DEVELOPMENT AND VALIDATION OF BIODOMINO A GAME-BASED TILE FOR ESTABLISHING MASTERY OF BIOLOGY CONCEPTS

Jacob, Sonny A.; Madrona, Ricardo B. Jr.; Mirabueno, Jovy L.

Completed 2023

II. ABSTRACT

Research Title: Development and Validation of BioDomino a Game-Based Tile for Establishing Mastery of Biology Concepts

Name of the Researchers: Sonny A. Jacob
sonny.jacob1@deped.gov.ph
Jovy L. Mirabueno
Jovy.mirabueno@deped.gov.ph
Ricardo B. Madrona Jr.
ricardojr.madrona@deped.gov.ph
Legazpi City Science High School

Date of TA Session: June 27, 2023

Summary

Specifically, the following is the summary per objectives of this study:

1. The researcher used a game-based intervention for the least mastered competencies in Biology subject using BioDomino Tile. The tile was made of ½ centimeter plywood. The plywood was divided into 48 pieces of 8-centimeter by 16-centimeter tiles, they were spray painted with color white. Questions and concepts were printed in a specialty paper and laminated. Laminated questions and concepts were pasted in the wooden tile. Use such design was implemented to maintain the durability and versatility of the tile.
2. The researcher used the DepEd Learning Resource Management Development and System (LRMS) evaluation for non-print materials to evaluate the developed BioDomino Tile for establishing mastery of Biology concepts. Results showed that it passed in the three (3) factors of the materials. Specifically, in terms of content,

instructions, and technical quality. However, recommendations were provided to improve the material.

3. In assessing the variable of effectivity, practicability, and acceptability of the developed game board tile, the researcher used survey questionnaire. The results showed a very satisfactory rating given by teachers implementors and student respondents. Therefore, teachers and students were able to grasp how to use the game board tile and successfully acquired the content mastery.

Conclusion

The following conclusions were drawn based from the finding of the study.

1. Game-based BioDomino Tile made up of plywood and using affordable materials enables the replicability, sustainability, construction ease, customizability, and versality of the supplementary material. However, its overall success would also be influenced heavily by the quality of materials used.
2. The game-based learning using the gameboard BioDomino Tile attained the necessary standards both pedagogical value and integration in the subject area. This implies that the developed BioDomino Tile Game have a potential to be part of the supplementary materials that can be used by teachers and students.
3. The evaluation of the developed game board tile garnered highly satisfactory ratings from teachers, implementors, and student

respondents. The results indicate that both educators and students found the game board tile to be highly effective in facilitating learning and content mastery. The positive feedback received from the survey underscores the successful integration of the game board tile into the educational setting, highlighting its practicality and usability in classroom environments. The high level of acceptability among all parties involved demonstrates that the game board tile was well-received and embraced as an engaging and effective tool for enhancing the learning experience. Overall, the findings of this study affirm the game board tile's value in educational contexts, showcasing its potential to support teachers in delivering content and enabling students to grasp complex concepts more effectively.

Recommendation

Based on the salient findings and conclusion of the experts, teachers, and students, the following are recommended.

1. Ensure that the materials chosen for the game board tile are durable and able to withstand frequent use in an educational setting. Investing in high-quality materials will extend the lifespan of the tool and reduce the need for frequent replacements. The printed and limited part of the tile should adhere strong on the board to prevent the printed portion and tile to fall apart. By carefully

selecting and implementing materials the game board tile can continue to serve as an effective and engaging educational tool.

2. Include the game mechanics of the game itself in the back of the game tile itself. This promotes independence for the learners as they play the game.
3. To enhance the content quality of the “Biodomino” game, it is recommended that the information presented aligns with the relevant curriculum standards. Explanations should be concise, as well as offering various difficulty levels to assist with the players with various knowledge regarding the subject matter.
4. It is recommended to have thorough analysis of the least mastered competencies of the students to properly address the needs of the students.

III: ACKNOWLEDGMENT

The researchers would like to express his sincerest gratitude to the following for the assistance given in the completion of this study.

First and foremost, The DepEd Regional Office headed by **Gilbert T. Sadsad**, Regional Director IV and Asst. Regional Director **Bebiano I. Santillas** together with Sir **Roy T. Bañas** (CES-PPRD), **Francisco B. Bulalacao, Jr.** (CES-CLMD), **Engr. Ronald C. Asis** (CES, ESSD), **Jocelyn O. Dy** (CES-HRDD**), Evangeline A. Saculo** (CES-FRAD), and **Teresa C. Arcayera** (CAO-FD) for giving trust of approving my research proposal to be part of the Basic Education Research Fund.

The Regional Research Committee headed by **Hallen R. Monreal** for the invaluable comments and suggestions for the improvement of this paper.

The SDO Legazpi family headed by **Danilo P. Despi**, Schools Division Superintendent; **Marivic Diaz**, Asst. Schools Division Superintendent; **Portia P. Encisa**, CID Chief; **Maria Solidad P. Nuyles**, SGOD Chief; for the utmost support and consideration extended.

The Legazpi City Science High School headed by **Annavi M. Maravilla** for believing in the proponent of making this research endeavors come true and for considering and allowing the researcher to take leave to focus on finishing the action research.

To the respondents: **evaluators, validators, teachers, and students** for the time and effort especially for the commendations, recommendations, and

suggestions to build the research paper and to enhance of the BioDomino a Game-Based Tile for Establishing Mastery of Biology Concepts

Special thanks to **Michelle D. Losanez**, EPS Science for the suggestions given as to presentation of data and statistical analysis of the data.

Also, to **Henry Buban** for the assistance extended during the entire conduct of the study.

Our family and friends, for the understanding and moral support.

Above all to Almighty God, who has blessed him throughout the years.

Sonny, Jovy, Ricardo

TABLE OF CONTENTS

LIST OF TABLES

IV: Content and Rationale

Biology is a specific branch of science that studies living organisms and all the processes that keep them alive. Considering its huge scope in education, biology is one of the most complex educational subjects to tackle. According to WorkVeteran (2022), Biology is hard because of the vast amount of information required to learn but also involves a lot of unfamiliar concepts wherein some of which are difficult and require mastering an unfamiliar vocabulary which is true of any science. Most studies confirm that most Science Technology and Engineering Mathematics (STEM) students are having difficulties in memorizing unfamiliar terms and their respective definitions.

In this generation, it is an ideal opportunity for students to use interactive games through entertainment, while also acquiring knowledge particularly with the involvement of concepts regarding science, especially nowadays that students are oriented towards interactive simulations and games. Through these, the use of games became the latest phenomena in attempts to fully engage students in learning.

Academics are difficult for most students. Board games provide them with an enjoyable and challenging way to learn. The interactive nature of board games allows children to make connections, understand new concepts more easily, and retain the information they have learned. According to an article from New Path Learning, (2021), board games are an excellent way to demonstrate to them that concepts learned in the classroom are also applied in everyday life. These useful

and valuable resources are appropriate for a wide range of age groups and can be leveled according to individual needs.

In addition to this, Scholastic, (2019), stated that board games offer opportunities for early learning. Even simple games help young players identify colors, count spaces, and develop hand eye coordination and skill in moving cards and pieces around the board.

In recent years, there has been a resurgence of board games designed for entertainment as well as to teach or explain real-life problems. The revival of board gaming has been discussed in the mainstream media and has piqued the interest of researchers. However, in the field of games studies, the concept of games as learning spaces is primarily emphasized using interactive games. Board games are spaces for educational learning as well as fun spaces that can facilitate the learning of a variety of topics. Board games allow for a variety of interactions, resulting in computational thinking, teamwork, and creativity on the part of the players. (Bayeck, R. Y. 2020).

And in this time of pandemic, the use of board games in education is under-utilized. Education can reinvent itself and create better learning environments as we emerge from this pandemic and adjust to new directions. Games can be used to engage students with varying learning styles and to inspire individual creativity. Board games are the missing tool in our toolboxes, and they have the potential to replace traditional lectures with a method that reaches all students.

Students learn by playing games, until, according to Mackay (2013), they go to school. Then the games stop, and so does learning (Mackay, 2013).

Additionally, Mackay asserts that human minds are designed to learn together, taking advantage of a “collective intelligence,” and that people play everywhere except in school.

Tasnim (2012) writes that “games are the most ancient and time-honored vehicle for education.” He also posits that to even pose the question regarding the value of games in education is absurd (Tasmin 2012).

According to Sasivimol Premthaisong and Niwat Srisawasdi, (2020), education games, also known as serious games, have increased the role of instruction procedures in learning. Many researchers have discovered that interactive learning can increase students’ motivation and interest by representing abstract concepts. In their study, it was showed that attitude of perception in general science topic could promote students’ perception of science learning. Furthermore, the students have a positive effect perception after playing the interactive game.

In relation to this, according to Plass, J. L., et. al., (2015), using games in teaching can help increase student participation, foster social and emotional learning, and motivate students to take risks. One study of the popular multiple-choice quiz game Kahoot found that it improved students’ attitudes toward learning and boosted their academic scores. In addition, studies have found that virtual games can improve focus and attention for students with ADHD and help students with dyslexia improve spatial and temporal attention, which can translate into improved reading.

But games aren't substitutes for other forms of learning. Like any educational tool, they need to be well-planned and integrated only when they're relevant to the learning objectives. Experience leads to learning, but experience alone is not enough. According to Treher (2011) a combination of "hands-on and heads-on learning works best," and asserts that "properly designed board games are an effective way to provide this combination" (Treher, 2011). Dahlin et al. (2015) also list many acquired skills from game playing, including "know-how, awareness, understanding, exploring attitudes and values, systems thinking, information processing, decision making, collaborative working and communication skills" and state that these strongly contribute to the ability to learn.

With the arising conflict among students, the researchers came up with an interactive board game for the Science Technology Engineering and Mathematics (STEM) students of Legazpi City Science High School. BioDOMINO Interactive Board Game aims to determine observable improvements in memory skills of the students in terms of retention and retrieval, observe its effectiveness of the overall engagement of the game to the target audience, and describe how the mechanics of the game develop the learner's competitive skills. The Researchers believe that Interactive board and the tile games can be used not only for entertainment but also for learning while having fun. However, due to the current mode of learning, this limits the fun activities that can be done during class hours that can also affect the student's learning. In connection, this study will aid the student to assess their

understanding as well as acquiring knowledge in Biology specifically the least mastered topic in the second quarter of the semester.

V: Innovation, Intervention, and Strategy

School year 2022-2023, the Grade 12 students of Legazpi City Science High School took a diagnostic test in Biology, the result shown that most of the topic are low mastered. The researchers think of ways how to help students in familiarization and understand more of the concepts in Biology. With this, the researchers decided to use the concept of Domino in enhancing the level of mastery of the students.

This requires that there is an easy way to help students in understanding the biology concepts with mastery, also for the learners to be properly guided and facilitated by the teacher in using the intervention material the BIODOMINO. This simplified material will be given to the students before, during and after the lesson as part of their activity to enrich learning in biology specifically the least learned competency.

At a time when scientific and technological competence is vital to the nation's future, the weak performance of students in science reflects the uneven quality of current science education. Although students come to school with innate curiosity and intuitive ideas about the world around them, science classes rarely tap this potential. Many experts have called for a new approach to science education, based on recent and ongoing research on teaching and learning. In this approach, simulations and games the BioDOMINO could play a significant role by

addressing goals and mechanisms for learning science: the motivation to learn science, conceptual understanding, science process skills, understanding of the nature of science, scientific discourse and argumentation, and identification with science and science learning.

To explore this potential, Learning Science: Simulations, and Education, reviews the available research on learning science through interaction with simulations and games. It considers the potential of modern games and simulations to contribute to learning science in schools and everyday life. With this type of Board Games tiles it will help to the science program implementer in the delivery of teaching and learning process in the school, district, and the division in achieving the high performance in science especially in biology subject.

Similarly, the researchers designed their BioDOMINO game a Game Board development as one of the alternative methods in the learning process. BioDomino games of Biology concepts has been adapted from the domino game in general. The difference is that this BioDOMINO game lies in the tile where the tile contains the keyword in Different topics in biology. Students will analyze the tile to play it. The analysis covers the categories recognize, guess, count, categorize and more. In BioDOMINO game, students are also invited to identify keywords that exist on the tile, then also guess the card will fit when connecting it with another tile that is still associated with giving proper reasons.

In the development of conducting this study the researchers consider the eight phases: **Phase 1: Literature Review.** The researchers will conduct a

thorough literature review to identify significant previous scholarly articles, background on the field of study, and potential barriers. **Phase 2: Collection of Sources and Game Questions.** The lessons and topics to be included in the game will be gathered by the researchers. The questions will be organized and categorized based on the topic they belong to. **Phase 3: Game Creation.** The game will have a theme of Domino It will be created by the researchers using tile made of wood, with the assistance of a carpenter who has experience in making wood tile measuring 1inc x 2 inches. Questions from least mastered topic in biology will be formulated and it will be posted on the sides of tile and the players are presented with choices to choose from. **Phase 4: Trial Run.** A trial run will be done by the jurors, teachers in biology and students for more suggestion to improve the games.

Phase 5: Game Distribution and Pretest Data Collection. The finished game will then be distributed to chosen respondents from a specific school. These respondents are Grade 12 students who will first take a pretest before playing the game. Mechanics and instructions will be stated clearly by the researchers for a smooth flow of conducting the experiment. **Phase 6: Posttest and Comprehensive Data Collection.** A pretest will be given to the respondents after they have finished the game-based reviewer. Data for the experiment will be collected from the pretest and posttest evaluation forms answered by the respondents. **Phase 7: Evaluation and Analysis.** The researchers will look over through the data collected and identify strong and weak points. They will also gather the participants' review and feedback on the game. **Phase 8: Results and**

Discussion. The researchers will draft the final report on findings, draw conclusions, and indicate recommendations. Afterwards, the researchers will arrange and organize the results of the evaluation.

VI**: Action Research Questions**

This study aims to develop Interactive Game board Tile. Material of Biology. Specifically, It sought to answer the following question.

1. What are the features of the develop Game Board Tile ”BioDomino” in teaching biology?
2. What is the experts’ Evaluation of the develop Game Board Tile”BioDOMINO” in the following aspects;
    a. Content quality;
    b. Instructional quality; and
    c. Technical quality?
3. What is the level of effectiveness, practicability, and acceptability of the developed Game Board Tile “BioDomino” to
    a. Teachers, and
    b. Students?

VII: Action Research Methods

Purposive sampling, also known as judgmental, selective, or subjective sampling, is a form of non-probability sampling will be used in this study in which the researchers rely on own judgment when choosing members of the population to participate in the surveys.

This survey sampling method will be followed by the researchers to have prior knowledge about the purpose of the studies so that the researchers properly choose and approach eligible participants for surveys to be conducted.

The type of this research is research and development (R & D), which is researching and developing instructional media such as Tile game Domino Biology to practice analytical thinking skills of students on the least mastered competency in second quarter of the semester.

Learning device used in this study is the MELCS and lesson plans, while instruments in the form of Validity sheet research, observation sheet student activities, student response observation sheet, sheet analytical thinking skills test, and the test sheet and analytical thinking.

Data collection method used is the method of observation, validation, and testing. Observation method to collect data of student activity and students' response to the media playing on dominoes, validation method is used to determine how the feasibility of BioDOMINO game that has been developed, the test methods to collect data analytical skills. Assays were conducted as much as 2 times the initial tests before learning (pre-test) and test-final after learning (post-test).

The data analysis technique used is the validation analysis covering the content and construct validation, analysis of the effectiveness of BioDOMINO game based on the improvement of students 'analytical thinking skills and student activities, as well as practicality analysis based on the observation of students' response to the least mastered topics in Biology.

Research Procedures

a. Participants and/or other Sources of Data and Information

The Grade 12 students, jurors and teachers are the respondents and main sources of data and information of this action research. 171 STEM students, One (1) Education Supervisor in Science, One (1) School Principal, One (1) Master Teacher in Biology, and Two (2) Experts in the field of Biology from University.

The jurors and students will evaluate to determine the effectiveness of the intervention material. the materials using the tools provided. The respondents may comment, suggest, and give other information to improve the Intervention materials and tool.

Teachers are responsible in administering the questionnaires and the use of intervention tool to the students.

The researcher used the following instruments for the data collection of the study (a) Learning Resources Management and Development (LRMDS) under Evaluation Rating Sheet for Non-Print Materials, (b) Teacher's acceptance scale and (c) Learner's Acceptance Scale.

Learning Resources Management and Development (LRMDS) under Evaluation rating Sheet for Non-Print Materials. It is a standard tool by the Department of Education (DepEd) in evaluating non-print materials like CD-ROM, VCD, DVD, VHS, slides, transparencies, cassette tape, and digital interactive materials. This system has been developed in response to the findings of baseline research conducted by the DepEd. The main objective of the system is to provide

a technical basis for assessing acquiring, adapting, developing, producing, and distributing quality learning and teaching resource materials for students and instructional support materials for teachers. The researcher will use one of the guidelines in the LRMDS, especially the evaluation rating sheet for non-print materials which have categories: content quality, instructional quality, technical quality, and other findings. The content quality refers to whether the material reinforces, enriches, and/or leads to the materials of certain learning competencies for the subject and grade level it was intended. The instructional quality means that adequate support material in provided; activities are summarized; extension activities are provided; the suggested activities support innovative pedagogy. The technical quality suggests that the manipulative is safe to use, the size and composition of the manipulative is appropriate for the intended audiences, and it must provide manual tasks that are compatible with the motor skills of the intended users. This evaluation is a Likert Scale with four (4) corresponding ranges: (4) – Very Satisfactory (VS); (3) – Satisfactory (S) / Not Applicable (NA); (2) Poor; and (1) Not Satisfactory.

b. Data Gathering Methods

For the instrumentation, the researchers utilized the Learning, Resources, Management, Development, and System (LRNDS) evaluation tool for non-print material.

The one-group pretest-posttest design will be employed in this study. In this design, a single group is measured or observed not only after being exposed to a treatment of some sort, but also before.

The mixed- method of research will also adopted since both qualitative and quantitative methods will be employed in the conduct of this study. As emphasized by Fraenkel & Wallen (2010), the use of this research approach provides a more complete understanding of research problems than does the use of either approach alone.

Along quantitative section, the experimental method of research utilizing the pretest-posttest design is also be adopted to determine level of science concepts of the students.

For the qualitative section, an interview/ focus group discussion will be conducted among the research participants to determine their perceptions towards the Game based Tile.

The project will be implemented in a form of remediation, enhancement, and interactive discussion for five consecutive days. The goal also of this strategy is to engage the research participants by finding ways for them to interact with the content, the facilitator, and their co- participants. In this strategy, the facilitator incorporates engagement triggers and breaks the lecture at least once per session to allow the research participants to participate in an activity that will let them work directly with the materials. The engagement triggers capture and maintain participants' attention and allow them to apply what they have learned or give them a context for upcoming discussion material.

Before project implementation, a pretest will be administered to the research participants to assess prior knowledge on science concepts based on the

least mastered competency in Biology. This will be followed by the project implementation proper and administration of posttest. Further, answering of survey questionnaire and focus group discussion will be likewise conducted.

The collected data will be tabulated and processed quantitatively using mean, percentage, and t- test to arrive at scientific analysis and interpretation of results.

To ensure learning and proper implementation of the project in the classroom, all the research participants will be monitored/observed in their performances in the subject.

Pretest and posttest results were utilized to determine the science process skills level of the teachers. Interview/ focus group discussion will be conducted to identify level of attitude towards the project. Interview/ focus group discussion among the research participants will be likewise conducted to verify research participants' responses to the survey questionnaire. In this case, other concerns about science process skills which are not included in the survey questionnaire was clarified by science teachers during the interview.

To determine if significant pre-post mean gain exists in the science concepts in the students, t-test will be used. Mean and percentage will be used to determine the level of performance of the students.

VIII: Discussions of Results and Reflection

Over the course of 3 years, we have witnessed the deterioration and the modification of the societal processes we were once adapted to. Our lives revolved

in an innate philosophy and concept of fear, which hindered our societal development. Individuals are forced into confinement, scientific and societal progress came to a stop, and recessions were found to be recurrent in various parts of the world. This was evident with the global inflation rate rising to 8.8 percent in 2022, higher than the pre-pandemic levels we have seen (IMF, 2023). Although, one can argue that the pandemic has brought a myriad of effects within our society, it can also be stated that it has given us a new threshold that we must exceed to achieve advancement, and to overlook the negative portrayals that we have foregone.

One of these thresholds include the teaching learning process, according to the University of Maryland (2019), the teaching learning process is often assumed as the education process, which is defined as a systematic course of action on the teacher and learner to acquire outcomes associated with teaching and learning. This process includes 4 methods, namely assessment, planning, implementation, and evaluation.

Assessment is the initial process, this includes inquiring and imputing one's educational needs, this includes the readiness to acquire knowledge, as well as adjustment and association with different learning styles. This comes as an essential step, as this would provide a conclusion on the necessary interventions for each student with varying demographic profile. According to Tinto (1975), demographic characteristics are an essential variable in shaping students' academic performance. This provides a viable solution to what an educator may do, to foment the learner's production.

The second step would include planning, this includes the process of developing structured teaching plans and interventions to meet the learner's needs. Saha (2001) defined this process as the identification, development and implementation of strategies designed to attain the educational needs of a student efficiently. An essential process is to attain an idea of what should be implemented structurally in response to the exalting conundrums seen within the education system.

These processes are then implemented, synthesized with teaching and evaluated through various assessment and statistical means, to further infer upon the statistical significance of the process deeming it efficient or not.

Yet, problems and challenges are found to arise within such process, a study conducted by Nemenzo (2018) has found that there is a need to allocate sufficient time for remediation and developing structural interventions to avoid the risk of failing or dropping out. However, with the systematic problem in education found within the schools, as stated by the Philippine Institute for Development Studies (2020), this is the main cause of the prevalence of poor academic performance in the country. As seen with the poor NAT results from 2018, which was 37.4 percent and the 0.2 gap in reading skills.

Now, with the onset of the pandemic, reports of manifestations of distress depression and insomnia are found after the pandemic (Tee et al, 2020). And approximately one of every four students suffer from anxiety (Cao et al, 2020). In turn, this has resulted in the poor academic performance of students. Results from

studies have indicated that the pandemic had a negative impact on learning behaviors and academic performance (Zheng et al, 2023)

These signs may further persist, though the pandemic is slowly coming to an end. This would result in poor motivation and performance of students, seeing a significant decrease in the quality of education that is to be attained. Contributing to the growing number of out-of-school youth which has climbed from 16.9 to 25.2 percent in January to April of 2020 (OHCHR, 2022). This proves a growing problem to educators, and interventions and measures are provided to ensure the containment of the problem that was discovered. Solutions are endowed to provide to this pervasive predicament of pedantry, in a teacher's perspective, they are aware of the concept of various learning styles, and attempts were brought out, as well as interventions to tackle said problems (Khan, 2015). Interventions would vary from technology-based structural lesson plans to that of games synthesized with the lesson. The development of such method has promoted and reinforced the learning of the students stating that it is effective in knowledge retention and increase of interest as well as motivation for learning (Selvi et al, 2018). Therefore, the development of a domino-based biology game encompassed with the least mastered competency in biology was done by the researchers, entitled "***DEVELOPMENT AND VALIDATION OF BioDOMINO A GAME-BASED TILE FOR ESTABLISHING MASTERY OF BIOLOGY CONCEPTS***", to further promote motivation and knowledge retention within the students. In this study, the BioDOMINO tile will serve as a pilot for other educators to craft their locally and contextually materials depending on the school context and the needs of the

learners. Moreover, the integration of pedagogical approaches will surely increase its functions, purpose and be more useful for both teachers and students. An open inquiry based pedagogical and instructional approach is about communicating, reflecting, collaborating, and analyzing the student's thoughts, ideas and questions. (Lutheran education qld) This constructivist approach allows students to collaboratively question and interpret their ideas and develop them further with the help of a ***teacher*** who frames their journey and aids in developing broader concepts.

Development of Biology-based Domino Board Game entitled "BioDOMINO"

For the development of a domino game tile that is summarized with the least mastered competencies this would include 6 criteria to attain, as the development of such would provide a normative framework used to determine the merit or worth of an intervention (OECD, 2023). The criteria and process would include; (1) Preparation of teachers; (2) Purpose of the development of game tile; (3) Parts of the game tile; (4) Formulation of questions and others; (5) Discussion of teachers and utilization of the BioDOMINO in class; and (6) Post-test administration. Each process would serve as an essential guide in developing a well-structured program and intervention to tackle the student's lack and decrease of motivation and participation that has persisted due to the pandemic (Boring-Bray 2020).

The initial process of preparation for the teachers would include the administration of a pre-test to the learners as a method of evaluation and assessment to determine the insufficiencies found amongst the learners, as well as the various learning styles and what the students are interested with. This process provides a way for teachers to gather key information about the knowledge

of students and what they are able to do prior to instruction (Murky, 2011). An essential process as to determine what structured and plan is needed to attain for the development of a gameboard tile.

Proceeding from the former is the purpose of the development of the gameboard tile. Purpose as defined by the Cambridge Dictionary (2023) is an intention or aim; a reason for doing something or for allowing something to happen. With the growing problem found within students, such as the inadequacy of motivation and participation amongst most. Intervention and the development of such serves as a method of improving student's comprehension of key concepts and knowledge (Cusack et al, 2018). This serves as a method to bridge the gap between the body of knowledge that is taught by the educators and learners themselves. Allowing proper assimilation of topics, as well as a better grasp on the least mastered competencies.

The researchers would then have to consider the parts of the gameboard tile, the gameboard tile will be measured with dimensions of 8 cm x 16 cm. Length will possess 8 centimeters, whereas the width would possess 16 centimeters. This is halved for the purpose of synthesizing biology concepts, and domino patterns. When designed with these principles that revolve around learning, the concept of the "BioDOMINO" can increase student motivation, engagement, and learning (Pho et al, 2015), assisting with the problems found within the classroom.

The 4th process would include the formulation of questions and other concepts that are to be synthesized with the domino boards. Questions are gathered from various forms of literature, including but not limited to modules, and

books. This would generate well-crafted questions, leading to new insights, procure discussion and promote the comprehensive exploration of subject matter (Tofade et al, 2013). Through this, the researchers will be able to attain the necessary objectives of mastering the least mastered competency found in biology, giving profound insights necessitated for the subject matter.

Through this, the intervention, entitled “BioDOMINO” is then integrated with the discussion of teachers and used in class, as a structured method of active and hands-on learning. In this system the student is a directly engaged with the instructor, a myriad of benefits is found with the implementation of such, as it encourages students to think outside the box, promoting critical thinking and the necessary 21st Century Skills for the preparation of tertiary education (Martin, 2020). Students are therefore able to retain and acquire sufficient insight regarding the least mastered competency, therefore increasing the quality of education and learning in biology.

Lastly, educators then administer a post-test. This is defined by the American Psychological Association (2023) as an assessment carried out after the application of a certain intervention, this is done to measure any changes that have occurred. This phase is crucial in the development of this structural intervention and approach entitled “BioDOMINO”, as this allows the educator to acquire awareness as to what the students have learned and what may be extensively done to further enhance the intervention proceeded by the educator and researchers (Shivaraju et al, 2017). Ensuring the quality of the education, as well as bridging the gap found with learner and educator.

Features of the Develop Game Board Tile BioDOMINO

The researchers aim to develop and evaluate a domino-based biology game, entitled “BioDOMINO” in constructing the tile, 48 pieces of 8 centimeter by 16-centimeter wooden tiles were used, they were spray painted with the color white and questions were pasted. As seen from Plate 1.

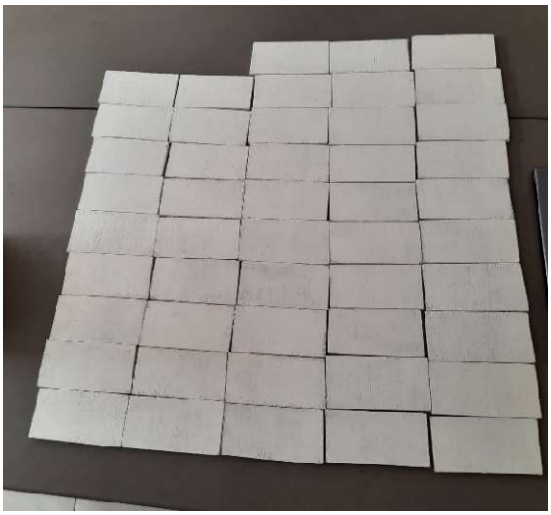

Plate 1. 48 Pieces of Biodomino Tile

Use of such design was implemented in order to synthesize the requisite concepts found in the least mastered competency of the subject. As a method to engage students with the teaching-learning process, through this process it improves the mindset and growth of the learner (Adipat et al, 2021). With this, an intervention such as this acts as a supplementary material in the teaching-learning process. One that could be used in mastering and gaining more than sufficient insight regarding the least learned competencies in biology. You may already play some domino games. If so, you may change the rules on how to play the BioDOMINO tile. There are many domino games that go by different names and yet have extremely similar, and sometimes even identical, rules. Also, there are

many games that go by the same name in various parts of the world, but the rules vary from place to place and depending on the teachers' guidelines. Whether you choose to follow the rules precisely or create your own variation is irrelevant, as long as all the players clearly understand what the rules are and agree to them before the game begins because the main objectives is to learn the concepts in enjoyable way. It is also important, of course, that you make sure the rules you choose to play with are functional.

Shuffling the Tiles. Before every game, a player shuffles the tiles face down on a flat playing surface, thoroughly mixing them by moving them with his hands. The player's hands may not stay on the same tiles while shuffling, and the player who does the shuffling should be the last to draw his hand for the game. Players may choose to take turns shuffling before each game or the same player may shuffle the dominoes before each game. Here are two of several options: 1) The player to the right of the player making the first play does the shuffling for a game; or, 2) The winner of the previous game shuffles for the next game.

Seating Arrangement. A player's position at the table in a game with three or more players is called a seat. One way to determine seating arrangements is by lot. After the tiles are shuffled, each player draws a domino from the stock. The player who draws the tile with the greatest number of pips has first choice of seats. The player holding the next highest seats himself to the left, and so on. If there is a tie, it is broken by drawing new dominoes from the stock. The tiles are returned

to the stock and reshuffled before the players draw their hands. When a partnership game is played, the partners sit opposite each other.

Order of Play. There are several different ways to determine which player will make the first play: 1) Draw lots. 2) Begin the game by setting the heaviest domino. 3) Have the winner of the previous game make the first play of the next game. After it is determined who will make the first play of the game, the order of play will be decided by the seating arrangement. Play will continue to the left, clockwise, after the first play is made. Or, you may choose to play in a counter-clockwise rotation, as is done in some Latin American countries, as long as all players agree to it before the game.

Drawing Lots to Determine Who Will Make the First Play
After the tiles are shuffled, each player draws a domino from the stock. The player who draws the heaviest tile will make the first play. If there is a tie, it is broken by drawing new dominoes from the stock.

Beginning the Game by Setting the Heaviest Domino. In some domino games, the rules state that the first play must be made by the player with the highest double in his hand. Rules for other games state that the first play must be made by the player with the heaviest domino, double or single, as the case may be.Highest Double: After the tiles are shuffled, each player draws his hand from the stock. The player who draws the set (i.e., terms if playing with a term), plays it as the lead. If the highest double was not drawn, the second highest double is played

Drawing the Hand. Each player draws the number of tiles specified in the rules for the domino game being played and then places them in front of himself in such a way that the other players can't see the pips on his tiles. After all hands have been drawn, there may be a surplus of tiles left in the stock. These tiles should remain face down, and, depending on the rules of the game being played, may be bought (See "Passing and Byeing" below.) later in that game.

Opening the Game. Determine who will make the first play, as explained above in "Order of Play" and according to the rules of the particular domino game being played. The player making the first play may be referred to as the setter, the downer, or the leader. He should place his tile face up in the middle of the table. The words set, down, and lead are all used as verbs to refer to the act of making the first play of the game. "The set," "the down," and "the lead" are used as nouns to refer to the first domino played in a game and also the first play of the game. Here is a rule variation that players may agree to employ: Anytime a player plays a double, whether for the opening of the game or anytime thereafter during the game, he may immediately play a second tile onto his double before the next player makes his play.

This intervention may be manipulated and modified for the benefit of the students, as it is an example of a method of hands-on learning. Which is defined where teachers engage with students in direct experience to enhance the student's knowledge according to a blog by Top Hat (2023). With this structuralize method of learning, this provides and necessitates the gap that the students must bridge in the formulation of the requisite 21st Century Skills for secondary education and

job readiness, as this method of learning allows every student to actively participate and engage in the subject matter, promoting development for individual and collaborative skills (Keim, 2020).Therefore, an intervention such as this is effective in bridging gaps and promoting foundational skills for learners of the 21st Century.

The Experts' Evaluation of the Develop Game Board Tile" BioDOMINO"

Nevo & David (1985) stated that experts' opinion is a valuable tool of evaluation, a relatively cost effective and time-saving method essential for formative evaluation. In this study, respondents A were brought upon to assess the material; this consisted of One (1) Education Supervisor in Science, One (1) School Principal, One (1) Master Teacher in Biology, and Two (2) Experts in the field of Biology from University. These respondents have scrutinized the device in the following aspects such as; content quality, instructional quality, and technical quality. Assessment of such essential criteria would provide a basic idea on the quality of education that is to be attained from the intervention, as this provides a complementary perspective, giving a holistic view of the intervention (OECD, 2021)

In terms of content quality, the material was able to garner a total mean of 38.38 falling in the range of acquiring a very satisfactory result, wherein content that was used in the medium was accurate, this included concepts, questions, theories, and the likes that are encapsulated within the least mastered competencies in the subject of Biology, therefore contributing to what it is designated to. With the relevant content of the study this will allow students to

remember the material better, and transfer the attained content to that of other learning scenarios (Haury & Rillero, 1992, p.5)

Table 1. Expert's Evaluation on the Content Quality of the "BioDOMINO" Intervention Material

Factor A. Content Quality	Mean Score	Descriptive Interpretation
Content is consistent with topics/skills found in the DepEd Learning Competencies for the subject and grade/year level it was intended	3.88	Very Satisfactory
Concepts developed contribute to enrichment, reinforcement, or mastery of the identified learning objectives	3.63	
Content is accurate	3.75	
Content is up to date	4.00	
Content is logically developed and organized	4.00	
Content is free from cultural, gender, racial, or ethnic bias	4.00	
Content stimulates and promotes critical thinking	3.88	
Content is relevant to real-life situations	3.63	
Language (including vocabulary) is appropriate to the target user level	3.88	
Content promotes positive values that support formative growth	3.75	
Total Mean Score	**38.38**	**Passed**

Therefore, the researchers can conclude that the content of the material was highly accurate and was able to provide the necessary functions as it is intended to do. As according to Aronoson (2021) the content delivered to the

participants is essential, for their development of the requisite 21st Century Skills is attained due to the formulation of such method.

Moreover, to enhance the content quality of the “Biodomino” game, it is recommended that the information presented aligns with the relevant curriculum standards. Explanations should be concise, as well as offering various difficulty levels to assist with the players with various knowledge regarding the subject matter.

The content of the “Biodomino” is crucial as it provides the requisite aspects needed to be retained. Moreover, it provides an essential role in the learner’s development, as well as the teaching-learning process. As it provides a structural approach to what an educator ma does to tackle the problem found within content standardization

Instructional Quality had acquired a mean score of 39.13, lying in the range of a very satisfactory result, due to such this would assist in the learner’s dependence, avoiding the overemphasis on recitation and rote learning (Tuimur et al, 2015). Improving higher order thinking for classroom and institutional purposes, therefore assisting the development of the 21st Century skills that are required for learners to possess.

Table 2. Experts Evaluation on the Instructional Quality of the "Biodomino" Intervention Material

Factor B. Instructional Quality	Mean Score	Descriptive Interpretation
Purpose of the material is well defined.	4.00	Very Satisfactory
Materials achieve its defined purpose	4.00	
Learning objectives are clearly stated and measurable	4.00	
Level of difficulty is appropriate for the intended target user	3.63	
Graphics/ colors / sounds are used for appropriate instructional measures.	3.88	
Material is enjoyable, stimulating, challenging, and engaging	4.00	
Material effectively stimulates creativity of target user	4.00	
Feedback on target user's responses is effectively employed	3.75	
Target user can control the rate and sequence of presentation and review	3.88	
Instruction is integrated with target user's previous experience.	4.00	
Total Mean Score	**39.13**	**Passed**

To conclude, instructional quality was able to attain an immensely satisfactory rating. Therefore, posing positive results on the manner in which the instructions of the developed intervention has provided to the respective learners. Through this it has provided a myriad of benefits allowing learning to be more practical, interesting, realistic, and appealing (Ajoke, 2017). Enhancing the motivation and participation found within the learners, through with the pandemic has decreased and persisted to decrease. Providing a positive solution to such growing problem.

To further enhance and necessitate the use of instructional materials, teachers should always attempt to utilize such in order to make lessons more

interesting. Encourage the search for the required visual instructional materials that can appeal to the learners, to encourage participation and promote academic standard.

Instructional materials are often used to provide a basic idea on the proper execution of a procedure. In a biology-based domino game, this allows the learners to promote independence from their educators, as well as enhance collaboration and communication within their peers. An essential skill that is needed to be mastered as found from the development of the pandemic.

Table 3. Experts Evaluation on the Technical Quality of the "Biodomino" Intervention Material

Factor C. Technical Quality	Mean Score	Descriptive Interpretation
Visual presentations (non-text) are clear and easy to interpret	4.00	
Visuals sustain interest and do not distract user's attention	4.00	
Visuals provide accurate representation of the concept discussed	3.88	
The user support materials (if any) are effective	3.63	
The design allows the target user to navigate freely through the material	3.88	
The material can be easily and independently be used	3.88	
The material will run using minimum system requirements	3.75	
Total Mean Score	**27.02**	**PASSED**

Technical quality was recorded to have an average of 49.25, which belongs to the range that had a greatly satisfactory result. Therefore, promoting adequate delivery of academic knowledge from the teachers, this imparts the

socioemotional skills needed to promote hands-on learning (Evans, 2021). Posing myriad of positive effects, crucial for the development of the 21st Century skills needed for each learner.

A record of very satisfactory was found within the technical aspects of the game, indicating a positive correlation to the accessibility that such intervention aims to acquire. Therefore, the technicalities found within the “Biodomino” was greatly accessible, and easily understood. This then leverages access, participation, engagement, and continued application of new skills (Wilichowski et al, 2021). Fostering the requisite skills for tertiary education preparation and those needed for 21st Century learners.

To foster this aspect of the intervention, educators have to build a knowledge base on how to integrate this aspect to the design and classroom (Scheffler et al, 1999), and apply instructional technologies prior to use (Wilson et al, 2003). Through these, learners will acquire sufficient insights regarding the process, and eventually develop participation within the game and classroom.

Technical qualities are one of the fundamental dimensions of the quality of service (Sharma et al, 1999), service may come in the form of an intervention. The technical qualities found in this intervention allows for the propagation of thought required for each learner. Promoting a stabler foundational perception with the intervention method, as well as insights regarding essential aspects of the domino tile.

Game-based learning has gained increased attention in education as it can create accurate situations within a game and incorporate gaming elements, such

as competitiveness, challenges, motivation and imaginary into science lessons specifically biology. Educational games can also employ a narrative thread to get students immersed in the story and learn from it. However, there is very little guidance on how to design such materials to best support the learning of biology. For instance, BioDomino, whether for education or entertainment purposes, can have an additional of mechanics, shapes, elements, and sizes. In addition to the abundant variation between games, multiple evaluation frameworks have been proposed to classify and identify the efficacy of different types of GBL practices as well as the learning outcomes that one is trying to achieve. Hence, game design process plays a crucial role in ensuring that educational games can balance entertainment elements, educational content, and the seriousness of gaming.

An important aspect of any educational game is the focus on creating engaging experiences for players to lessen traditional teaching problems, such as increasing interactivity between students in the classroom. In order to achieve this, identifying an appropriate game development framework is key to ensure that an educational game experience is 'translated to a variety of mediated forms with each form capturing the essentials of the gameplay while controlling the strengths and minimizing the weaknesses. Furthermore, Klopfer *et al* also describes that many educational games often fail to achieve learning goals due to meaningless and simplistic game designs, leading to a perception that educational games are not fun to play or ineffective to support learning. In the context of biology education, there are specific constraints that may add a new layer of difficulty in the development and implementation of educational games in education. Particularly,

learning new and complex material in biology lessons can be intimidating. Biology often described as subject that is difficult to comprehend with a strong mathematical tendency and male-dominated. Further, biology and science-themed educational games often include a great deal of complex information for students to master while solving the game. Moreover, the previous experience of the target audience with games should also be considered during design to ensure that all players can glean the same skills and knowledge from the educational game in the same way, which is not an easy task given the pluralistic environment of a classroom. Besides this, teacher familiarity with educational games, classroom management during gameplay, and connection with the curriculum, also influence the likelihood that science educational games are adequately developed and adopted as part of their regular practice. In this way the development of educational games to support formal physics teaching and learning require careful design choices to embed 'play and learning in meaningful contexts'

Effectiveness, Practicability and Acceptability of the Developed Game Board Tile BioDOMINO.

In assessing the variable of effectivity, practicability, and the acceptability of the developed game board tile, 8 biology teachers and 171 students were given surveys to evaluate such intervention. Through this method, educators will acquire sufficient insight as to how to further improve the components of the developed game board tile. As this process gathers data to better understand the strengths and weaknesses of student learning (Harris and Hodges, 1995). From the

garnered data, educators may curate and produce well-structured and better interventions to master the least-understood competency.

a. Teacher

Table 4. Effectiveness, Practicability and Acceptability of the Game "BioDOMINO" Tile in Terms of Content Relevance

Statement	Mean Score	Descriptive Interpretation
The game applied the concepts revolving around Biology.	3.78	Very Satisfactory
The game correctly explained the Biology concepts and aids the player in answering the questions.	4.00	
The game accurately utilized the concepts of Biology to help the students develop strategic and logical thinking skills.	3.88	
TOTAL MEAN SCORE	**11.66**	**PASSED**

Based on the assessment of eight (8) biology teachers, the questions respectively had acquired a very satisfactory result with the content that it had. Content was accepted and assimilated by the students, which promoted better comprehension regarding the least mastered competencies of the game. With content that is relevant to the study, students will be able to retain the said content, as well as use it for various learning scenarios (Haury & Rillero 1992)

Table 5. Effectiveness, Practicability and Acceptability of the Game "BioDOMINO" Tile in Terms of Visual Aspects

Statement	Mean Score	Descriptive Interpretation
The design of the game is pleasing.	3.89	Very Satisfactory
The game's design prevents boredom.	4.00	
The game is learner friendly.	3.80	
The game has an original design and seems like it was fun to play.	4.00	
TOTAL MEAN SCORE	**15.69**	**PASSED**

Visual aspects had a mean score that ranged from 3.80 to 4.00, a total of 15.69 which indicated that it had a very satisfactory result, this component of the game would assist in the development of visual thinking, therefore better understanding concepts and retain information with images and words (Raiyni, 2016). This enhances the higher level of intelligence, and the development of the requisite 21st Century skills for learners in tertiary education preparation.

Table 6. Effectiveness, Practicability and Acceptability of the Game "BioDOMINO" Tile in Terms of Accessibility

Statement	Mean Score	Descriptive Interpretation
The game was easy to play.	4.00	Very Satisfactory
It was easy to manipulate and user-friendly.	3.98	
The game piqued the interest of the student.	4.00	
The instructions were clear and easy to understand.	3.78	
TOTAL MEAN SCORE	**15.76**	**PASSED**

Accessibility was recorded to have a total mean score of 15.76, in which it indicated that it passed and had a very satisfactory result, with this, students are able to develop the same skills and achieve the same level of knowledge as their peers (Foxwell, 2022). With this, it advances the principles of education and research found in the field (Fleming et al, 2021). An essential phase for the development of the 21st Century Learning Skills for learners with their preparation for a higher form of education.

b. Students

171 students were assessed as to determine the content relevance of the said intervention, their perception regarding such material is essential as students will be able to articulate the perceived benefits of the intervention, as well as the issue that might be found in such (Parker & Winstione, 2016). Educators will acquire sufficient insight on what may be done to modify the intervention and make it more learner-friendly, which would allow the mastery of the least-mastered competencies found in biology.

Content relevance is the right content that enables the learner or instructor to be informed correctly in accordance with the expected objective to be attained (Ireri et al, 2017). Learners will be able to retain a myriad of ideas and develop enhanced perception through adequate content relevance. Based on **Table 7** content relevance acquired a total mean score of **11.65**, wherein it had a very satisfactory result from the students. This points out that content was accurate and encapsulated that of the least mastered competency if the subject. This piques the interest of the students, in turn allowing an increase of participation (Hosek, 2023). Therefore, students are able to grasp and acquire an adequate idea regarding biology through this.

Table 7. Effectiveness, Practicability and Acceptability of the Game "BioDOMINO" Tile in Terms of Content Relevance

Statement	Mean Score	Descriptive Interpretation
The game applied the concepts revolving around Biology.	3.87	Very Satisfactory
The game correctly explained the Biology concepts and aids the player in answering the questions.	4.00	
The game accurately utilized the concepts of Biology to help the students develop strategic and logical thinking skills.	3.78	
TOTAL MEAN SCORE	**11.65**	**PASSED**

Visual aspects is defined as the aspect relating to sight (Collins Dictionary, 2023), this includes the physical aspects of the game as well as how it is viewed by learners. From **Table 7**, the visual aspects garnered a 15.62 total mean score, in which the visual aspects were very satisfactory. Due to such it allows the educator to represent complex concepts (Evagorou et al, 2015). Therefore, the visual

aspects assist the educator in providing mastery to the least mastered competency of the intervention, allowing the assistance of the retention of knowledge found in the game board tile. As the role of graphics enhances the user experience and contribute to the overall success of a game (Mc Bride, 2023)

Table 8. Effectiveness, Practicability and Acceptability of the Game "BioDOMINO" Tile in Terms of Visual Aspects

Statement	Mean Score	Descriptive Interpretation
The design of the game is pleasing.	3.88	Very Satisfactory
The game's design prevents boredom.	4.00	
The game is learner friendly.	3.78	
The game has an original design and seems like it was fun to play.	3.96	
TOTAL MEAN SCORE	**15.62**	**PASSED**

Visual aspects is defined as the aspect relating to sight (Collins Dictionary, 2023), this includes the physical aspects of the game as well as how it is viewed by learners. From **Table 8**, the visual aspects garnered a 15.62 total mean score, in which the visual aspects were very satisfactory. Due to such it allows the educator to represent complex concepts (Evagorou et al, 2015). Therefore, the visual aspects assist the educator in providing mastery to the least mastered competency of the intervention, allowing the assistance of the retention of knowledge found in the game board tile. As the role of graphics enhances the user experience and contribute to the overall success of a game (Mc Bride, 2023)

Table 9. Effectiveness, Practicability and Acceptability of the Game "BioDOMINO" Tile in Terms of Accessibility

Statement	Mean Score	Descriptive Interpretation
The game was easy to play.	4.00	Very Satisfactory
It was easy to manipulate and user-friendly.	3.86	
The game piqued the interest of the student.	3.95	
The instructions were clear and easy to understand.	4.00	
TOTAL MEAN SCORE	**15.81**	**PASSED**

Cambridge University (2023) has defined accessibility as the quality of being able to be used by everyone, regardless of what hindrances that they may possess. Based on the data from **Table 9**, the intervention acquired a score of 15.81, which had a very satisfactory rating similar to the other 2 aspects. This allows students to participate actively with the discussion, allowing the proper occurrence of hands-on learning. A properly structured method, encouraging the development of the necessary 21st Century Skills for learners in higher education preparation (NewSchool, 2023). Providing a myriad of benefits for the learners as well as their future academic endeavors.

Effectiveness is the extent to which the objectives of a research project have been procured (Royal Academy for Overseas Sciences, 203). It is when the desired outcomes and results are achieved and attained. Furthermore, there are two other factors that are brought into consideration. Practicability and acceptability, respectively, they are defined as capable of being put into practice with the available means (Dictionary, 2023), and how well an intervention will be received by the target population and the extent to which it might meet the needs

of the target population (Ayala, 2011). In this study, the following variables were measured with Respondents B and Respondents C, which comprised of teachers in the field of biology and 171 students.

Based from the data that was acquired, 171 students or 100% of the respondents stated that the “Biodomini” was an effective tool that helped them assimilate concepts in biology, as well as retain complex theories and ideas. It was also used in practice for classes and was a well-thought-out intervention method for the growing difficulty found in comprehending concepts that are encapsulated in biology. As this method was an example of hands-on learning, and through this method it gives students engagement and practice, further enhancing the retention rate of students, as well as promote better critical thinking (Martin, 2020). Similarly, teachers found the material to be effective, when integrated with their lesson plan. It helped in assisting them with teaching difficult concepts, seeing better student engagement and participation. As well as retention, in the least mastered competency. Promoting development in creative and critical thinking, further enhancing the necessary 21st Century Skills for learner development.

IX Action Plan

The researchers intended to do each part of the study according to the research work plan below.

	Month	Activities
Pre-implementation	January – February 2023	- Designing questionnaires and surveys - Conduct validation for the researcher-made instruments - Forward letter for request - Finalizing the timetable for the implementation
Implementation proper	February – May 2023	- Conduct the actual study - Briefing and signing of documents the students who will be part of the study - Evaluation of the outputs with the jurors - Revision of outputs with the jurors
Post-implementation	May – June 2023	- Collecting and analyzing the data - Double check missing results or data - Follow-up (If necessary) - Finalize the manuscript and ready the PowerPoint Presentation for the final defense

The outcomes of the study will be delivered first in the school-based learning action cell specifically in the science department to discuss further the benefits of incorporating game – based learning in the classroom. Also, the opportunity of this LAC session will also allow collecting more suggestions and recommendations for further improvement specifically in crafting the guidelines and the policies. Also, this can be presented during the in-service training of teachers at the school to allow other subject areas or disciplines to incorporate game-based learning in their area. It will also open another opportunity to craft rubrics that will be more specific to the subject area. If this becomes more successful, the researcher may propose to the education program specialist to deliver the results of this to the whole division.

X: Plans for Dissemination and Utilization

Along this line, a training on usage, dissemination, utilization, and advocacy training plan of BIODOMINO will be conducted to Legazpi City Science High School science teachers on July 2023. The following topics are to be discussed:

1. **The features of the BIODOMINO**. In this topic, The researchers will be discussing the features of the BIODOMINO.

2. **Articulating Science Game- Based Learning**. The why's and how's of integrating science concepts in BIODOMINO in science instruction shall be comprehensively discussed in this topic. Alignment of science concepts in the BIODOMINO in the lesson shall be likewise given emphasis.

3. **Mechanics of the Game***.* The researchers will discuss how to use, play and apply the BIODOMINO.

4. **Interactive Discussion on Lesson Planning Integrating Game Based Learning.** It is important to note that problem solving through game-based learning is given more emphasis.

5. **Interactive Discussion on Critical Thinking Skills***.* Critical thinking is crucial to developing a deep understanding of the concepts and competencies required for students to succeed in science, hence a need for the teachers to be equipped with the innovative strategies and techniques on how to promote critical thinking skills employing Game Based- Learning.

To ensure learning among the participants, a workshop will be conducted to be facilitated by the resource persons. A research presentation on Reinforcing Science Concepts of Science Teachers through Game Based Learning in BIODOMINO shall be likewise conducted by the researcher.

TRAINING on USAGE, DISSEMINATION, ULITIZATION, and ADVOCACY TRAINING PLAN of BIODOMINO

PROPOSAL

<table>
<tr><td>Title of the Activity/Training</td><td colspan="2">USAGE, DISSEMINATION, ULITIZATION, and ADVOCACY TRAINING PLAN of BIODOMINO</td></tr>
<tr><td>Proponent</td><td colspan="2">SONNY A. JACOB
JOVY L. MIRABUENO
RICARDO B. MADRONA Jr.
Proponents</td></tr>
<tr><td rowspan="2">Duration, Proposed Date and Venue</td><td>Duration:</td><td>Proposed Date: June 9, 2023</td></tr>
<tr><td>Specify no. of day(s): 3</td><td>Proposed Venue: Legazpi City Science High School</td></tr>
<tr><td>Expected participants</td><td colspan="2">Junior and Senior High School Science Teachers</td></tr>
<tr><td>Rationale</td><td colspan="2">As observe traditional classroom cannot longer meet the needs of education in the 21st- century. As teacher must make radical changes to create the classroom that will motivate students to</td></tr>
</table>

	learn. Teachers today teach using different pedagogical approaches and various instructional methods specifically in Legazpi City Science High School where the students are more advanced. According to fact that our educational system is changed with the help of technology the 21st -century classroom should be a creative environment where students can develop the skills they will need in workplace. Hence, it is an ideal opportunity for students to use interactive games through entertainment, while also acquiring knowledge particularly with the involvement of concepts regarding science, especially nowadays that students are oriented towards interactive simulations and games. According to Bayeck R.Y. (2020) board games are spaces for educational learning as well as fun spaces that can facilitate the learning of a variety of topics. Board games allow for a variety of interactions, resulting in computational thinking, teamwork, and creativity on the part of the players. According to WorkVeteran (2022), Biology is hard because of the vast amount of information required to learn but also involves a lot of unfamiliar concepts wherein some of which are difficult and require mastering an unfamiliar vocabulary which is true of any science. Most studies confirm that most STEM students are

	having difficulties in memorizing unfamiliar terms and their respective definitions. That is why, to adhere with goals of Legazpi City Science High to continuously provide learners with quality education in science to equip the learners with attitude and knowledge of the concepts and applications as they make sense of the concepts while having fun in learning in Biology. Hence, BioDOmino was launched by the proponents a game board as backbone of the game-based learning in Biology subjects to enhance the mastery of students in learning.
Objectives	**Terminal:** To enhance the teaching learning process using game based learning for mastery of Biology Concepts using BioDomino gameboard.
	Enabling: 1. Provide teachers with the innovative strategies utilizing BioDomino in the game-based lesson. 2. Prepare a learning plan Game-Based Learning with BioDomino. 3. Demonstrate how to process activities leading to science process skills development

Expected Output	Learning Plan Integrating Game-based learning with BioDomino.	
Training/ Program Management Team	Responsibility/TOR	Proponents/ In-charge
	Program Manager	Ricardo B. Madrona Jr.
	Resource Manager	Sonny A. Jacob
	Registration	Jovy L. Mirabueno
	Documentation Accommodation	Deanne C. Moralde Franklin Margallo
	M&E	Michelle Ann P. Saribong
	Secretariat Welfare Officer	Christine Lee B. Bayna Jay G. Asuncion

VIII: References

Akbasli, S., Sahin, M., & Yaykiran, Z. (2016). *The Effect of Reading Comprehension on the Performance in Science and Mathematics, Journal of Education and Practice*. ERIC.https://eric.ed.gov/?id=EJ1108657#:%7E:text=Findings%20of%20this%20resear ch%20indicate,in%20math%20or%20science%20classes.

Akilli, G. K. (2007). *Games and simulations: A new approach in education?* In D. G Gibson, C. A. Aldrich, & M. Prensky (Eds.), Games and simulations in online learning: R esearch and development frameworks (pp.1-20). Hershey, PA: Information Science Publishing.

Alaswad, & Nadolny. (2015). *Designing for Game-Based Learning: The Effective Integration of Technology to Support Learning*. SagePub. https://journals.sagepub.com/doi/abs/10.1177/0047239515588164

Alviz, A. A. (2018). *GRIN - Utilizing Game-based learning in Explicit Instruction for Early Grades Reading Fluency*. GRIN. Retrieved March 31, 2022, from https://www.grin.com/document/436031

Archy Learning. (2021, August 26). *The Science Behind Game-Based Learning*. https://archylearning.com/blog/the-science-behind-game-basedlearning/#:%7E:text=The%20research%20showed%20that%20pupils,who%20us ed%20game%2Dbased%20learning.

Cahill, G. (2016). *Why Game-Based Learning?* The Learning Counsel. Retrieved March 31, 2022, from https://thelearningcounsel.com/article/why-game-based-learning

Careers360, T. (2022, February 3). *Books vs e-learning: Which is best?* Careers360.Com An Education Platform to Explore Colleges, Courses, Exams, Schools, Careers Options, and More! Retrieved March 31, 2022, from https://engineering.careers360.com/articles/books-vs-e-learning-which-best

Cedar Grove Elementary School. (n.d.). *Interactive Powerpoint Games for the K-2 Classroom*. Cge.Rcschools.Net. https://cge.rcschools.net/apps/pages/index.jsp?uREC_ID=687650&type=u&pRE C_ID=1695494#:%7E:text=There%20are%20several%20benefits%20to,t%20req uire%20an%20internet%20connection.

Chaudhari, A. (2022, May 18). *Descriptive Research Design*. Voxco. Retrieved June 1, 2022, from https://www.voxco.com/blog/descriptive-researchdesign/#:%7E:text=Descriptive%20research%20design%20is%20a,problem%2C %20rather%20than%20the%20why.

Check J., Schutt R. K. Survey research. In: J. Check, R. K. Schutt., editors. *Research methods in education.* Thousand Oaks, CA:: Sage Publications; 2012. pp. 159– 185.

Cherry, K. (2020, March 31). What Are Piaget's Four Stages of Development? Verywell Mind. https://www.verywellmind.com/piagets-stages-of-cognitive-development-2795457#:%7E:text=Jean%20Piaget's%20theory%20of%20cognitive,stage%3A%20birth%20to%202%20years

Conner, M. (2011). *Introduction to Andragogy + Pedagogy*. Marcia Conner. Retrieved 11 November 2021, from http://agelesslearner.com/intros/andragogy.html

Denham, A. R., Mayben, R., & Boman, T. (2016). *Integrating Game-Based Learning Initiative: Increasing the Usage of Game-Based*

Learning Within K-12 Classrooms Through Professional Learning Groups. Tec Trends, 60(1), 70-76.

Eng, D. (2021, December 28). *What is Expectancy Theory?* BoardGameGeek. https://boardgamegeek.com/blogpost/126451/what-expectancy-theory

Enicola, P. (2021, May 6). *The Importance of Technology in Education in the Philippines*. ChildHope Philippines. Retrieved March 31, 2022, from https://childhope.org.ph/importance-of-technology-in-philippine-education/

Eutsler, L. (2020, November 17). *Pandemic induced remote learning increases need for mobile game-based learning to engage learners*. SpringerLink. Retrieved March 31, 2022, from https://link.springer.com/article/10.1007/s11423-020-09861-7?error=cookies_not_supported&code=edff5401-f357-4d76-b498-14a417de0773#citeas

Evangelista. (2016). *The Effectiveness of Using PowerPoint Presentation in Teaching Electromagnetic Spectrum to the Academic Performance of Selected Grade 10 Students of the Lipa City National High School*. ResearchGate. Retrieved March 31, 2022, from https://www.researchgate.net/publication/301889328_THE_EFFECTIVENESS_O

F_USING_POWERPOINT_PRESENTATION_IN_TEACHING_ELECTROMAGN
ETIC_SPECTRUM_TO_THE_ACADEMIC_PERFORMANCE_OF_SELECTED_
GRADE_10_STUDENTS_OF_THE_LIPA_CITY_NATIONAL_HIGH_SCHOOL

Figueroa, C. (2020, March 21). *The surprising role of digital technology during the COVID19 pandemic* | D-Lab. Lab. https://dlab.berkeley.edu/blog/surprising-role-digitaltechnology-during-covid-19-pandemic

Fredrick, & Hummel. (2014, January 1). *Reviewing the Outcomes and Principles of Effective Instruction*. ScienceDirect. Retrieved March 31, 2022, from https://linkinghub.elsevier.com/retrieve/pii/B9780125060417500036

Hamari. (2016, January 1). *Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning*. ScienceDirect. Retrieved March 31, 2022, from https://linkinghub.elsevier.com/retrieve/pii/S074756321530056X

Huang, Kuo, & Chen. (2020, September 1). *Applying digital escape rooms infused with science teaching in elementary school: Learning performance, learning motivation, and problem-solving ability*. ScienceDirect. Retrieved March 31, 2022, from https://www.sciencedirect.com/science/article/abs/pii/S1871187120301553

Hunter, J., & Fitzgerald, T. (2020, April 7). *STEAM games are good for learning in elementary schools: A study of teacher professional development in the Philippines.* Learning & Technology Library (LearnTechLib). Retrieved March 31, 2022, from https://www.learntechlib.org/p/215789/

James, M.K. (2020). *The Impact of Game-Based Learning in a Special Education Classroom*. Master's Theses & Capstone Projects. https://nwcommons.nwciowa.edu/cgi/viewcontent.cgi?article=1240&context=edu cation_masters

Jaucian, M. B. (2020b, February 17). *70,000 Bicol pupils can't read – DepEd*. INQUIRER.Net.

https://newsinfo.inquirer.net/1229537/70000-bicol-pupils-cantread-deped

Jovancic, N. (2021, June 21). *5 Research Design Types + Key Elements and Characteristics*. LeadQuizzes. Retrieved April 6, 2022, from https://www.leadquizzes.com/blog/research-design-types/

Ke, F. (2009). *A qualitative meta-analysis of computer games as learning tools*. In R. E. Ferdig (Ed.), Handbook of research on effective electronic gaming in education (pp. 132). Kent state: Information Science Reference.

Labor, J. S. (2016, December 6). *College students' views on the use of Classroom-based PowerPoint presentations*. Academia. Retrieved March 31, 2022, from https://www.academia.edu/23588056/College_students_views_on_the_use_of_C lassroom_based_PowerPoint_presentations

Lazares, W. (2006). DOST Science and Technology Leads Philippines, Communication Resources and Production Division, Manila.

Liu, M., Rosenblum, J. A., Horto, L., & Kang, J. (2013, November 30). *Designing Science Learning with Game-Based Approaches*. Eric.Ed.Gov. https://eric.ed.gov/?q=game+AND+design+AND+fun&id=EJ1029163

Liu, Z. (2020, July 31). *Using the Concept of Game-Based Learning in Education | International Journal of Emerging Technologies in Learning (iJET)*. iJET. https://online-journals.org/index.php/i-jet/article/view/14675

May, A. (2021). *Gamification, Game-Based Learning, and Student Engagement in Education.* Leadership Education Capstones.https://openriver.winona.edu/cgi/viewcontent.cgi?article =1059&context=leadershi peducationcapstones

McCombes, S. (2019). Descriptive research. Retrieved 10 December 2021, from https://www.scribbr.com/methodology/descriptive-research/

National Research Council. (2011). *Learning science: Computer games, simulations, and education.* Washington, DC: Board of Science Education, Division of Behavioral and Social Sciences and Education.

Papastergiou, M. (2009a). *Online computer games as collaborative learning environments prospects and challenges for tertiary education*. Journal of Educational Systems, 37(1), 19-38.

Petkov, M., & Rogers, G. (2011). *Using Gaming to Motivate Today's TechnologyDependent Students*. Virginia Tech Libraries, 48(17), 9. Retrieved from http://scholar.lib.vt.edu/ejournals/JSTE/v48n1/pdf/petkov.pdf

Plass, J.L., Homer, B.D., & Kinzer, C. K. (2015). *Foundations of Game-Based Learning.* Division 15, American Psychological Association. https://files.eric.ed.gov/fulltext/EJ1090277.pdf

Railyn, J. (2016). The Role of Visual Learning in Improving Students' High-Order Thinking Skills. Journal of Education and Practice, 7.https://files.eric.ed.gov/fulltext/EJ1112894.pdf

Richey, R. C. (n.d.). *ERIC - ED373753 - Developmental Research: The Definition and Scope., 1994*. ERIC. Retrieved June 1, 2022, from https://eric.ed.gov/?id=ED373753

Rusu, C. (2022, March 24). *What are the advantages and disadvantages of PowerPoint*. VisualHackers. https://visualhackers.com/blog/what-are-the-advantages-anddisadvatages-of-powerpoint/

Singleton R. A., Straits B. C. *Approaches to social research .* New York: Oxford University Press; 2012.

Steinkuehler, C., Squire, K., & Barab, S. (Eds.). (2012). *Games, learning, and society: Learning and meaning in the digital age*. Cambridge, MA: Cambridge University Press. http://dx.doi.org/10.1017/CBO9781139031127

Tarng, W., & Tsai, W. (2015). *The Design and Analysis of Learning Effects for a Gamebased Learning System*. World Academy of Science, Engineering and Technology. Retrieved March 31, 2022, from https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.192.8685&rep=rep1&t ype=pdf

Teaching with PowerPoint - NIU - Center for Innovative Teaching and Learning. (2020). Northern Illinois University. Retrieved March 31, 2022, from https://www.niu.edu/citl/resources/guides/instructional-guide/teaching-withpowerpoint.shtml

IX: Financial Report

The table below shows the list of expenses for the whole duration of the study. It includes the supply, transportation, and communication allowance needed. In each identified activity, there are corresponding items, supplies, and services needed to provide.

DESCRIPTION	ITEMS	QTY	UNIT PRICE	AMOUNT
Supplies	Ink Epson 003 - Ass	4pcs	242.00	968.00
	Advance Bond Paper-S	2reams	198.00	396.00
	Advance Bond Paper-L	1reams	232.00	232.00
	Laminating Film	20pcs	13.75	275.00
	System Folder-Long	3pcs	9.00	27.00
	APLS Copy Paper – L	1ream	297.00	297.00
	Epson Blank Ink 003	1pc	260.00	260.00
	Epson Cyan Ink 003	1pc	275.00	275.00
	Epson Magenta Ink 003	1pc	275.00	275.00
	Epson Yellow Ink 003	1pc	275.00	275.00
	Gel Pen	8pcs	12.00	96.00
	Epson Bottle Refill	1pc	290.00	290.00
	Mongol Pencil	2pcs	32.00	64.00
	1 White Paint	1pc	270.00	270.00
	1 Sandpaper	1pc	20.00	20.00
Transportation	January 1 – June 5 Transportation	13.85L	63.10	1,000.00
		12.71L	62.95	800.00
		7.94L	62.95	500.00
Meals/ Representation	Legazpi Golden Dragon Restaurant		690.00	690.00
	Legazpi Golden Dragon Restaurant		405.00	405.00
	Palamigan Bayan Fast food		395.00	395.00
	Jollibee		570.00	570.00
	Jollibee		1,005.00	1,005.00
	Jollibee		1,561.00	1,561.00
	Jollibee		828.00	828.00
	Jollibee		486.00	486.00
	Jollibee		190.00	190.00
Binding	Hardbound	6copies	400.00	2400.00
Load Allowance	Load Card	2pcs	300.00	600.00
			TOTAL	**15,450.00**