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# Nurturing Conceptual Understanding in Science 7 through Universal Design for Learning

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**ABSTRACT**

Students usually receive a unidirectional approach to instruction using a single material source and this lead to limited differentiated activities. Therefore, some students can face a sink-or-swim scenario if they dislike the presented activities. To address this issue, the researcher developed a learning material that is based on the Universal Design for Learning. It offers differentiated options from which students may choose based on their needs and interests. Thus, this study aimed to propose a solution for improving access to education for students with diverse learning needs through the use of Universal Design for Learning-based Workbook. The study used mixed research methods to gather data from both quantitative and qualitative sources, aiming to provide comprehensive information about the problem. The results of the study were analyzed using T-test data analysis technique. Based on the research analysis, it was concluded that applying the principles of Universal Design for Learning in education can improve the overall learning experience and conceptual understanding for a broad range of students. Overall, the study suggests that adapting UDL can improve education accessibility and enhance the overall educational experience of students with diverse learning needs.

## Introduction

Learners have diverse qualities, preferences, requirements, and skills. Such unique characteristics may impact their academic achievements and educational experiences. Therefore, a more than one-size-fits-all approach is needed because students acquire learning differently. To help students reach their maximum potential and give everyone an equal chance to advance knowledge, teachers should offer the appropriate support and direction based on students' learning needs and skills so that no one is left behind. Learners should be empowered with choices to learn and overcome learning barriers. In today's classroom, students must feel safe, valued, interested, and motivated by appropriate challenges. Instead of focusing on just one type of assessment, teachers should use multiple methods to teach and give students different learning opportunities relevant to the subject. This will help each student reach their potentials.

In relation to this, learning and participating in Science requires thinking and analyzing information to make meaning and sense of the world. Even when outcomes should be consistent with Science, scientific inquiry can provide a completely open and disorienting experience. As a result, it can be a barrier for many students. Also, Science is an interdisciplinary subject that is not only focused on thinking but mostly on exploring, experimenting, collecting, and developing innovative ideas. Critical-thinking skills, inventions, and advancements are undoubtedly integral to the 21st century.

Science teachers must be given ideas, resources, and the help they need to create safe and welcoming places for students to work together and learn in general science classrooms. Because of this, it is necessary to incorporate these techniques in programs for teacher training and continuing education (Baurhoo & Asghar, 2014).

Traditionally, Science has been taught using the chalk-and-board method, which gives learners less time to develop Scientific Method and Critical Thinking skills. The lecture method is the easiest way to teach because it can be used with many students at once and does not need many supplies. The lecture method is primarily a one-way procedure with less interaction between learners and teachers. Thus, individual differences may be overlooked (Inocencio et al., 2021).

Activities in Science learning require learning media to assist students in the discovery process which can influence learning effectiveness (Ceriasari et al., 2019). The use of media in communication can facilitate the teaching and learning process, helps the instructor in making the material more engaging and less tedious, so learning media are valuable tools for achieving learning objectives. A student workbook for instance, is a form of instructional material that enables students to contribute information about the concepts they have acquired through methodical learning activities. It also allows teachers to direct students to discover concepts through their activities (Schmidt, 2012).

However, learning barriers arise due to individual learners' differences and learning styles. Concerning this, the Center for Applied Special Technology (CAST) developed a method for designing learning activities that may suit the needs of all students. The strategy refers to Universal Design for Learning (UDL). It was created based on education, neuroscience research, and the expanding effect of digital technology (Meyer et al., 2014).

According to an additional study, UDL can remove the achievement gap between able and challenged individuals (Hall et al., 2015). Thus, developing and utilizing the Universal Design Learning-based workbook may use as learning media in Science.

Relative to this, a senior high school science workbook shows promise in increasing students' performance. Workbooks can aid in reinforcing reading, math, and science skills. Learners are encouraged when a teacher uses a workbook, which improves their abilities, such as thinking, observation, experimentation, and interpretation. In addition, the workbook contains worksheets that follow the same components, which are coherent with each other. It also includes a variety of exercises, such as diagrams to be labelled, blank areas, sketches and clipping, and suggestions for additional study (Inocencio & Calimlim, 2021).

However, existing students' worksheets need to meet the requirements of quality students' worksheets. After being analyzed, the students' worksheet from the issuer has many areas for improvement. These areas for improvement include the contents of the students' worksheets only focusing on the cognitive. The information on students' worksheets does not correspond to the syllabus indicators, making exploring and introducing ideas difficult. The application of student concepts focuses on answering objective questions (Rogayan Jr. & Dollete, 2019).

Teachers have full responsibility for ensuring that instructional materials and methods meet the learning objectives because they are the ones who develop and use them. To ensure that instruction is effective, these objectives must be appropriate for the assessment and evaluation procedures used. To determine whether the educational goals have met, evaluation of students' learning should also be conducted. However, none of these tasks could be completed completely without first evaluating the teaching materials. Truly, teachers play the biggest role in the education field (Manalastas & De Leon, 2021).

In addition, the general description of UDL is based on the notion that the traditional curriculum is difficult for some students because these students have distinct educational needs and requirements from traditional learners. (Meyer et al., 2014). Consequently, it is acknowledged that people generally have various disabilities, body types, and ways of thinking and being, including different abilities, skills, interests, and needs. Therefore, all students benefit from implementing UDL including those fast and gifted learners, students with or without disabilities, and struggling learners. It attempts to provide a more expanded, diversified, adaptable, and personalized curriculum, supporting the removal of barriers to learning and engagement among the student population (Sadowski, 2014).

Universal Design for Learning (UDL) actively reduces learning impediments, including those seen in accommodations-based approaches (Toutain, 2019). In a related study, UDL can positively influence student outcomes, satisfaction, and engagement while reducing emotions of discouragement, debasement, insecurity, and isolation (Al-Azawei et al., 2016). UDL values, such as establishing engaging learning settings, respect for students, and appreciation of student diversity, also broadly transfer into good teaching techniques. It highlighted another advantage of UDL as an effective tool for supporting cross-cultural learning (Dwyer, 2019).

UDL promotes the development of curricular resources and activities that make learning goals attainable for individuals with vastly different capacities to see, hear, speak, move, read, write, comprehend English, attend, organize, interact, and remember without requiring repeated curriculum adaptations to accommodate special needs (Brand & Dalton, 2012).

In addition, UDL is emphasized as an inclusive framework founded on learning Science (Grillo, 2021). It promotes and eliminates learning barriers for all students while maintaining high standards. However, educators and administrators are still determining if there is a need to understand what it entails or how to execute it fully. Previous researchers have discovered that educators are more inclined to employ inclusive teaching approaches such as UDL when there are favourable views shaped by their culture, experiences, and training. UDL serves all students, not just those with particular needs, by improving student engagement and removing learning barriers.

Furthermore, UDL guides the creation of goals, methods, materials, and assessments so that these instruction components can work for every student. Rather than a "single, one-size-fits-all" approach, each component should be flexible with each learner's options to optimize learning (Martin & Wolanin, 2014). They added that the UDL framework could assist educators in designing freeway learning activities for all students. It is a framework for establishing universal learning activities, a universal curriculum, and universal assessment so that all students have an equal opportunity to participate actively in learning activities. Given the reality of their classrooms and the initiatives at schools, the researchers determined that teachers are free to select the elements that resonate for them. If a school has implemented a predetermined curriculum, teachers might need more time to make all components flexible. However, teachers can consider how to add flexibility as a steppingstone for students to attain their end goals (Rao & Meo, 2016).

Universal Design for Learning (UDL) consists of three principles founded on cognitive neuroscience research and the academic process. The three principles provide multiple means of representation, action and expression, and engagement (Meyer et al., 2014). By giving students multiple representation methods, learners have various ways to acquire information and build knowledge. Representation is also called the "What" of learning. Some examples of diverse engagement modes include students reading an article, watching a film, listening to a podcast, or visiting a museum to learn curricular content. No single representation method is best for all learners; therefore, giving options for representation is critical (CAST, 2018).

Using multiple means of representation in Science teaching and learning presents big ideas on the subject. Science educators must use multi-sensory means. Students should be encouraged to commit mistakes and failures and learn from them, just like "real" scientists do in their field, to establish an inclusive atmosphere that fulfils the individual academic needs of all learners. To assist students with learning differences, teachers must develop secure and encourage learning settings where all science students can engage freely without fear of being scrutinized by their teachers or peers. Science teachers can engage their students in multi-sensory experiences and learning about the natural world by using multiple means of representation (Baurhoo & Asghar, 2014).

By giving students multiple modes of engagement that tap into their interests, learners have diverse environments that challenge them appropriately and motivate them to learn (CAST, 2018). Engagement is also called the "Why" of learning. Some examples of diverse modes of engagement are working individually, working in pairs, having an extensive group discussion, or discussing directly with the teacher.

When learning Science, it is also essential to provide students with a variety of options to encourage active participation and boost their motivation. Active learning experiences that include hands-on investigations, reflection on observations, collaboration, and cooperative learning can engage learners with learning differences while minimizing distractions (Baurhoo &Asghar, 2014).

Learners differ in their ability to navigate an educational setting and convey what they know. By giving students multiple means of student action and expression, they have alternatives to demonstrate what they have learned (CAST, 2018). Expression is also called the "How" of learning. Some illustrations of learner behavior include encouraging students to write a poem, sing a song, act out a scene, bake a cake, or take an exam to show understanding. To demonstrate Science learning, students participate in multimodal Science learning through inquiry-based activities. Various assessment strategies are used, both formative and summative—which are crucial to elicit and track students' thinking and emerging understanding (Baurhoo &Asghar, 2014).

Different modes of representation, action and expression, and engagement necessitates design principles that heavily rely on the instructional setting's context and pedagogical intentions. Universal Design for Learning (UDL) based features also allowed students to gain self-directed learning. Instructions, checklists, and guidelines on the breadth of the content, how to navigate the learning resources, and how to process the concepts presented by the materials assisted learners in developing their sense of competence. The flexibility provided by the UDL-based features also aided in improving time management and study time approximations. These benefits encompass not only students' cognition but also their metacognition (Reyes et al., 2021).

Furthermore, UDL has developed guidelines for designing learning activities based on these three principles. Teachers may minimize hurdles in curriculum and improve chances for every student to achieve similar high expectations by incorporating UDL into curriculum planning and developing flexible pathways for achieving learning objectives. With the teacher being more aware of the UDL background, preferences, abilities, and requirements of the students, teachers may ensure that the lessons they teach can comprehend all students and capture their interest (Hall et al., 2012).

In the recently conducted Regional Diagnostic Assessment as per Regional Memorandum No. 492, s. 2022, only 2.36% or five students out of 212 takers of Partida National High School (PNHS) who finished Science 7 attained or surpassed the MPL in Science. In Eddis III, out of 6,966 takers, only 91 students, or 1.31%, obtained or surpassed the MPL in Science. This result reveals a learning gap or low academic achievement in Science from the two years of modular distance learning set-up.

The importance of change and innovation in assessment and instruction is a must. This is to improve and create new dynamics and dimensions on how learning and assessment will take place to ensure that students are engaged, participate in the discussion, and develop positive outlook and behavior towards the lesson. This is because, as observed, Filipino learners performed staggeringly low in both national and international Science and mathematics education (Paz & Nuñez, 2019).

For this reason, more research is needed to build proven strategic frameworks to achieve university-wide UDL adoption and evaluate outcomes from all stakeholders' viewpoints, including students involved. For example, a process-driven, holistic whole-university approach to UDL development. Conversely, they admit that additional work is required to uncover the broader pedagogic influence on student experience and educational outcomes (Moriarty & Scarffe, 2019).

In this context, the researcher aimed to determine the effectiveness of nurturing conceptual understanding in Science 7 through Universal Design for Learning based-workbook. This study also determined if there is a significant difference between the students' conceptual understanding in Science before and after the use of the Universal Design for Learning in nurturing conceptual understanding in Science 7 for the school year 2022 – 2023.

## Literature Review

Numerous learning theories, including Universal Instructional Design (UID), Universal Design for Learning (UDL), and Universal Design of Instruction (UDI), have been developed and proposed to accommodate a great variety of student characteristics. The Universal Design influenced the creation of these models (UD) architectural framework. Educationalists have shown considerable interest in the UDL framework for addressing limits in curriculum design, as evidenced by prior research (Rao et al., 2014).

Addressing the transition and the specific needs of learners and their abilities UDL is gaining popularity in academies and pre-schools worldwide. It also encourages the creation of teaching materials and activities, make learning goals attainable for persons with vastly different capacities to see, hear, speak, move, read, write, grasp English, attend, organize, interact, and remember without having to repeatedly adjusted the curriculum to suit special needs. Successful instructional designs, according to UDL, would remove needless barriers that inhibit students from having meaningful interactions. with classmates, educators, and courses (Rappolt-Schlichtmann et al., 2013).

Concerning this, the Department of Education (DepEd) has issued directives on flexible learning and materials, specifically DepEd Order No. (DO) 21, s. 2019 Policy Guidelines for the K-12 Basic Education Program. It establishes Flexible Learning Options (FLOs), which encompass various modes of delivery and appropriate resources in response to the needs, context, and a range of students.

Furthermore, to guarantee that no student is left behind, the Department of Education (DepEd) issues DepEd Order No. 044, Section 2021, which Policy Directives for the Provision of Educational Programs and Services for Students with Disabilities in the K–12 Basic Education Program. This is in accordance with Section 3 of Republic Act No. 10533, referred to as the 2013 Improved Basic Education Act, as well as Sections 8 and 8.2 of its implementing regulations. The annexed policy directives must include general direction and guidance for the organization, administration, and implementation of suitable interventions, amenities, and programs for students with disabilities.

Similarly, to address the learning loss and to introduce innovations in fostering resiliency and embedding the rights of children and youth in education, the Department of Education (DepEd) issues DepEd Order No. 024, s. 2022, or the Basic Education Development Plan 2030's adoption. DepEd also released a policy directive on the implementation of the 2010 Secondary Education Curriculum (SEC), also known as DepEd Order No. 076, s. 2010. This guideline places an emphasis on teaching and learning for understanding and doing so by design. Understanding by Design (UbD) and Universal Design for Learning (UDL) are two approaches to education that center their attention on the requirements of students together with their self-perceived preferences.

Correspondingly, scientific activities necessitate the use of educational media to support students' exploration. The learning mediums used can have an impact on learning effectiveness. Media are a form of communication that can aid in simplifying the procedure of instruction and education; therefore, learning media is a tool that facilitates learning. The media facilitate the instructor's ability to present the material in one way that is more engaging and less monotonous. A student workbook is a form of instructional material that can assist students in adding information about concepts learned through systematic learning activities and aid instructors in leading students to discover concepts through their activities (Schmidt, 2012).

## Materials and Methods

### Research Design

This study utilized the mixed method of research which involves collecting and analyzing both quantitative and qualitative data to provide a comprehensive understanding of the effects of the Universal Design for Learning-based Workbook on student learning outcomes, engagement, and satisfaction. Under the quantitative method is the quasi-experimental design wherein a pretest was given to both the control and experimental groups before the use of the Universal Design for Learning-based Workbook. Then, a posttest was carried out to assess the effect on the groups after the use of the Universal Design for Learning-based Workbook in the third quarter period.

A quasi-experimental design attempted to establish the cause-and-effect relationship between an independent and dependent variable (Thomas et al., 2020). The effectiveness of the Universal Design Learning Science 7 was tested with Grade 7 students of Partida National High School (PNHS), who served as the control and experimental groups.

Then, it was followed by the collection of qualitative data to explain the quantitative outcomes further. The students asked to write their views and insights based on use of the Universal Design for Learning-based Workbook in their Science journals.

In addition, the identities of the student respondents were kept confidential throughout the investigation and evaluation of their responses to the administered instruments. The differences or inconsistencies resulting from respondents' divergent perspectives were managed with care and without bias or preconception.

This study's methodology is modified to identify the students' insights and views on the Universal Design of Learning-based workbook. The study's instruments, namely the pretest and posttest and workbook were validated by three Science experts, one language evaluator and two lay-out evaluators.

### Sampling Method

Paired sampling was used in selecting students-respondents to measure the effectiveness of Universal Design Learning in nurturing conceptual understanding in Science 7. The researcher matched the grade in the second quarter of the 30 students from 7-Gumamela with the grades of 30 students in 7-Ilang-ilang regardless of their age, gender and other characteristics.

In this study, the students-participants in the experimental group were exposed to the intervention, while the control group was exposed to the traditional way.

### Respondents

The respondents of the study were Grade 7 students of Partida National High School.

**Table 1**

*Distribution of the Respondents*

| Group | Section | No. of Participants |
|---|---|---|
| Control | 7-Ilang-ilang | 30 |
| Experimental | 7-Gumamela | 30 |

As shown in table 1, the respondents were composed of 30 students-participants for the control and another 30 for the experimental groups.

**Instruments**

Two instruments were used and developed in the study. The first instrument was the 50-items pretest/posttest and the other one was the researcher-made and validated Universal Design for Learning-based Workbook. The developed workbook was subjected to expert validation to gauge its face and content validity based on integrity, learner focus, usability, and accessibility. Three Science experts, one English critic and two lay-out evaluators were requested to validate the workbook.

The two Science experts are Master Teachers at San Miguel National High School, and the other is the current Assistant Basic Education Principal at St. Paul University at San Miguel. An instructor at Bulacan Agricultural State College and a former Division LRMDS evaluator, and the other, an award-winning school paper adviser at San Ildefonso National High School, served as the lay-out evaluators. Lastly, the one who served as the language evaluator is a teacher and school paper adviser at San Miguel National High School who was recognized as the Most Outstanding School Publication Adviser in the Philippines.

Validators' verbal suggestions and comments were considered for the material's revision then the revised Universal Design for Learning workbook was subjected to final evaluation.

**Classroom Intervention Implementation**

The classroom intervention was implemented in the third quarter of the school year 2022-2023. Prior to the execution of the intervention, the researcher asked permission to the respondents' parents and about the conduct of the research and the role of their children as participants. Permission and all the necessary documents were secured by the researchers before the actual application of the intervention.

This study focused on determining the effectiveness of Universal Design Learning-based Workbook in nurturing conceptual understanding with the pretest and posttest scores of Grade 7 students at Partida National High School. Two sections were used in the study, with 30 respondents in each section. The study delineated the topics in the third quarter of Science 7.

**Research Ethics Consideration**

Permission to conduct the study sought first. The researcher included in the request sent to the Schools Division Office of Bulacan were: the endorsement from Bulacan Agricultural State College; a copy of the approval from the College Research Ethics Review Committee; and the instrument used, as stated in the DepEd Region III, Regional Memorandum No. 228, section 2020, "Policy Guidelines on the Adherence to Ethical Research Principles and Responsibilities in Studies Involving Teaching, Teaching-related Personnel, and Learners."

In addition, a letter of request that the Grade 7 students participate in the study was forwarded to the principal. In the course of the study, the students took pretest and posttest on the third quarter lesson and wrote their insights and views on the use of the Universal Design for Learning-based workbook in their Science journals.

Furthermore, as part of ethical considerations, the identities of the students-respondents were kept confidential throughout the investigation and evaluation of their responses to the instruments administered to them. The differences or inconsistencies arise due to the respondents' differences in their views and insights were handled with caution and without bias or preconception.

**Data Collection**

Pretest and posttest scores were recorded while the responses from the interviews were consolidated. Hereunder is the verbal description for the pretest/posttest scores.

**Table 2**

*Test Score Interpretation*

| Test Scores | Verbal Description |
|---|---|
| 41-50 | Outstanding (O) |
| 31-40 | Very Satisfactory (VS) |
| 21-30 | Satisfactory (S) |
| 11-20 | Fairly Satisfactory (FS) |
| 0-10 | Did Not Meet Expectations (DNM) |

Note. Table 2 in the study of Inocencio & Calimlim (2021) entitled Development and Validation of Teacher-Made Science Workbook of Grade 8 Students in the Philippines, 2021, https://doi.org/10.11594/ijmaber.02.10.02

On the other hand, the students' journal responses were evaluated using content analysis.

**Data Analysis**

To analyze the data collected on testing the effectiveness of the Universal Design Learning workbook, weighted mean and frequency were used. A T-test was employed to compare the results of the pretest and the posttest.

On the other hand, journal writing of the students' insights and views on the use of Universal Design for Learning-based workbook was analyzed using content analysis to draw out the main theme and sub-themes.

## Results and Discussion

### Students' Conceptual Understanding in Pretest and Posttest

Students' performances were based on the pretest and posttest in Physics for the third quarter period, pretest as basis to assess students' prior knowledge regarding the possible topics taken on the study. Posttest used to assess students' learning after the use of Universal Design for Learning-based Workbook. The main goal of administering pretest and posttest was to compare the two scores and evaluate if the students had progressed.

**Table 3**

*Levels of Conceptual Understanding of the Control Group (Traditional Method)*

| | Pretest | | Posttest | |
|---|---|---|---|---|
| Range | Frequency | Percentage | Frequency | Percentage |
| 41 – 50 | 0 | 0 | 0 | 0 |
| 31 – 40 | 0 | 0 | 4 | 13.33 |
| 21 – 30 | 1 | 3.33 | 8 | 26.67 |
| 11 – 20 | 25 | 83.33 | 18 | 60.00 |
| 0 – 10 | 4 | 13.33 | 0 | 0 |
| Mean | 14.33 | | 21.57 | |
| Verbal Interpretation | Fairly Satisfactory | | Satisfactory | |
| SD | 3.35 | | 6.92 | |

*Legend: Outstanding (41-50); Very Satisfactory (31-40); Satisfactory (21-30); Fairly Satisfactory (11-20); Did Not Meet Expectations (0-10)*

The findings of the control group (traditional method) are shown in Table 3 with a mean of 14.33 and a standard deviation of 3.35 for the pretest, along with a verbal interpretation of "Fairly Satisfactory" while a mean of 21.57 and a standard deviation of 6.92 with a verbal interpretation of "Satisfactory" for the posttest. Additionally, the majority of students in both the pretest and posttest received scores that fell between the ranges of 11 and 20, and this pattern continued in the posttest. Furthermore, in the pretest, a score of 22 was the highest recorded, and a score of 10 was the lowest. In the posttest, a score of 38 was the highest recorded, and a score of 13 was the lowest recorded.

Based on the result, the conceptual understanding of the control group increased only by one level, moving from "Fairly Satisfactory" to "Satisfactory" with a mean difference of only 7.24. This may imply that the control group's conceptual understanding slightly improved as a result of being exposed to the traditional method.

In consonance to the findings of Schacter et al. (2010), frequently viewed as antiquated and associated with a number of drawbacks: lectures failed to give teachers feedback about their students' learning and were based on the assumption that all students learn at the same pace. Additionally, the study showed that the interest of learners' wanes rapidly during lectures and that passive learners tend to forget information quickly. Lastly, lectures place an emphasis on listening, which is unfavorable for students who prefer other educational approaches.

Similarly, Park and Choi (2014), demonstrated through their research that there are two areas in the traditional classroom—a "golden zone" and a "shadow zone"—that differ in the learning experiences of students according on where they are seated. Furthermore, despite the disparity in learning attitudes, only students with high General Performance Averages (GPAs) were more motivated to learn in the traditional classroom setting. It is in contrast with the conclusions of Schwerdt and Wuppermann (2011), which indicated that traditional lecture-style teaching is associated with significantly higher student achievement.

**Table 4**

*Levels of Conceptual Understanding of the Experimental Group (Developed Universal Design for Learning-based Workbook)*

| | Pretest | | Posttest | |
|---|---|---|---|---|
| Range | Frequency | Percentage | Frequency | Percentage |
| 41 – 50 | 0 | 0 | 5 | 16.67 |
| 31 – 40 | 0 | 0 | 15 | 50.00 |
| 21 – 30 | 0 | 0 | 10 | 33.33 |
| 11 – 20 | 27 | 90 | 0 | 0 |
| 0 – 10 | 3 | 10 | 0 | 0 |
| Mean | 15.20 | | 32.80 | |
| Verbal Interpretation | Fairly Satisfactory | | Very Satisfactory | |
| SD | 3.33 | | 6.53 | |

*Legend: Outstanding (41-50); Very Satisfactory (31-40); Satisfactory (21-30); Fairly Satisfactory (11-20); Did Not Meet Expectations (0-10)*

Table 4 shows the result of the experimental group (Universal Design for Learning based-Workbook) with a mean and standard deviation values of 15.20 and 3.33, respectively, for the pretest with a verbal interpretation of "Fairly Satisfactory." For the posttest, the mean was recorded at 32.80, and the value for the standard deviation was 6.53, with a verbal interpretation of "Very Satisfactory."

The table also shows that in pretest, majority of the students obtained scores within 11-20 scoring range, same with the control group with a percentage of 90%. Meanwhile the posttest results show a remarkable improvement in the knowledge of the students in the third quarter lessons. In fact, majority of the students obtained scores within 31-40 scoring range with a percentage of 50%. Moreover, the highest recorded score in the pretest was 20, and the lowest score was six but, in the posttest, 44 points were recorded as the highest score and 21 points as the lowest.

The results revealed a significant increase in the conceptual understanding of the students in the experimental group. It increased by two levels from “Fairly Satisfactory" to "Very Satisfactory”, with a mean difference of 17.60. The findings imply that the experimental group's conceptual understanding was considerably improved as a result of exposure to the Universal Design for Learning-based Workbook.

It is in relation to the findings of Khalil et. al (2010), self-learning module have reportedly been shown to increase knowledge and retention. It provides learners’ control and to help in preparation for subsequent in-class discussion. Similarly, Nwike (2013) mentioned that the performance of students instructed with curricular materials was comparable to that of students taught without instructional materials.

The result also conforms the study of Rao and Meo (2016), learning materials promoted cultural and social factors and the inability of teachers in designing learning activities which is useful for all learners resulted in only some students who may succeed in understanding the lessons in a classroom. Furthermore, in relation to Katz's (2013) findings, by applying the UDL principle in teaching, students become more interested in learning, more willing to do the work, the interaction of the students becomes more intense, and they respect individual differences more.

**Table 5**

*Test of Significant Difference on Pretest between Control (Traditional Method) and Experimental (Universal Design for Learning-based workbook) Groups*

| | Mean | t-Value | p-Value | Decision | Verbal Interpretation |
|---|---|---|---|---|---|
| Control Group | 14.33 | 0.780 | 0.05 | Do not reject | There is no significant difference |
| Experimental Group | 15.20 | | | | |

*Legend: < 0.05 = sig*

As seen in Table 5, the test of significant difference on the pretest between two groups (control and experimental) was 0.780, which is greater than the level of significance at 0.05. Therefore, the null hypothesis was accepted.

Henceforth, there is no significant difference between the pretest of the control and experimental groups before the use of Universal Design for Learning-based workbook. This implies that prior to the treatment, both the control and experimental groups had the same level of conceptual understanding about the lesson. Furthermore, the mean scores of the control and experimental groups at the onset of the investigation, before the Universal Design for Learning-based Workbook was used, were at par with each other.

**Table 6**

*Test of Significant Difference on Posttest between Control (Traditional Method) and Experimental (Universal Design for Learning-based workbook) Groups*

| | Mean | t-value | p-Value | Decision | Verbal Interpretation |
|---|---|---|---|---|---|
| Control Group | 21.57 | 0.00** | 0.05 | Reject $H_o$ | There is a significant difference |
| Experimental Group | 32.80 | | | | |

*Legend: < 0.05 = sig*

Table 6 illustrates the test of significant difference on posttest between the control and experimental groups. Since the computed t-value was 0.00, which is less than the level of significance of 0.05, there is a significant difference between the posttest scores of the traditional method and the developed Universal Design for Learning-based workbook.

The result may suggest that after exposing the learners to the developed Universal Design for Learning-based workbook, experimental group showed significant improvement in students’ Science conceptual understanding in comparison to control group. They yielded a higher mean for posttest scores with the difference of 11.23 between the control and experimental groups. Further scrutiny of the results connotes that the experimental group, having been exposed to the developed Universal Design for Learning-based workbook, performed better than their peers in the control group who were not exposed to the said approach.

Consequently, the study may imply that the Universal Design for Learning approach, as a non-traditional method, resulted in a considerably higher performance gap in favor of the experimental group. The findings showed that the Universal Design for Learning-based workbook helped the experimental group enhance their posttest performance. This suggests that the proposed science teaching intervention has the potential to enhance students' conceptual understanding in the subject. The students were able to recall and grasp the teachings for a long time, resulting in a high posttest score.

This confirms the study of Hall et al. (2015) that developed UDL to remove the distinction between competent and impaired students. Moreover, the result of the study was in line with the findings of Al-Azawei et al. (2016) that Universal Design for Learning (UDL) positively influences student outcomes, satisfaction, and engagement while reducing emotions of discouragement, debasement, insecurity, and isolation.

Additionally, the outcome is consistent with Abuda's (2019) findings. Based on the result of the pretest, the experimental and control groups' levels of mastery before being exposed to the intervention were comparable. Compared to the control group, the general learning gains of the experimental group that received the learning intervention material showed a greater and more significant difference.

***Insights and Views on the use of Universal Design for Learning-based workbook***

Students used the Universal Design for Learning-based workbook in the third grading period. They learned the lessons in Physics with the help of this learning material. Students-respondents encountered for the first time a workbook that provides flexible options, wherein they have the chance and free will to choose the activity they like the most, contrary to the usual workbook, wherein students must answer the provided activities whether it suits their interests or not. Participants found out that learning could be demonstrated differently from the learning of their classmates. Furthermore, students found it helpful for independent learning because it is friendly to users and easy to understand, especially the computation process. (See Table 7)

Similarly, presenting subject matter in a range of techniques can boost student interest in learning and extend students' access to lecture material (Davies et al., 2013). Thus, the Universal Design for Learning-based workbook provided a range of learning opportunities for the students to actively participate and become invested in their own personal learning processes. Due to their increased level of understanding, students will participate more often and remember more information.

**Table 7**

*Summary of Students' Journal Responses on the Use of the Universal Design for Learning-based Workbook*

| Main Theme | Subtheme | Significant Statements |
|---|---|---|
| The students enjoyed learning the topics in Science specifically in Physics on the use of Universal Design for Learning-based workbook for the third quarter period | ▪ UDL-based workbook contains activities appropriate to the students' level, interests, and needs.<br>▪ UDL-based workbook make students learn more because they provide options to students which are fun, enjoyable, exciting, interesting and engaging.<br>▪ UDL-based workbook encourage independent learning, it is user-friendly and easy to understand.<br>▪ UDL-based workbook helps the students to showcase and demonstrate their learning differently. | ▪ *Universal Design for Learning-Based Workbook is appropriate for us because we have different needs and interests.*<br>▪ *Universal Design for Learning-Based Workbook provides options to choose from our interest.*<br>▪ *Universal Design for Learning-Based Workbook is a friendly user, helps me to study alone and there is an appropriate activity included.*<br>▪ *Using Universal Design for Learning-Based Workbook, I demonstrate my learning differently to the learning of my classmates.*<br>▪ *Universal Design for Learning-Based Workbook contains different fun, exciting, interesting and engaging activities.*<br>▪ *With the use of Universal Design for Learning-Based Workbook, I can answer and learn independently by trying to answer alone the given activity.*<br>▪ *Universal Design for Learning-Based Workbook provides us a freedom to choose, do or answer the activity that we like the most.* |

Interestingly, students' responses show that they have enjoyed learning Science on the use of the Universal Design for Learning-based workbook. It increases their interests and conceptual understanding in Science 7 for the third grading period.

This present study is in line with the study of Reyes et al. (2021) that the UDL framework can support and further enhance students' learning irrespective of their individual contexts. It promotes inclusion by minimizing barriers against and maximizing opportunities for learning. Implementing the three principles of the UDL framework (providing multiple means of representation, action and expression, and engagement) provides ways to maximize the participation of various learners in a meaningful and challenging learning environment. Similarly, Nardo (2017) mentioned that instructional materials enable the learners to become independent, self-faced, and advanced at their own rate and ultimately give students a sense of self-satisfaction, the essence of modular education.

Universal Design for Learning-based workbook as a supplementary learning material provided the diverse students an option of the activities they want to answer or do. Thus, it boosts their confidence and gains interest in the subject matter.

**Students' Journal Responses on the Universal Design for Learning-based Workbook as to Most Liked Activity**

Universal Design for Learning-based Workbook provides options or activities connected to its three principles based on cognitive neuroscience research and the learning method. Upon the use of this workbook, the activities in which the students enjoyed participating were as follows: computation-related activity, followed by drawing activity; next is listening-related activity; grouping-related activity; matching-type activity; reading related activity; plotting; writing; arranging; oral presentation; and watching (see Appendix G). Most of the students chose computation-related activities, and very few of the participants picked reading, plotting, writing, arranging, oral presentation, and watching. Students enjoyed calculation-related activities because these kindle their interactivity, promotes science processes skills, supports higher-order thinking skills and uplifts critical thinking abilities. In fact, they appreciated the flexible options available in the workbook for each lesson.

Congruent to the study of Baurhoo and Asghar (2014), as the importance of educating different learners in general science classrooms increases, scientific educators must be provided with the strategies, resources, and help they need to establish inclusive, secure environments for collaborative learning. Therefore, it is important to incorporate such approaches in programs for continuous professional development and teacher preparation.

Moreover, the responses only show that the use of Universal Design for Learning-based Workbook has greatly changed the way students perceive and learn problem-solving. They developed a favorable attitude towards computation and an interest in self-directed worksheets for performance enhancement. The challenge therefore lies in how the teachers choose the appropriate activity for a particular lesson.

**Students' Journal Responses on the Universal Design for Learning-based Workbook as to Least Liked Activity**

The Universal Design for Learning-based Workbook provides different activities to the students, but students have least preferred or least liked activities as follows: writing an essay or paragraph; drawing activities; group-related activities; computation-related activities; listening activities; plotting activities; and watching-related activities (see Appendix G). Whereas most of the students did not prefer writing-related activities, on the other hand, plotting and watching activities were chosen as the least liked by a few of the students. Students' responses showed that writing-related activities are their least liked because these brought boredom to the students due to the monotonous flow of the lessons and routinely pace delivery of the topics.

Congruent to the study of Rao and Meo (2016), teachers can lessen curriculum barriers and create opportunities that enable all students to achieve the same high standards by taking UDL into account when organizing lessons and creating flexible pathways to meet learning objectives. Thus, providing flexible options to demonstrate their learning improves their conceptual understanding in Science, lessens the learning barriers and improves their participation rate.

**Students' Journal Responses on the Influence of the Universal Design for Learning-based Workbook on the Conceptual Understanding in Science 7**

With the use of Universal Design for Learning-based Workbook**,** it influenced the conceptual understanding of the students through providing them the options to choose the activity they want to perform or answer (see table 8). In accordance with the findings of Al-Azawei et al., (2016), traditional 'one-size-fits-all' teaching cannot accommodate the diversity of today's students. Adapting educational content to the choices of students or creating flexible and accessible educational environments that do not require retrofitting or adaptation are the two primary ideas that have been established to address the deficiencies of this strategy.

Similar to the study of Davies et al., (2013), it has been found that when concepts from Universal Design for Learning (UDL) are implemented in the classroom, students show a greater interest in taking part in the learning process. Making it simpler for the students to get their hands on the necessary materials for the class.

Therefore, the use of Universal Design for Learning-based workbooks was intended to increase the participation rate and gain the conceptual understanding of the diverse learners in Physics for the third quarter period. When it comes to the procedure of instruction and learning, it is important to take into consideration the learner's preferences, interests, and requirements.

**Table 8**

*Summary of Students' Journal Responses on the influence of the Universal Design for Learning-based Workbook in the conceptual understanding of the students*

| Main Theme | Subtheme | Significant Statements |
|---|---|---|
| Universal Design for Learning-based Workbook influenced the conceptual understanding of the students in Science 7 | ▪ UDL-based workbook provides options to students.<br>▪ UDL-based workbook serves as supplementary material for learning. | ▪ *Through the different options available in the activity, I have a chance to choose the options that best suit my interest.*<br>▪ *Choosing the option, I like the most.*<br>▪ *Giving us an option to choose the activity we want to answer.* |

| | | |
|---|---|---|
| | ▪ UDL-based workbook boosts the confidence of the students by choosing the activity that they are comfortable with.<br>▪ UDL-based workbook encourages independent learning. | ▪ *It serves as my additional support to further understand the lesson.*<br>▪ *A variety of activities available to choose, it builds my confidence as a learner especially if I choose the one that suits my interest.*<br>▪ *Reading and studying independently to further understand the lesson* |

***Students' Journal Responses on the Use of Universal Design for Learning-based Workbook as to Challenges on Its Use (difficulties/problems met)***

Majority of the students who used the Universal Design for Learning-based workbook encountered no difficulties or any problems; some of them cannot find group mates in the activity that requires grouping because their classmates prefer other activities; other mentioned that sometimes there are activities or options they want to perform or answer all; and very few of the students are distracted by their other classmates who choose other options or activities.

Conformity with the findings of Schermbrucker and Lyons (2017), the choice of the learning activities and the learning resources stress the immense pedagogic value of supporting in-class and out-class interactions. It is seconded by Lachheb and Boling (2021), who stated that this approach entails that design tools serve the requirements of the designer, rather than directing or scaffolding their design in a predetermined manner. This method also necessitates that designers develop the ability to generate strong instrumental assessments that assist them in determining which design tools to use, when, how, and why.

Therefore, it is fitting that the Universal Design for Learning-based workbook was designed and implemented to enhance the teaching-learning process in a particular topic which is timely and relevant not only in terms of one particular aspect in education but also in diversified activities.

***Students' Journal Responses on the Use of Universal Design for Learning-based Workbook as to Challenges on Its Use (solutions done)***

Of the students who cannot find group mates in the activity that requires grouping, the solutions they have done are to choose the second most liked option or activity in the workbook, while those students who wanted to answer all the options provided, asked permission of the teacher and were allowed to do or answer all the options they preferred; meanwhile, students who are distracted by their other classmates find a specific place to concentrate to answer or do the activity they prefer; on the other hand, many of them had not experienced or encountered any difficulties while using the workbook.

Students have different preferences and interests. Their preferred activity might not be the same as the others. Congruent to the study of Kennette, L. N. and Wilson, N. A., (2018), it is necessary to observe that the data presented reflect the perceptions of students and faculty.

In general, students find UDL principles beneficial to their learning, and instructors are generally competent at incorporating these elements into the curriculum. When designing curricula, faculty may give special consideration to the elements that students found most beneficial, but they should also ensure that all three UDL principles are represented. Thus, considering students preferences, needs and interests and also providing diversified activities might increase students' engagement.

***Evaluation on the Educational Soundness of the Universal Designed for Learning-based Workbook***

Table 9 shows the educational soundness of the Universal Design for Learning-based Workbook as rated by three Science experts, two lay-out evaluators and one language evaluator.

**Table 9**

*Evaluation on the Educational Soundness of the Universal Design for Learning-based Workbook*

| Educational Soundness General Evaluation Checklist | Mean | SD | VD |
|---|---|---|---|
| A. Integrity | 3.83 | 0.28 | VS |
| B. Learner Focus | 3.83 | 0.25 | VS |
| C. Usability | 3.89 | 0.24 | VS |
| D. Accessibility | 3.77 | 0.38 | VS |
| Overall Mean | 3.83 | 0.03 | VS |

*Legend: VS-Very Satisfactory (3.25-4.00); S-Satisfactory (2.50-3.24); P-Poor (1.75-2.49); NS-Not Satisfactory (1.00-1.74)*

Table 9 presents the mean and standard deviation of the validators' evaluation of the Universal Design for Learning-based Workbook in Physics on Educational Soundness. Based on the evaluation of the three Science experts, two lay-out evaluators, and one language evaluator. It can be noted that Factor C, "Usability" received the highest mean (M = 3.89) with a standard deviation of 0.24 and a verbal description of "Very Satisfactory." On the other hand, Factor D, "Accessibility," is the one that received the lowest mean of 3.77 (Very Satisfactory) with a standard deviation of 0.03.

The overall mean was computed at 3.83, which was verbally described as "Very Satisfactory." The table also shows that all factors obtained a verbal description of "Very Satisfactory." This implies that all descriptors are satisfied as evaluated by the validators and the workbook can be used by the students as supplementary material in Science 7 for the third quarter period.

Evaluators commented that the developed workbook are aligned with the Most Essential Learning Competencies (MELC). The workbook's design and exercises will engage students and the language used is easy to understand and follow. Furthermore, the objectives are clearly stated, the content is appropriate to the level of the students and relevant to the intended learning outcomes.

In relation to the findings of Manalastas and De Leon (2021), the developed electronic instructional module was suitable for the intended target user by providing enjoyable, interesting, challenging, and relevant material that was in line with topics and qualities listed in the DepED Learning Competencies for the subject and grade level it was intended for, as well as the instrument's capacity to contribute to enhancement, encouragement, or proficiency of the outlined educational objectives. The researcher and author of the educational module were successful in providing essential concepts in the material. Sufficient samples and relevant ideas were also given emphasis. The strategies and activities used in the workbooks were appropriate and can boost the interest of learners in learning physics. With the help of illustrations and a step-by-step guide to solving mathematical problems, it would assist or enhance the learning of students on the said topics.

A few minor improvements may be made to better cater to the demands of the students. Science experts suggested to include rubrics in some of the activities that require performance, while the lay-out evaluators recommended to make some of the illustrations larger.

Overall, the impression on the module was very promising. It will facilitate a better and simpler way of learning science subjects, especially during the now-normal times. It is recommended that the workbook be used as learning materials for the intended subject in distance learning, alternative learning, and in-person classes, not only at the school level but in DepEd as a whole.

The results of the study are congruent to the study of Auditor and Naval (2014), which shown that the developed modules were accepted by physics students in the tenth grade. Furthermore, in relation to the findings of Manalastas & De Leon (2019), the developed workbook was deemed to be highly acceptable as validated by the experts. The instructional content has sufficiency, coherence, appropriateness, and usefulness, according to the expert-validators, who strongly concur.

## Conclusion

Based on the findings of the study, the use of a Universal Design for Learning-based workbook is effective, helpful, and relevant as a learning material in Science 7. It contributed to reach the potential of the students, lessened the learning barriers, and had an opportunity to improve their conceptual understanding in Science 7. The workbook encourages individual learning, differentiates instruction, and empowers choices. Furthermore, it was sufficiently varied to cater to the diverse learning needs of the students, so no one was left behind.

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