the time when the respective groups took the tests may have influenced the results. Those students in the experimental group who received the treatment and took the tests in the second period of the morning class may have been fresher and more relaxed than those in the control group, who received no treatment and took the tests in the third period of the morning class.

Conclusions

Incorporating SciLAPs in teaching Science on Grade 10 students can be effective. It will, however, take time and effort on the part of the teacher. Learning materials that fit the characteristics of the current generation of learners, with properly chunked information, and have enough activities for self-directed learning would engage students in meaningful and lifelong learning. Instructions that are structured for collaboration, as well as the provision of accessible online resources in the SciLAPs, would lead to extend learning opportunities. With the presence of the teacher to act as a resource person and provides feedback every time the student is in doubt would increase the student's motivation to complete the tasks required in each learning packet. If these considerations can be carried in developing a SciLAP that will be used as an approach to instructions or intervention in teaching, we will surely see an improved learning performance among Grade 10 students in Science.Authors including an appendix section should do so before References section. Multiple appendices should all have headings in the style used above. They will automatically be ordered A, B, C etc.

Recommendations

It is recommended that the school heads will implement the development and integration of SciLAPs into the present curriculum. The intent of the learning activity packets is to improve students' learning performance as they further enhance their understanding of Science as well as improve mastery level in problem-solving by taking enough time to repeatedly practice tasks.

It is emphasized that the use of learning activity packets as an intervention may be applicable to any subject area and would help teachers increase the subject literacy of their students in a self-directed manner. The experiences gained were of great benefit to further improve or develop the study. Future researchers may find other ways to enhance the intervention and utilize other strategies to improve the learning performance of the students. It is also recommended that future studies should aim to replicate results in a larger sample including the use of random selection for the sample distribution to both experimental and control groups.

With the advent of digital technology and the characteristics of the current generation of learners, SciLAPs are sought to have a good potential to further improve learners' performance by way of developing learning activity packets in digital format and made available online. On the other hand, it is questionable if additional time was given to students to fully comprehend the material if the results would be the same.

REFERENCES

Baker, A. J., Piotrkowski, C. S., & Brooks-Gunn, J. (Spring/Summer 1999). The Home Instruction Program for Preschool Youngsters (HIPPY). The Future of Children HOME VISITING: RECENT PROGRAM EVALUATIONS Vol. 9 • No. 1, 116-133.

Barnhill, S. (1998). Technology Lab 2000. Tech Directions. 57., 30-31.

Bartz, W. H., & Darby, C. L. (1965). A Study of Supervised and Nonsupervised Programmed Instruction in the University Setting. Journal of Educational Research, 58, 208-211.

Basho, M. (2005). Basho's Journey: The Literary Prose of Matsuo Basho. Trans. David Landis Barnhill. Albany: State University of New York Press.

Black, P., & William, D. (1998). Assessment and Classroom Learning. Assessment in Education 5(1), 7-73.

Bro, R. (1974). Individualized instruction - do it now. Man. Society. and Technology. 33, 104-105.

Bruner, J. (n.d.).

Choo, S. S., Rotgans, J. I., Yew, E. H., & Schmidt, H. G. (2011). Effect of worksheet scaffolds on student learning in problem-based learning. Advances in health sciences education: theory and practice, 16(4), 517-28.

citeseerx. (2015). Download: citeseerx.ist.psu.edu. Retrieved from http://citeseerx.ist.psu.edu: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.391.1920&rep=rep1&type=pdf

Cruz, M. J. (2017, March 11). Science Ed and a Thinking Society. Philippine Daily Inquirer.

Culatta, R. (2019). theories/information-processing/. Retrieved from www.instructionaldesign.org: https://www.instructionaldesign.org/theories/information-processing/

Das, N., Singh, A., & Amrita. (2014). IMPORTANCE OF SCIENCE IN SCHOOL CURRICULUM. WeSchool Knowledge Builder - The National Journal, 2. 4.

David, L. (2015, December 4). Information Processing Theory. Retrieved January 12, 2018, from https://www.learning-theories.com: https://www.learning-theories.com/information-processing-theory.html

Davis, R. H., Marzocco, F. N., & Denny, R. M. (1970). Interaction of individual Differences with Modes of Presenting Programmed Instruction. Journal of Educational Psychology, 61, 198-204.

Detaramani, C., & Chan, I. S. (1999). Learners' Needs, Attitudes and Motivation Towards the Self-Access Mode of Language Learning. RELC Journal, 30(1); 124-150.

Digital Repository. (2019, May). Digital Repository: Iowa State University. Retrieved from lib.dr.iastate.edu: http://lib.dr.iastate.edu/

Dublin, R., & Taveggia, T. (1968). The Teaching-Learning Paradox. Oregon: University of Oregon Press.

Encyclopedia of Educational Research. (1960). New York: Macmillan.

Epstein, J. L., Herrick, S. C., & Coates, L. (1996). Effects of Summer Home Learning Packets on Student Achievement in Language Arts in the Middle Grades. School Effectiveness and School Improvement, 7:4, 383-410.

Espich, J. E., & Williams, B. (n.d.). Developing Programmed Instructional Materials. Palo Alto, California: Fearon.

Farooq, U. (2013, November 19). Programmed Instruction Method Meaning, Advantages & Disadvantages. Retrieved from http://www.studylecturenotes.com: http://www.studylecturenotes.com/curriculum-instructions/programmed-instruction-method-meaning-advantages-disadvantages

Fell, A. (2019). Generation Z defined; The 5 characteristics of today's students. Retrieved from McCrindle: https://mccrindle.com.au/insights/blog/generation-z-defined-5-characteristics-todays-students/

Geis, G., & Chapman, R. (1971). Knowledge of Results and Other Possible Reinforcers in Self-Instructional Systems. Educational Technology, 11, 38-51.

Generation. (2019, May). In Cambridge Dictionary. Retrieved from https://dictionary.cambridge.org/us/dictionary/english/generation.

Gloeckner, G., & Adamson, G. (1996). Modular Technology Education. the Technology Teacher. 56, 16-21.

Infoplease. (2017, April 6). Programmed Instruction. Retrieved from www.infoplease.com: https://www.infoplease.com/encyclopedia/social-science/education/concepts/programmed-instruction

Jones, R. (1968). Learning Activity Packets; An Approach to Individualized Instruction. Journal of Secondary Education, 43, 178-183.

Kalkhurst, D. (2018, March 12). Engaging Gen Z students and learners. Retrieved from www.pearsoned.com: https://www.pearsoned.com/engaging-gen-z-students/

Kaptan, K., & Timurlenk, O. (2012). Challenges for Science Education. Procedia - Social and Behavioral Sciences 51, 763 – 771.

Levett-Jones, T. (2005, July 25). Self-directed learning: implications and limitations for undergraduate nursing education. Retrieved from www.ncbi.nlm.nih.gov: https://www.ncbi.nlm.nih.gov/pubmed/15894411

Locke, L. F. (1971). Prepackaged Sports Skills Instruction: A Review of Related Research. Journal of Health, Physical Education, Recreation, 57-59.

Loughery, J. W. (May 1968). Instructional Systems—Magic or Method. Educational Leadership, 25, 730-734.

Lund Research Ltd. (2012). principles of research ethics. Retrieved January 30, 2019, from laerd dissertation: http://dissertation.laerd.com/principles-of-research-ethics.php

Mager, R. F. (1961). Preparing Objectives for Programmed Instruction. San Francisco, California: Fearon Publishers.

Mager, R. F. (1968). Developing Attitudes Toward Learning. Palo Alto, California: Fearon Publishers.

Maheshwari, V. (2019, May 18). The Wardha Scheme of Education –GANDHI JI POINT OF VIEW. Retrieved from http://www.vkmaheshwari.com: http://www.vkmaheshwari.com/WP/

Manatt, R. P., & Meeks, B. E. (1971). An Educator's Guide to the New Design. Dubuque, Iowa: Kendall/Hunt Publishing Company.

Marzahi, T. (2001). Effectiveness of Self-Directed Learning Activity Packets Versus Lecture. Menomonie, Wisconsin, USA: http://citeseerx.ist.psu.edu. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.391.1920&rep=rep1&type=pdf

McBurney, D. (1994). Research Methods (3rd ed.). California: Cole Publishing Company.

Mclntyre, C. J. (1963). The Impact of New Media on College Instruction. Journal of Higher Education, 34, 85-91.

Meeks, B. E. (1971). Learning Packages Versus Conventional Learning Packages Versus Conventional. Ames, Iowa: Unpublished Ph.D. dissertation.

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological Review, 63(2), 81.

Nejad, M. (1998). Comparison of computer simulations vs. traditional laboratory instruction in solid-state electronics. Journal of Industrial Technology. 14, 12-17.

Nteere, N., Kwaria, J., & Kirimi, N. (2017). Influence of Selected Factors on Students' Attitude towards Physics in Public Secondary Schools. American Journal of Educational Research, 5(9), 939-943.

Nworgu, B. (1991). Educational Research: Basic Issues & Methodology. Ibadan: Wisdom Publishers Limited.

Ofiesh, G. D. (1964). "Introduction" in Trends in Programmed Instruction. Washington, D.C.: National Education Association.

Olsen, J. (1966). Coining Revolution in Textbooks: Instructional Program Packages. High Points, 48, 14-21.

Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards Science: A Review of the Literature and its Implications. International Journal of Science Education 25, 1049–1079.

PEI Department of Education. (2008). Evaluation and Selection of Learning Resources: A Guide. Retrieved from http://www.gov.pe.ca/educ: http://www.gov.pe.ca/photos/original/ed_ESLR_08.pdf

Popham, W. (1964). The Impact of Programmed Instruction on Conventional Instruction" in Trends in Programmed Instruction. (N. S. Instruction, Ed.) National Education Association, 65-67.

Reissman, F. (March 1966). Styles of Learning. NEA Journal, LV, 15-17.

Robson, J. (1998). A Profession in Crisis: status, culture, and identity in the further education college. Journal of Vocational Education and Training, Vol. 50, No. 4, 585-607.

Shulman, L. (1986). Those who understand: Knowledge growth in teaching. Educational Researcher 15, 4-14.

Skinner, B. (1954). The Science of Learning and the Art of Teaching. Harvard Educational Review, 24, 86-97.

Smith, K. T. (November 1969). A LAP on writing LAPs. Unpublished mimeo. Fort Lauderdale, Florida: Broward County Board of Public Instruction.

Staples, T. (2018, December 18). Gen Z: How They Learn. Retrieved from www.chieflearningofficer.com: https://www.chieflearningofficer.com/2018/12/18/gen-z-how-they-learn/

Talbert, R. L. (January 1968). A Learning Activity Package: What is it? Educational Screen and Audiovisual Guide, 20-21.

The Center for Genrational Kinetics. (2019, May 8). Generational Breakdown: Info About All of the Generations. Retrieved from https://genhq.com/faq-info-about-generations/: https://genhq.com/faq-info-about-generations/

The Columbia Encyclopedia, Sixth Edition. (2001-05. HTML, retrieved 16:22, 16 August 2007 (MEST)).

Timmerman, L. D. (1972). Learning activity packages vs audio-tutorial instruction as a vehicle for teaching physical education. 6126: Retrieved from https://lib.dr.iastate.edu/rtd/6126.

Tips for Teaching Science to High School, Grades 9-12. (2019, February 12). Retrieved February 12, 2019, from Home Science Tools: https://learning-center.homesciencetools.com/article/tips-for-teaching-science-to-high-school/

Tongco, M. C. (2007). Purposive Sampling as a Tool for Informant Selection. Ethnobotany Research & Applications, 5:147-158.

Tracy, D. (1969). A Comparison of the Effectiveness of Teacher-Directed Study and Learner-Directed Study. Dissertation Abstracts 29: 11A, 3784.

U.S. Naval Academy. (2010). Military manual for teaching in the military. Denver, CO: Author.

UNESCO's International Institute for Education Planning. (2018, March 29). https://learningportal.iiep.unesco.org/en. Retrieved from http://www.iiep.unesco.org/en: https://learningportal.iiep.unesco.org/en/issue-briefs/improve-learning/teachers-and-pedagogy/effective-and-appropriate-pedagogy

The University of Texas at Arlington. (2017, September 8). Importance of Science Education in Schools. Retrieved January 11, 2019, from The University of Texas at Arlington Online: https://academicpartnerships.uta.edu/articles/education/importance-of-science-education.aspx#

Wachob, P. (2019). Methods and materials for motivation and learner autonomy Methods and materials for motivation and learner autonomy. Research Gate.

Welty, K., & Wei-Kun, T. (1995). Impact of Individualized Instruction materials on technology education programs. International Journal of Instructional Media. 22, 321-325.

Zulueta, & Guimbatan. (2002).