Development of Design Thinking-Based Lesson on Schistosomiasis for Senior High School Learners

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DOI: https://dx.doi.org/10.47772/IJRISS.2024.806070

Received: 18 May 2024; Revised: 30 May 2024; Accepted: 04 June 2024; Published: 03 July 2024

ABSTRACT

This study aimed to develop a Design Thinking-Based Lesson on Schistosomiasis (DTLS) for Grade 12 senior high school STEM learners. The respondents of the study were fifty-five (55) Grade 12 STEM learners for the pilot testing. This study was conducted at one of the public secondary schools in Davao City, Davao del Sur, Philippines, where the disease is prevalent. This study employed a quasi-experimental design with one group pretest-posttest. The lesson plan was developed following the principles of design thinking and tailored to address the issue of schistosomiasis comprehensively. Expert validation ensured the lesson plan's alignment with educational standards and its potential effectiveness. The DTLS was rated excellent in all areas, with an overall mean of 3.87. Learners' prototypes were evaluated using a rubric that measured critical thinking, creativity, communication, and collaboration skills, which were all rated at proficient level with an overall mean of 3.23 for all groups. Results indicate that the DTLS significantly enhanced learners' engagement and prototype quality across all assessed dimensions and was capable of developing the 4Cs. Furthermore, based on the results of the paired t-test, learners' post-test mean score of 18.60 was considerably higher than their pre-test mean score of 13.69. This indicates that Grade 12 learners had a higher conceptual understanding of the topic of schistosomiasis ($p = 0.00$) after the DTLS integration. These findings suggest that incorporating DTLS into science education can effectively foster the 4Cs and improve learners' conceptual understanding.

Keywords: Conceptual Understanding, Design Thinking-Based Lesson, Schistosomiasis, 4Cs.

INTRODUCTION

The 21st century is an era where the world is undergoing rapid advancement, which demands individuals be prepared to face the unexpected challenges of the future (Yektyastuti et al., 2019). Along with the changes, science education is advancing at a quick pace, and learners need to be equipped with skills such as critical thinking, creativity, communication, and collaboration (4Cs) that are essential for the modern workforce (Griffin, McGaw, & Care, 2012). According to the Partnership for 21st Century Learning (2019), the 4Cs of 21st century skills are the four most essential competencies that need to be completely incorporated into classrooms, schools, and districts throughout the nation in order to produce citizens and workers who are appropriately equipped. Since then, there has been a greater focus placed on these subjects, as well as initiatives to increase the standard of curriculum and instruction. (Bahrum et al., 2017).

In an effort to get insight into the background of the country's performance, the Philippines took part in Program for International Student Assessment (PISA) of the Organization for Economic Co-operation and Development (OECD) for the first time, primarily aimed at assessing the nation's educational quality in order to facilitate its endeavors towards the globalization of educational standards (DepEd, 2019). The Philippines came second from the bottom among the 79 participating nations with a Science Literacy score of 357 on its first attempt (DepEd, 2018) and recently, out of the 81 participating nations, the Philippines scored third to last internationally (OECD, 2022). According to OECD data from 2018 and 2022, the average scientific literacy score of Filipino learners decreased by one point, from 357 to 356 points. The nation's educational dilemma is mirrored in these statistics, indicating the necessity of vigorous measures to raise scientific literacy in public schools. The dismal quality of fundamental science education in the Philippines is exemplified by the students' long history of poor performance on national and international assessments (Ulla, 2022).

Learning process must be accelerated by practicing problem solving through the study of current global issues in order to improve their problem-solving abilities (Maruli et al., 2022). Design Thinking (DT), a methodical, user-focused approach to resolving real-world issues, is one of the emerging learning methodologies that has been used for innovation and creating value in various fields. DT has become an integral part of design, engineering, and business, but it can also positively impact education in all 21st century disciplines (Talibe et al., 2023) and is very effective for supporting students' 21st century skills (Vallis et al., 2021) such as creativity and problem-solving skills (Retna, 2015). However, there is a lack of empirical research evidence and literature on design thinking, its concept, adoption, and implementation in the Philippine education context.

In view of this, this study aims to explore the potential impact of design thinking approach on learners' conceptual understanding in the context of Schistosomiasis, a tropical disease that is prevalent in the endemic areas of Los Amigos. As a result, the design thinking methodology employed in this study is a creative and innovative technique that may stimulate interest among learners in Science concepts and enable them to take on new challenges and solve real-world issues.

With this pressing issue, in a goal to bridge the gap between the students' conceptual understainding in Biology in Senior High School as well as developing their critical thinking and problem-solving skills, creativity, collaboration, and communication abilities in solving social issues, this study aims to develop and implement a Design Thinking-Based Lesson on Schistosomiasis. According to Goldman and Zielezinski (2016), lesson planning that incorporates design thinking enhances the application of the competencies by providing opportunities for relevance and engagement with the new skills and competencies needed to approach the comprehensiveness and deep conceptualization of the core standards in a meaningful way. As with design thinking approaches, the problem-solving process of empathize, define, ideate, prototype, and test motivates students to learn, work together, and produce creative and useful solutions (White 2016).

Statement of the Problem

Schistosomiasis is a water-borne helminthic disease caused by parasitic worms known as schistosomes, which can infect through dermal contact with cercaria-infested freshwater (Braun et al., 2018). When eggs get stuck in host tissues, schistosomiasis can cause severe morbidity and mortality. This is caused by a persistent local inflammatory response that can lead to intestinal illness, hepatosplenic inflammation, liver fibrosis, and even death (Gray et al., 2011).

The World Health Organization (WHO) identifies schistosomiasis as a major global health issue affecting millions of people with severe consequences for morbidity, mortality, and socio-economic development. The Pediatric Praziquantel Consortium (2024) supports the legal designation of neglected tropical diseases (NTDs), such as schistosomiasis, as priority for global action under Sustainable Development Goal (SDG)

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

3, which is Good Health and Wellbeing. Target 3.3 of SDG 3 specifically demands that the epidemics of AIDS, TB, malaria, and NTD be eradicated in order to promote welfare and ensure that people of all ages enjoy healthy lives.

In the Philippines, schistosomiasis is a long-standing problem affecting mostly the poor living primarily in rural areas (Blas et al., 2004). To date, approximately 12 million Filipinos are living in endemic areas and 2.5 million individuals are directly exposed to infection (Leonardo et al., 2015). The freshwater snail Oncomelania hupensis quadrasi was discovered by Dr. Marcos Tubangui in 1932 as the intermediate host of Schistosoma japonicum (Leonardo et al., 2016). The snail O. h. quadrasi is present in approximately 3012 bodies of water in the country. Cercariae shed by the snails actively infect mammals, their final hosts. The need to manage snails led to the development of molluscicides, which were pesticides against snails. These herbicides were used to effectively eliminate all stages of the schistosome life cycle in bodies of water.

The study conducted by Belizario et al. (2016) revealed that greater prevalences were noted utilizing ELISA Ag and Ab tests in Davao City, Davao del Sur, and Compostela Valley, with 5.0% and 34.4%, 3.0% and 19.2%, and 14.4% and 56.5%, respectively. Consequently, this global issue affecting the people in the said locality inspired the researcher to conduct a study in an effort to provide a feasible and alternative solution using an emerging innovative and creative approach.

In recent years, there has been a growing recognition of the importance of empowering communities and individuals in the prevention and control of tropical diseases such as schistosomiasis. Results from PISA 2018 and 2022 highlighted the crisis in the Philippines' science education, particularly in science literacy, which articulates the use of real-life context, which may highlight conceptual understanding. This is particularly relevant in the context of the prevention and control of schistosomiasis, where the active involvement of learners will engage students in thinking creatively and critically and working collaboratively. Thus, interventions were felt to be needed in order to help the teachers and students enhance the teaching and learning process.

OBJECTIVES OF THE STUDY

The main objective of this study is to develop a Design Thinking-Based Lesson Plan on Schistosomiasis for Grade 12 STEM learners. To attain the general objective, this study aimed to:

1. Develop a Design Thinking-Based Lesson Plan on Schistosomiasis for Grade 12 STEM learners;
2. Validate the developed DT-Based Lesson Plan on Schistosomiasis;
3. Evaluate the learners' DT-based prototype in terms of:

3.1 critical thinking

3.2 creativity

3.3 communication

3.4 collaboration; and

4. Determine if there is a significant difference in the conceptual understanding of Grade 12 STEM learners on Schistosomiasis before and after the DT-Based Lesson integration.

METHODS

The following subsections describe the development of the design thinking-based lesson on schistosomiasis:

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

Development of the Design Thinking-Based Lesson on Schistosomiasis

In developing the design thinking-based lesson on schistosomiasis, several steps were carried out to align it with the K-12 curriculum and the pedagogical framework of the Science education. Moreover, this study employed the 5 stages of design thinking in crafting the lesson plan namely empathize, define, ideate, prototype, and test (Plattner et al. 2009).

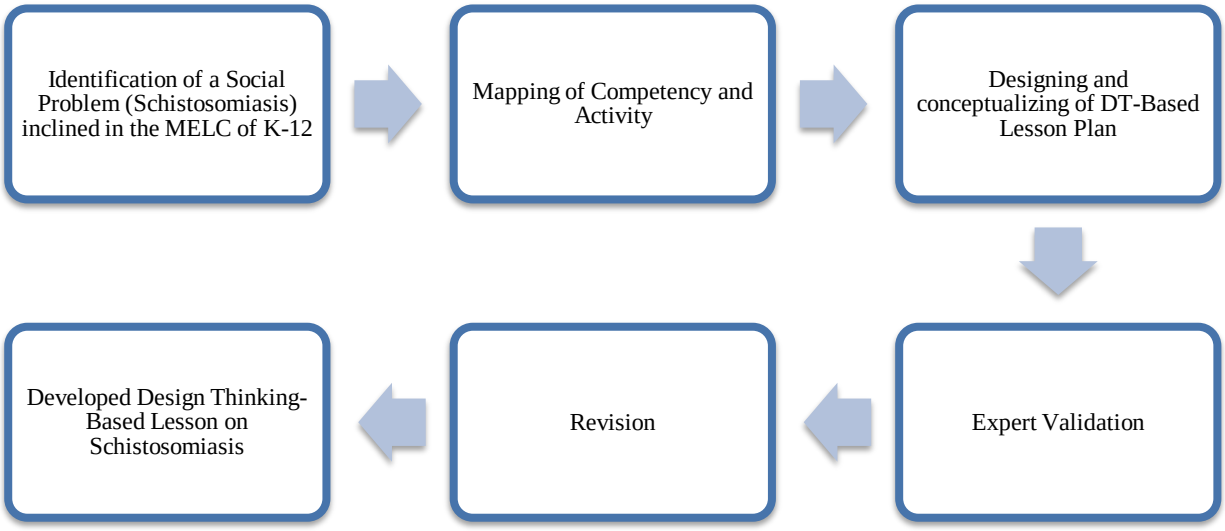

Figure 1. Development of Design Thinking-Based Lesson on Schistosomiasis

The following stages were followed in developing the design thinking-based lesson on schistosomiasis:

Identification of Social Problem

Before developing the Design Thinking-Based Lesson Plan, a social issue (Schistosomiasis) was first identified based on the MELC in K-12 competency. This social problem served as the basis for the crafting of the five stages of design thinking. Moreover, the basis for the conduct of the study was the prevalence of the tropical disease, schistosomiasis in Brgy. Los Amigos among school-age children in selected study sites using clinical diagnosis ELISA Ag and ELISA Ab from March and June 2015 (Belizario et al., 2016).

Mapping of Competency and Activity

The lesson and learning activities of this study were aligned with the standards and learning criteria of the K–12 Science Curriculum.

Designing and conceptualizing of DT-based Lesson Plan on Schistosomiasis

In designing and conceptualizing the DT-based lesson plan on schistosomiasis, the performance standards and learning competencies were considered. The researcher adopted the Design Thinking Approach of Plattner et al. (2009) in developing the lesson plan. The following are the different stages of DT-based lesson plan:

Context Setting

During the initial stage, identification of the social problem as the Design Challenge was the first activity. This was incorporated to set the context of schistosomiasis for learners. To develop familiarity and bonding between the learners, they were grouped together to come up with an innovative name for their group. After

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the post-naming of groups, the teacher asked the learners to articulate upon the HOTS questions. In this specific case, the teacher selected target 3.3 of SDG 3 (Good Health and Wellbeing), one of the sustainable development goals of the United Nations, which focuses on the eradication of neglected tropical diseases (NTDs), particularly Schistosomiasis, in order to promote welfare and ensure that people of all ages enjoy healthy lives. The biology teacher then conducted a group discussion on the biology of the Schistosoma parasite, its life cycle, and the modes of transmission. The teacher let the learners watch educational videos and review case studies to understand the socio-economic impact of schistosomiasis on affected populations and provided the data and statistics for students to analyze and assess the prevalence and distribution of schistosomiasis globally and locally.

Empathy

The first stage of the lesson was empathy. This stage determines the characteristics of the audience for which the product is designed through detailed observations, interviews, or surveys, engaging, watching, and listening. To achieve this, attention and participation are required, as well as empathy with people to understand their experiences and identify their values and motivations. Learners conducted interviews through a set of questions from the empathy map template to understand the perspectives and experiences of individuals or communities infested with schistosomiasis, as well as the stakeholders involved in the prevention and control of the said disease, including government agencies (Barangay Health Center). Learners were provided with an empathy map template, which essentially helps them articulate the human aspects of the individual's problems. Using the empathy map, learners created personas, a particular category of individual according to the requirements captured, which include the interviewee's needs, challenges, and motivations. Learners also mapped out stakeholders involved in schistosomiasis prevention and control, including government agencies (Barangay Health Center), etc.

Define

In this phase, the information collected should be analyzed, categorized, and arranged in a way that facilitates the identification of the problem to be tackled. This generated a guiding statement that focuses on insights and the particular needs of the users. Based on the collected data from the previous phase, learners identified the needs and insights and developed a point of view (POV) for identifying the problem statement. The POV is a reframed problem statement based on the individual requirements, which get captured through the empathy map. From the collected POVs and insights, various HMW statements are created. A sample statement: how might we…so that…to? should include the following points: the focus on the outcome or impact; highlighting the constraints and the context; and HMWs should be neither too broad nor too narrow. Discussions with other group members who came up with heterogeneous views and experiences help in the design of effective PoVs and HMWs.

Ideate

The teacher facilitated brainstorming activities to scaffold students in generating ideas with a question such as, how many ideas can you come up with? What is your most original idea? Using the HWM as the baseline, learners got together to brainstorm potential interventions and strategies for prevention and control of schistosomiasis and come up with as many ideas as possible. This helped generate new ideas by building them on top of others. Learners may create visual diagrams using "the back of the napkin approach" to ideation and problem solving and may use post-its for recording their ideas.

Prototype

At this phase, learners create their prototypes and visualize proposed solutions using sketches and diagrams, as well as recyclable and indigenous materials found in their surroundings. Factors such as feasibility, scalability, and cost-effectiveness must be considered. The learners watched a TED video on rapid

prototyping for the development of Google Glass. The video provided a good and informative overview of how a prototype can be quickly developed with simple daily usage items. The teacher then provided students with laboratory apparatus and materials for the activity. Laboratory rules were highlighted to guide learners in crafting their prototype. The teacher and learners discussed the content integration of the activity using sample questions: Why did you choose to use these materials in developing your prototype? Why do you think this prototype will be feasible for the prevention and control of schistosomiasis? How will these prototypes aid in solving the issue of schistomiasis in our locality? Learners collected feedback from stakeholders, iterated on designs based on user input, and refined prototypes accordingly.

Test

The last stage of the lesson was to test and solicit feedback on the prototypes. The best solutions resulting from the prototype phase were examined in the context of the real product, using real designers, assessors, and users. The teacher established criteria to measure the success and impact of implemented solutions in preventing and controlling schistosomiasis. These rubrics were used to assess the developed prototype as well as the critical thinking, creativity, collaboration, and communication skills (4Cs) of learners. The learners performed a demonstration of the prototype to evaluate the effectiveness and usability of prototypes in real-world settings. Feedback was solicited to start the second iteration of the complete design thinking process, which goes on until it can convert the prototype into the expected final product.

Expert Validation

The developed DT-based lesson plan was evaluated and rated by panel of experts in the field of Science and in-service teachers. It utilized the adapted rubric of Tecson (2019).

Revision

The comments and suggestions of the panel of experts were considered in improving the learning contents, objectives, and design thinking stages of the lesson plan.

Developed Design Thinking-Based Lesson on Schistosomiasis

The developed design thinking-based lesson on schistosomiasis was used throughout the duration of the study.

Data Gathering Procedure

Prior to the conduct of the study, the researcher sent a formal letter to ask authorization to conduct the pilot testing and implementation of the study to the Schools Division Superintendent of Davao City. Another letter was sent to the School Principal of one of the schools in Cluster 7 located in Tugbok District following the approval of the SDS. Ethical considerations were thoroughly discussed following the approval of the School Principal.

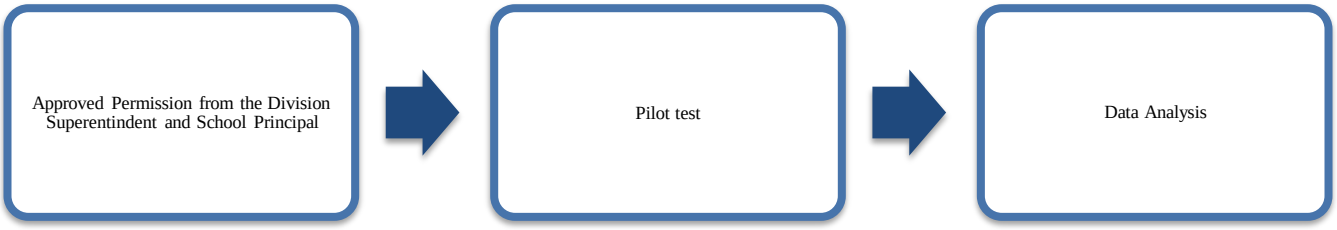

Figure 2. Data Gathering Procedure

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

Pilot Testing

The respondents for the pilot test were fifty-five (55) Grade 12 STEM learners from one of the schools in Davao City who were currently enrolled for the school year 2023-2024. Prior to the pilot test, the learners were given informed consent to ask for their voluntary participation in the study. Likewise, consent forms were given to the parents or guardians of the learners. The learners who agreed to participate were given a pretest to check their conceptual understanding before pilot testing. To ensure the authenticity of their answers, the pre-test was conducted face-to-face inside their respective classrooms. Moreover, their responses were treated with the utmost confidentiality.

Ethical Considerations

Prior to the implementation, learners were given informed consent forms to ask for their voluntary participation in the study. Likewise, consent forms were given to the parents or guardians of the learners. The learners who agreed to participate were given a pretest to check their conceptual understanding before the lesson. To ensure the authenticity of their answers, the pre-test was conducted face-to-face inside their respective classrooms. Their responses were treated with the utmost confidentiality.

To ensure the security of all the data obtained prior to the conduct of the study, the ethical standards were attained. This study utilized codes to protect the identity and maintain the confidentiality of the responses and the raters themselves. The soft copy of all the raw data such as scanned copies of the participants' responses, ratings of the evaluators, an Excel file of the study's results, and other associated files were included in the appendices. The hard copy of the manuscript was distributed to the in-charge departments, the library, and to the Department of Science and Technology – Science Education Institute (DOST-SEI) which gave scholarship grants for the completion of the degree.

RESULTS AND DISCUSSION

Table 1. Summary of Expert's Rating of the Developed Design Thinking-Based Lesson on Schistosomiasis

Components	Mean	Interpretation
Learning Objectives	3.92	Excellent
Learning Content	3.75	Excellent
Degree of Contextualization	3.81	Excellent
Design Thinking Lesson Stages	4.00	Excellent
Overall Rating	3.87	Excellent

The developed design thinking-based lesson plan on schistosomiasis was evaluated by the panel of experts in terms of learning objectives, learning content, degree of contextualization, design thinking lesson stages. The learning objectives received an average rating of 3.92, the learning content received 3.75, the degree of contextualization received 3.81, and the design thinking lesson stages received an average of 4.00. All components were given a description of excellent in which its mean interval corresponded to values of 3.25 – 4.00. This results demonstrated that the developed design thinking-based lesson on schistosomiasis had a certain level of quality as a research instrument in this study. According to Goldman and Zielezinski (2016), lesson planning that incorporates design thinking enhances the application of the competencies by providing opportunities for relevance and engagement with the new skills and competencies needed to approach the comprehensiveness and deep conceptualization of the core standards in a meaningful way.

Table 2. Summary of Expert's Rating of the Developed Achievement Test

Components	Mean	Interpretation
Clarity and organization of stem	3.97	Excellent
Wordiness	3.92	Excellent
Consistency and parallelism of stem and options	3.98	Excellent
Appropriateness of item to learning target	3.95	Excellent
Use of jargon	3.98	Excellent
Overall Rating	3.97	Excellent

The developed achievement test for this study was subjected to evaluation by a panel of experts. The test was comprised of thirty (30) items of multiple choice, based on the table of specifications made by the researcher to assure an equal and precise distribution of the levels of comprehension of the test. The clarity and organization of the stem received a mean of 3.97; wordiness received a mean of 3.92; consistency and parallelism of the stem and options received a mean of 3.98; appropriateness of the item to the learning target received a mean of 3.95; and use of jargon received a mean of 3.9. All components were rated as excellent, with an overall rating of 3.97, which is interpreted as excellent.

Context Setting (Day 1)

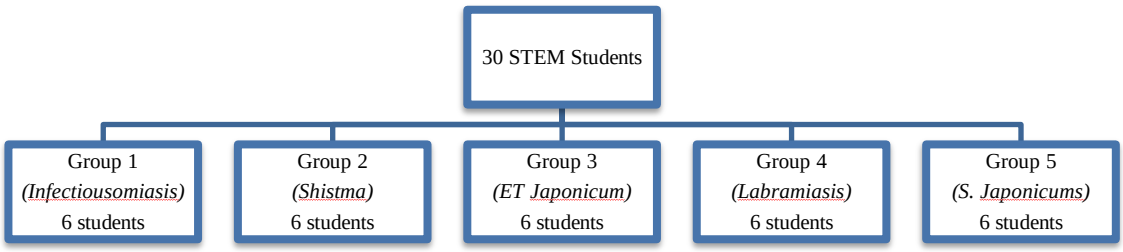

Figure 4.1. Formation of Student Groups

During the initial stage, identification of the social problem as the design challenge was the first activity. This was incorporated to set the context of schistosomiasis for learners. To develop familiarity and bonding between the learners, they were grouped together to come up with an innovative name for their group such as *Infectiousomiasis, Schistma, ET Japonicum, Labramiasis,* and *S. Japonicums* as shown in Figure 4.3. They continue working in groups for the rest of the implementation of the study.

Table 4.3 Design Challenge

Group Names	Design Challenge
Infectiousomiasis	SDG 3 (Good Health and Wellbeing) – Target 3.3 End the epidemics of neglected tropical diseases (NTD) such as *Schistosomiasis*
Schistma	
ET Japonicum	
Labramiasis	
S. Japonicums	

In this specific case, the teacher selected target 3.3 of SDG 3 (Good Health and Wellbeing), one of the sustainable development goals of the United Nations, which focuses on the eradication of neglected tropical diseases (NTDs), particularly Schistosomiasis, in order to promote welfare and ensure that people of all ages enjoy healthy lives as shown in Table 4.6. After the post-naming of groups, the teacher asked the learners to

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

articulate upon what is schistosomiasis? How might humans be affected by schistosomiasis? As a student, how can you prevent yourself from getting infected with schistosomiasis? Some formal definitions of schistosmiasis were presented and some misconceptions were discussed. The teacher then conducted a group discussion on the biology of the Schistosoma parasite, its life cycle, transmission, distribution, detection, control, and prevention. The teacher let the learners watch educational videos and review case studies to understand the socio-economic impact of schistosomiasis on affected populations and provided the data and statistics for learners to analyze and assess the prevalence and distribution of schistosomiasis globally and locally.

Phase 1: Empathy (Day 1)

The first stage of the lesson was empathy. This stage determines the characteristics of the audience for which the product is designed through detailed observations, interviews, or surveys, engaging, watching, and listening. To achieve this, attention and participation are required, as well as empathy with people to understand their experiences and identify their values and motivations. Each group conducted interviews through a set of questions from the empathy map template to understand the perspectives and experiences of individuals or communities infested with schistosomiasis, as well as the stakeholders involved in the prevention and control of the said disease, including government agencies (Barangay Health Center). Learners were provided with an empathy map template, which essentially helps them articulate the human aspects of the individual's problems as shown in Figure 4.2

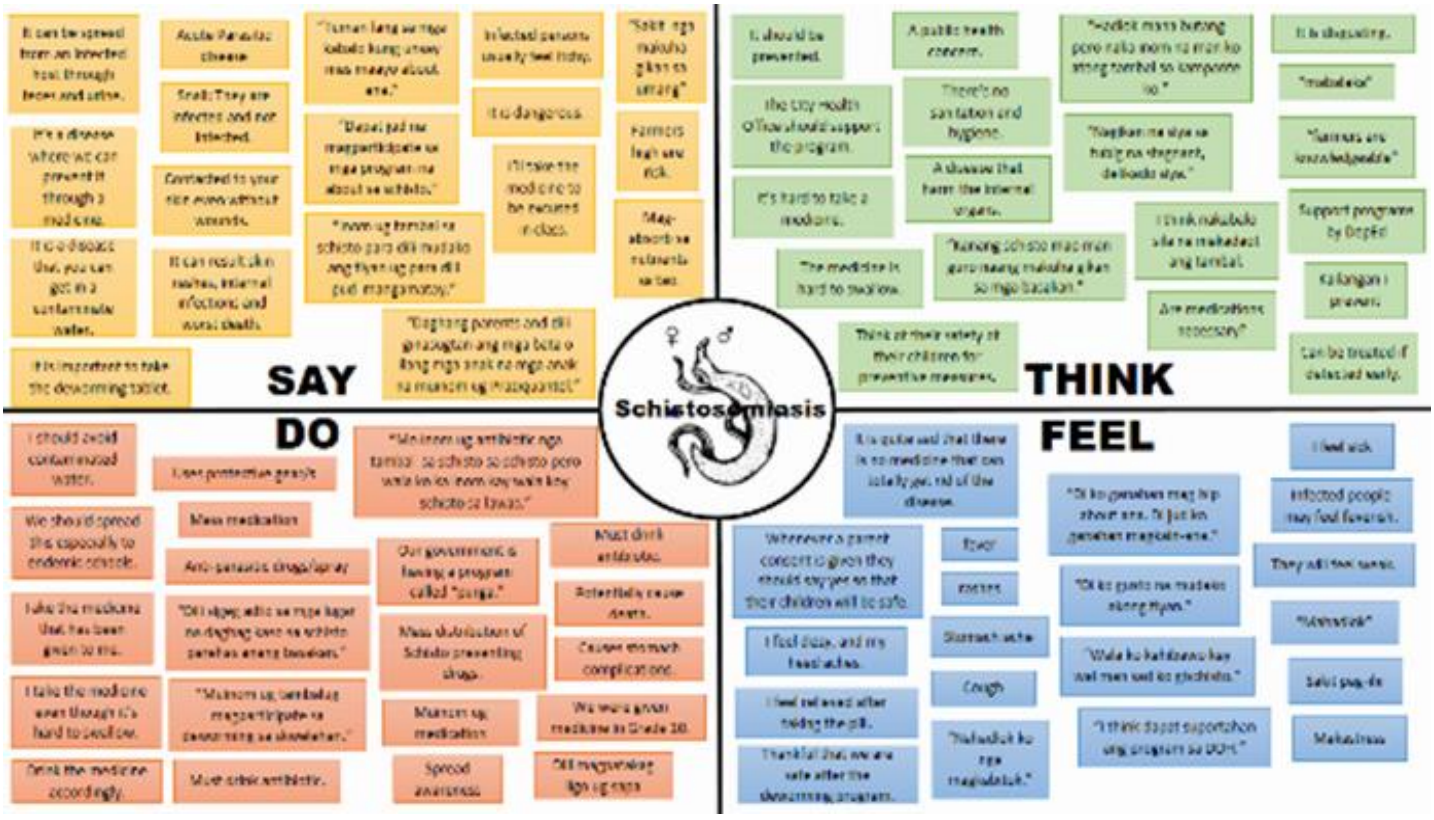

Figure 4.2. Empathy Map on the Stakeholders' Experiences and Perspectives on Schistosomiasis

Notes: Refer to the empathy map.

- Orange – represents what the stakeholders mostly said while answering the interview questions made by the learners.
- Green – represents the stakeholders' thoughts while answering the interview questions made by the learners.

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- Red – represents what the stakeholders' did in relation to their perspective and experiences on schistosmiasis.
- Blue – represents the stakeholders' feelings toward the issue on schistosmiasis.

Table 4.4 shows the persona framework of the target users of the different groups. Using the empathy map, each group created personas, a particular category of individual according to the requirements captured, which include the interviewee's needs, challenges, and motivations. Each group also mapped out stakeholders involved in schistosomiasis prevention and control such as student, parent, school nurse, and Barangay Health Worker (BHW). This activity enabled the groups to capture their stakeholders' traits, challenges, needs, and coping mechanisms on the issue of schistosmiasis which served as the basis for the second phase of design thinking, define.

Table 4.4. Personna Framework

Group Name	**Design User's Traits in relation to learning/ teaching**	**Our Design User's Challenges & Needs**	**How our design user copes with challenges and needs?**
Infectiousomiasis	– Users' resilience is the key to withstand the effect of the disease caused by a Schistosoma's parasitic worms.	– It is a problem that has a big impact on a person's body if left untreated immediately, so people should be aware of it.	– Users must be aware, knowledgeable, and observe protocols implemented by the DOH.
Schistma	– All snails are infected – You get bloating – You couldn't get infected without wounds.	– Infectious, absenteeism, focus – Mass medication – Visual presentation in preventing schistosomiasis	– Access to health care – Education and awareness – Sanitation and proper hygiene – Psychosocial support
ET Japonicum	– Mindset – Medication – Management	– Ignorant of the real nature of schisto – Often not allowed to take the medication – Heavy reliance on water	– Research/asking – Avoiding – Hope and pray
Labramiasis	– Users' learned that schistosomiasis is a disease cause by a parasitic worms that affect people exposed in infested water.	– The challenge is that people are not so educated about its problem, which results in their being unwilling to take proper action against it.	– Schistosomiasis is controlled through medicine. – It is also important to avoid contaminated water to prevent schisto.

S. Japonicums	– People living in areas near stagnant waters are at risk to the diease.	– Proper implementation of deworming. – Waters are infected as parasites are prevalent.	– It helps the people living in areas of water with parasite infestations to be knowledgeable with the disease.

Phase 2: Define (Day 2)

Table 4.5. Defining PoV from the Different Groups

Group	**Point of View Statement**
Infectiouso-miasis	– BHWs need to teach because a lot of people are not aware of what is schistosomiasis. – Nurse needs a way to share because a lot of citizens don't know how dangerous schistosomiasis. – Students need a way to learn because a lot of them is not aware of schistosomiasis. – Parents need a way to learn because it is important to know schistosomiasis.
Schistma	– Barangay Health Workers (BHWs) need a way to teach because in many community members may not aware of the symptoms and risks associated with schistosmiasis leading to delayed diagnosis and treatment. – Students need a way to educate because many of them may not fully understand the risks of schistosomiasis transmission through contaminated water sources or recognize the symptoms of the disease. – Parents need a way to advise because implementing preventive measures especially at home may benefit community-based initiatives and support networks. – Nurses need a way to update because many patients may face barriers such as stigma, lack of awareness, and financial constraints when seeking healthcare services for schistosomiasis.
ET Japonicum	– Farmers need a way to get rid of schistosomiasis' vectors without compromising their livelihood because snails tend to live in farm where watery terrain is present.
Labramiasis	– Student should be more educated of the problems that schisto possess as well as raise prevention awareness and medication to fight against schisto. This will give him the push necessary to take in medication.
S. Japonicums	– The people living near the waters with parasitic infestation need a way to prevent and eradicate the schistosomiasis because students and other people that are high risk to the disease will be less risk to short or long term diseases caused by the schistosomiasis.

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Table 4.6. Defining HMW from the Different Groups

Group	How Might We Statement
Infectiouso-miasis	– How might we provide protection or shield against schistosomiasis to those people living in an endemic zone or using water resource that is infested with disease so that transmission will be lessen?
Schistma	– How might we empower community members with knowledge and resources to prevent and manage schistosmiasis effectively so that they can adopt a healthier hygiene practices leading to a reduction of the disease within the community? – How might improve the access to early diagnosis and comprehensive care for patients with schistosomiasis in our healthcare facility, so that patients receive timely treatment, experience better health outcomes, and feel supported throughout their healthcare journey? – How might we raise awareness among students about the transmission, symptoms, and prevention of schistosomiasis to promote a healthier school environment, peer support, and encourage proactive health behaviors so that students can protect themselves and their peers leading to improved overall students' well-being? – How might we support parents in implementing preventive measures at home, recognizing symptoms, navigating healthcare system to seek timely treatment and support, so that families can safeguard their child health and access appropriately care when needed?
ET Japonicum	– How might we continue to produce food with less water reliance so that we can get rid of the host to prevent further spread of schistosomiasis?
Labramiasis	– How might we educate students of the dangers that schistosomiasis possess and help them be more aware of the necessary activities against schistosomiasis?
S. Japonicums	– How might we able to properly spread the awareness concisely so that it is comprehensible especially to the students who struggle in fully understanding how we can prevent the spreading of the schistosomiasis disease?

The second phase was define. In this phase, the information collected were analyzed, categorized, and arranged in a way that facilitates the identification of the problem to be tackled as depicted in Table 4.5. This generated a guiding statement that focuses on insights and the particular needs of the stakeholders which were identified by the learners. These are the students, parents, school nurse, and Barangay Health Workers. Based on the collected data from the previous phase, learners identified the needs and insights and developed a point of view (POV) for identifying the problem statement. The POV is a reframed problem statement based on the individual requirements, which get captured through the empathy map. Each group focused on different target users. The groups of *Infectiousomiasis* and *Schistma* group focused on students, parents, school nurse, and BHW. *ET Japonicum* group highlighted the perspective of rice farmers. The *Labramiasis* group pointed out the welfare of the students. Lastly, the group of *S. Japonicums* underscored the standpoint of the community as a whole. These variation are the result of their information collection through interview of different stakeholders in the locality.

From the collected POVs and insights, various HMW statements are created as depicted in Table 4.9. A how might we…so that…to statement should include the following points: the focus on the outcome or impact; highlighting the constraints and the context; and HMWs should be neither too broad nor too narrow. Discussions with other group members who came up with heterogeneous views and experiences collaborate in the design of effective PoVs and HMWs. These HMW served as the baseline in the next phase, the brainstorming activity.

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Phase 3: Ideate (Day 2)

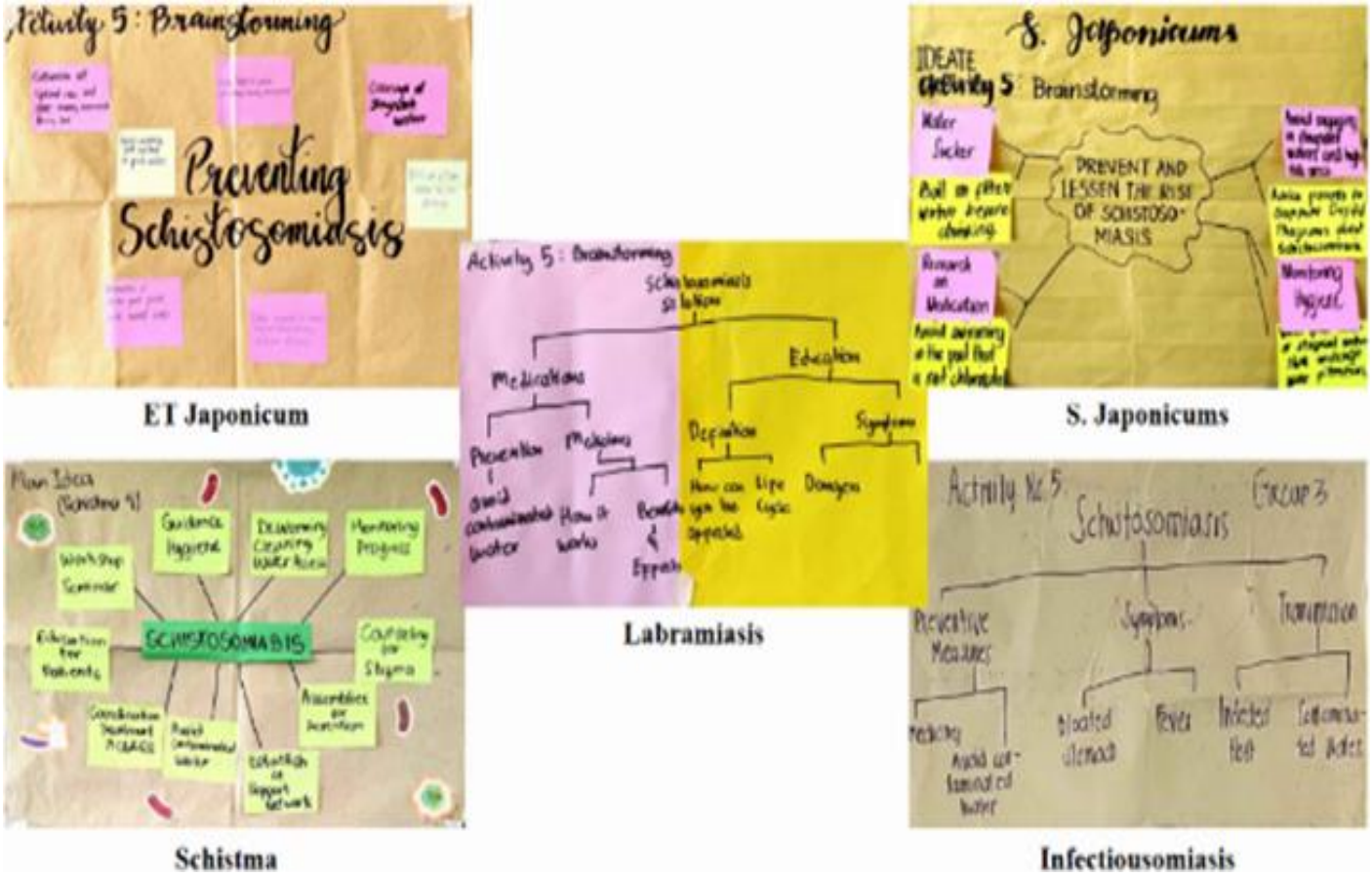

Figure 4.3. Brainstorming Activity for Potential Interventions and/or Strategies for Prevention and Control of Schistosomiasis

Using the HWM as the baseline, learners got together to brainstorm potential interventions and strategies for prevention and control of schistosomiasis and come up with as many ideas as possible as shown in Figure 4.3. This helped generate new ideas by building them on top of others. Each group created visual diagrams using "the back of the napkin approach" to ideation and problem solving and used post-its for recording their ideas. Groups *ET Japonicum, Schistma,* and *S. Japonicums* used bubble map as their visual representation while *Labramiasis* and *Infectiousomiasis* used organization chart to map out their ideas needed for the next phase, prototyping.

Phase 4: Prototype (Day 3 and 4)

At this phase, learners create their prototypes and visualize proposed solutions using sketches and diagrams, as well as recyclable and indigenous materials found in their surroundings. Factors such as feasibility, scalability, and cost-effectiveness must be considered. The learners watched a TED video on rapid prototyping for the development of Google Glass. The video provided a good and informative overview of how a prototype can be quickly developed with simple daily usage items. The teacher then provided learners with laboratory apparatus and materials for the activity. Laboratory rules were highlighted to guide learners in crafting their prototype. The teacher and learners discussed the content integration of the activity using sample questions: Why did you choose to use these materials in developing your prototype? Why do you think this prototype will be feasible for the prevention and control of schistosomiasis? How will these prototypes aid in solving the issue of schistosomiasis in our locality? Learners collected feedback from stakeholders, iterated on designs based on user input, and refined prototypes accordingly.

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

Phase 5: Test (Day 5)

Figure 4.4 Presentation of Prototypes for the Prevention and Control of Schistosomiasis

The last stage of the lesson was to test and solicit feedback on the prototypes. The best solutions resulting from the prototype phase were examined in the context of the real product, using real designers, assessors, and users. The teacher established criteria to measure the success and impact of implemented solutions in preventing and controlling schistosomiasis. These rubrics were used to assess the developed prototype as well as the critical thinking, creativity, collaboration, and communication skills (4Cs) of learners. The learners performed a demonstration of the prototype to evaluate the effectiveness and usability of prototypes in real-world settings. Figure 4.6 shows the different prototypes of each group. Starting from the upper left, the group *Schistma*, Gastropoda Hydro detection is a 3-D model of the supposed AI detector of Oncomelania quadrasii, a device use to capture the essence of monitoring both water quality and snail-related infections. This was inspired creation to a "miracidia hatching device" Jurberg et al. (2008). Second, on the upper right corner, the *ET Japonicum* created the illustration of an upland rice cultivation system

which was named as Shisto no somiasis. This unique way of rice planting ensures the eradication of schisto vectors by applying molluscicides, a potent chemical used in killing infected mollusks. Third, at the center, the group *Labramiasis* presented the "Project Prawndators," as an effective way to control the population of vector snails. These prawn are natural predators of the intermediate host of schistosoma parasites, the snails. These sketch prototype is inspired in the study of the Senegal River Basin in Africa as an ideal way of controlling schistosomiasis. Not only does it help control the disease but it can also act as a food source to the community. Fourth, on the lower left corner, the Shisto Shield sketch was conceived by the group *Infectiousomiasis* as a protection against schistosomiasis. This suit is equipped with different safety gadgets needed for protection against the disease. Lastly, on the lower right corner, Project A.Y.O.S. which stands for Awareness to Youth on Schistosomiasis was presented by the group *S. Japonicums* as their prototype strategy in controlling the spread of schistosomiasis. This project include a combination of Community-based youth education, consultation from health experts, health screening, and treatment as well as sanitation and hygiene. Feedback was solicited to start the second iteration of the complete design thinking process.

Experts' Evaluation of the Developed Design Thinking-Based Prototypes in Terms of Learners' 4Cs

Table 4.7 Summary of Expert's Rating of the Developed Design Thinking-Based Prototypes in Terms of 4Cs (Critical Thinking, Creativity, Collaboration, and Communication Skills)

Competency	**Mean**	**Description**
Critical Thinking	3.08	Proficient
Creativity	3.31	Proficient
Collaboration	3.25	Proficient
Communication	3.34	Proficient
Overall Rating	3.23	Proficient

Note. 1.00-1.40 Novice 2.50-3.40 Proficient

1.50-2.40 Basic 3.50-4.00 Advanced

Table 4.7 shows the evaluation of the design thinking-based prototypes yielded insightful results across the four critical 21st-century skills, known as the 4Cs: critical thinking, creativity, collaboration, and communication skills. Among the four competencies, communication skills received the highest rating at 3.34, showcasing that the prototypes are particularly effective in developing learners' ability to convey ideas clearly and interact effectively with others. This high score suggests that the designs likely include activities that promote both written and verbal communication, active listening, and presentation skills. With a score of 3.31, creativity is the second highest rating highlighted by the experts. This rating reflects that the prototypes are effective in inspiring innovative thinking and originality among learners. The rating of 3.25 for collaboration indicates a solid proficiency in facilitating teamwork and cooperative learning. The prototypes appear to be designed in a way that encourages users to work together, share ideas, and achieve common goals. Lastly, the prototypes received an average rating of 3.08 in critical thinking, indicating that the designs are proficient in promoting analytical and evaluative skills. This score suggests that the prototypes effectively engage users in questioning, problem-solving, and decision-making processes.

The overall ratings suggest that the design thinking-based prototypes are significantly successful in cultivating the 4Cs. The relatively balanced and high scores across all four competencies indicate that the design thinking-based prototypes are well rounded and capable of developing vital skills for the 21st century as underscored in the studies of Vallis et al. (2021) and Retna (2015).

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

Conceptual Understanding of Students during the Pilot Testing

A 30-item pre-test and post-test were administered to Grade 12 students to determine their conceptual understanding before and after the implementation of the Design Thinking-Based Lesson on Schistosomiasis. The basis for the construction of questions was the researcher-made Table of Specifications (TOS) aligned with the learning competencies of the K–12 curriculum. Table 4.3 presents the conceptual understanding of the students during the pilot testing phase.

Table 3 shows the paired t-test results of the pre-test and post-test scores of the Grade 12 STEM learners on the topic of Schistosomiasis during the pilot test. Based on the descriptive statistics, the average pre-test score of the Grade 12 learners is 13.69, while the learners' average post-test score is 18.60. The descriptive statistics show that it seems that the Grade 12 learners performed better on the post-test than they did on the pre-test. This observation was verified by conducting a paired t-test.

Table 3. Comparison of Pre-test and Post-test Mean Using Paired t-test during Pilot Test

Achievement Test	Mean	Mean Difference	t-value	Df	p-value	Remarks
Pre-test	13.69091	4.90909	-16.205	54	2.15296E-22*	Significant
Post -test	18.60000					
* significant at 0.05						

Since *p*-value 0.00 is less than the level of significance $\alpha = 0.05$, the null hypothesis stating that there is no significant difference between the pre-test and post-test scores of Grade 12 STEM learners on Schistosomiasis before and after the DT-Based Lesson Integration is rejected. Hence, there is sufficient evidence that there is a statistically significant difference between the conceptual understanding of students before (pre-test) and after (post-test) the implementation of the Design Thinking-Based Lesson on Schistosomiasis.

Moreover this findings corresponded with the study of Simeon et al. (2020) they found that applying the design thinking method to teach physics concepts in a STEM environment significantly improved the achievement of learners.

CONCLUSION

Based on the data analysis and findings of this study, it was concluded that the developed Design Thinking-Based Lesson on Schistosomiasis was rated "excellent" by the panel of experts. In addition, the DLTS helped improve the conceptual understanding of the Grade 12 learners on the topic of schistosomiasis. Furthermore, the design-thinking-based prototypes are significantly successful in cultivating the communication, collaboration, creativity, and critical thinking known as the 4Cs to proficient levels among Grade 12 learners.

RECOMMENDATIONS

Based on the results and conclusion of this study, the following were recommended:

1. The developed Design Thinking-Based Lesson on Schistosomiasis may be implemented for Grade 12 STEM learners in teaching the topic Schistosomiasis in Biology 2 for both public and private schools in Davao City.
2. The developed Design Thinking-Based Lesson on Schistosomiasis may be used as a basis for developing more Design Thinking-Based Lessons for other topics in biology.

3. Experts may conduct a thorough orientation, training, seminar, or webinar about the integration of the design thinking approach into lesson plans and activities for school principals, master teachers, and teachers, since this is a relatively new teaching approach.
4. For future research, a quasi-experimental study using a one-group pretest-posttest with a control group may be utilized to provide further support for the results of this study.

ACKNOWLEDGEMENT

My sincere gratitude to the Department of Science and Technology. The researchers are appreciative of the financing for their study provided by the Science Education Institute (DOST-SEI), the space provided for learning, creativity, and opportunity at Mindanao State University-Iligan Institute of Technology, and their devoted parents for their unwavering love and support. Above all, to the Almighty God, for His wisdom and providence.

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APPENDIX

APPENDIX A

DESIGN THINKING-BASED LESSON PLAN ON SCHISTOSOMIASIS
Developed by: Michael Jan R. Alima

Grade Level: 12 **Strand: STEM**
Subject: General Biology 2 **Quarter: 4th**

LESSON DESCRIPTION

In this lesson, we will embark on a journey to tackle one of the most pressing global health challenges: schistosomiasis. This Neglected Tropical Disease (NTD) affects millions worldwide, particularly in regions with poor sanitation and limited access to clean water. However, equipped with the power of design thinking, we can develop innovative solutions to prevent and control schistosomiasis effectively. Through this lesson, we will explore how empathy, critical thinking, creativity, and collaboration can drive impactful change in science education and public health.

LESSON OBJECTIVES

1. Describe the lifecycle of the parasitic worms responsible for schistosomiasis transmission.
2. Identify areas and communities most affected by the disease in the locality.
3. Recognize the experiences and challenges faced by individuals affected by schistosomiasis.

LESSON PROPER

Context Setting	**Day 1** **Activity 1: Identify the Design Challenge**1. To develop familiarity and bonding between the learners, they will be group together and will come up with an innovative name for their group.2. After post naming of groups, ask the learners to articulate upon the questions:·

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

<table>
<tr><td></td><td>What is schistosomiasis?· How might humans be affected by schistosomiasis?· As a student, how can you prevent yourself from getting infected with schistosomiasis?3. In this specific case, the teacher selected the target 3.3 of the SDG 3 (Good Health and Wellbeing), one of the sustainable development goals of the United Nations which focuses on the eradication of the neglected tropical disease (NTD) particularly Schistosomiasis, in order to promote welfare and ensure that people of all ages enjoy healthy lives.4. Conduct a group discussion on the biology of the Schistosoma parasite, its life cycle, and the modes of transmission.5. The teacher let the learners watch educational videos and review case studies to understand the socio-economic impact of schistosomiasis on affected populations.6. Let the students analyze the data and statistics to assess the prevalence and distribution of schistosomiasis globally and locally.</td></tr>
<tr><td>Empathize</td><td>
Day 1

Activity 2: Interview Using Empathy Map 1. Learners will conduct interview through a set of questions from empathy map template to understand the perspectives and experiences of individuals or community infested with schistosomiasis as well as the stakeholders involved in the prevention and control of the said disease, including government agencies (Barangay Health Center).2. Learners will be provided with an empathy map template which essentially helps them in articulating the human aspects of the individual’s problems.

Empathy Map Template
<table>
<tr><td>What do they SAY?</td><td>What do they DO?</td><td>What do they FEEL?</td><td>What do they THINK?</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>
Activity 3: Creation of Personnas

3. Using the empathy map, learners will create persona, a particular category of individual to the requirements captured which include the interviewee’s needs, challenges, and motivations.

4. Learners will also map out stakeholders, involved in schistosomiasis prevention and control, including government agencies (Barangay Health Center) etc.

Personna Framework
<table>
<tr><td>Design User’s Traits in relation to learning/ teaching</td><td>Our Design User’s Challenges & Needs</td><td>How our design user copes with challenges and needs?</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
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</td></tr>
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Define

Day 2

Activity 4: Defining PoV and HMW

Based on the collected data from the previous phase, learners will identify the needs and insights and will develop a point of view (POV) for identifying the problem statement. The PoV is reframed problem statement based on the individual requirements, which gets captured through empathy map.

Point of View Template

User	Need	Insight

From the collected PoVs and insights, various HMW statements gets created. A sample statement *How might we…so that…to?* should include the following points:

the focus on the outcome/impact,

highlight the constraints and the context

HMWs should be neither too broad nor too narrow.

Discussions with other group members who come up with heterogeneous views and experiences, help in the design of effective PoVs and HMWs.

Crafting the Problem Statement

Problem / Opportunity	Design Challenge

Ideate

Day 2

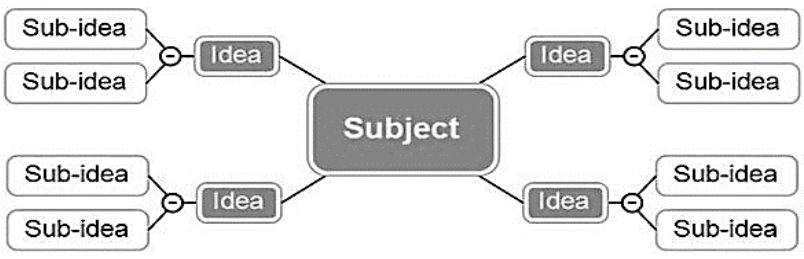
Activity 5: Brainstorming

The teacher will facilitate brainstorming activities to scaffold students to generate ideas with a question such as:

How many ideas can you come up with?

What is your most original idea?

Mind Mapping



Using the HWM as the baseline, learners will get together to brainstorm potential interventions and strategies for prevention and control of schistosomiasis and come up with as many ideas as possible. This helps to generate new ideas by building them on top of others.

Learners may create visual diagrams using “the back of the napkin approach” to ideation and problem solving and may use post-its for recording their ideas.

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Prototype	**Day 3 and 4** **Activity 6: Creating a Prototype** 1. The learners will watch a TED video on the Rapid Prototyping for development of Google Glass. The video will provide a good and informative overview of how a prototype can be quickly developed with simple daily usage items. 2. At this phase, learners will prototype and visualize proposed solutions using sketches, diagrams, as well as recyclable and indigenous materials found in their surroundings. Factors such as feasibility, scalability, and cost-effectiveness must be considered. 3. The teacher will provide students with laboratory apparatus for the activity. Laboratory rules will be highlighted to guide learners in crafting their prototype. 4. The teacher and learners will discuss the content integration of the activity using sample questions: · Why did you choose to use these materials in developing your prototype? · Why do you think this prototype will be feasible in the prevention and control of schistosomiais? · How will these prototype aid in solving the issue of schistomiasis in our locality? 5. Learners will collect feedback from stakeholders, iterate on designs based on user input, and refine prototypes accordingly.
Test	**Day 5** **Activity 7: Presentation of Prototypes** 1. The teacher will establish criteria to measure the success and impact of implemented solutions in preventing and controlling schistosomiasis. These rubrics will assess the developed prototype as well as the critical thinking, creativity, collaboration, and communication skills (4Cs) of learners. 2. The learners will perform a demonstration of the prototype to evaluate the effectiveness and usability of prototypes in real-world settings. 3. Water samples will be collected from the prototype and will be subjected to tests on biological parameters to evaluate the effectiveness of interventions against schistosomiasis 4. Feedback will be solicited to start the second iteration of the complete design thinking process, which goes on until it can convert the prototype into the expected final product.

APPENDIX B

Rubric for the Developed Design-Thinking Based Lesson

Adapted from Christine Mae Tecson, Monera Salic-Hairulla, Mark Anthony Torres, and Amelia T. Buan (2019)

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS |Volume VIII Issue VI June 2024

Evaluator Code:_____ Date Rated: _____

Direction: This scoring Rubric was designed to rate the developed teaching-learning materials in terms of its main features. Kindly write a check mark (✓) on the columns next to components' column that best indicates your rating to each features of the developed Design Thinking-Based Lesson on Prevention and Control of Schistosomiasis.

DESIGN THINKING-BASED LESSON ON SCHISTOSOMIASIS					
Components	**Needs Improvement (1 point)**	**Good** (2 point)	**Very Good (3 point)**	**Excellent** (4 point)	**Score**
A. Learning Objectives					
A.1 SMART – the learning objectives were Specific, Measurable, Attainable, Relevant, Time-bounded					
A.2 The learning objectives were expressed in behavioral terms.					
A.3 Appropriate learning goals/objectives based on the content of schistosomiasis.					
B. Learning Content					
B.1 Offers a clear, concise, detailed and accurate description of the lesson concepts					
B.2 Organization of content is in logical order.					
B.3 Based on the context and development level of the learners.					
C. Degree of Contextualization					
C.1 Creative and connected to real world problems or scenarios.					
C.2 Links new content to local experiences familiar to the learners.					
C.3 Lesson was modified to accommodate the unique contexts of the chosen locality (Los Amigos, Davao City).					
C.4 Lesson incorporates essential values of the chosen locality.					
D. Design Thinking Lesson Stages					
D.1 Context Setting					
D.2 Empathize					
D.3 Define					
D.4 Ideate					
D.5 Prototype					
D.6 Test					

				Total Score	

Comments and Suggestions:

_____

_____

_____
Evaluator's Signature over printed name

APPENDIX C

PRE-TEST AND POST-TEST QUESTIONNAIRE

Name (Optional): _____ Score:_____
Date: _____ Strand: _____

MULTIPLE CHOICE

Directions: Read the following items carefully and encircle the letter of the correct answer.

1. What is the common name for the disease caused by schistosomes?

A. Bilharzia
B. Filariasis
C. Elephantiasis
D. River blindness

2. What type of parasite causes schistosomiasis?

A. Fungi
B. Helminth
C. Bacteria
D. Protozoa

3. Which of the following species of blood trematodes is endemic in the Philippines?

A. Schistosoma mansoni
B. Schistosoma japonicum
C. Schistosoma intercalatum
D. Schistosoma haematobium

4. What are the key stages in the lifecycle of the parasitic worms responsible for transmitting schistosomiasis?

A. Egg, miracidium, sporocyst, cercaria, schistosomulum, adult worm
B. Egg, miracidium, sporocyst, schistosomulum, cercaria, adult worm
C. Egg, sporocyst, miracidium, cercaria, schistosomulum, adult worm
D. Egg, miracidium, cercaria, sporocyst, schistosomulum, adult worm

5. Which stage of schistosoma parasite is release in the freshwater, swims and penetrates specific snail

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intermediate host?

A. Miracidia
B. Cercaria
C. Sporocyst
D. Schistosomula

6. Which stage of schistosoma parasite is release from the snail and eventually penetrates the skin of the human host?

A. Miracidia
B. Cercaria
C. Sporocyst
D. Schistosomulum

7. Which stage of schistosoma parasite migrates via venous circulation to lungs, then to heart, and then develop in the liver?

A. Miracidia
B. Cercaria
C. Sporocyst
D. Schistosomulum

8. Which stage of schistosoma parasite is release in the freshwater which is a larval stage found in freshwater snails?

A. Miracidia
B. Cercaria
C. Sporocyst
D. Schistosomulum

9. Which of the following organs is rarely infected with *Schistosoma* parasites?

A. Lungs
B. Bladder
C. Intestine
D. Spinal Cord

10. Which of the following species of intermediate host snails does *japonicum* lives?

A. Bulinus
B. Biomphalaria
C. Oncomelania
D. Neotriculia aperta

11. Which of the following animals serves as reservoir for *japonicum*?

A. Dog
B. Fish
C. Frog
D. Bird

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12. What is the main route of schistosomiasis transmission?

A. Airborne
B. Foodborne
C. Waterborne
D. Vector-Borne

13. What is the primary host of schistosomes?

A. Fish
B. Birds
C. Snails
D. Humans

14. How do schistosomes enter the human body?

A. Through the skin
B. Through sexual contact
C. Through the respiratory tract
D. Through ingestion of contaminated food

15. Which statement BEST explains that adult schistosoma parasites are dioecious?

A. They possess distinct male and female reproductive organs.
B. They undergo asexual reproduction through binary fission.
C. They can change their sex depending on environmental factors.
D. They are hermaphroditic, possessing both male and female reproductive organs simultaneously.

16. Which of the following signs and symptoms are experienced by children who are repeatedly infected by schistosoma parasites?

I. Anemia
II. Obesity
III. Malnutrition
IV. Learning difficulties

A. I and II only
B. I and III only
C. I, II, and III only
D. I, III, and IV only

17. How can one prevent schistosomiasis?

I. Avoid swimming or wading in freshwater.
II. Use water directly from streams for bathing.
III. Boil water for at least 1 minute before drinking.
IV. Vigorous towel drying after very brief water exposure.

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A. I and II
B. II and III
C. I, II, and III
D. I, III, and IV

18. Which of the following systemic symptoms is NOT a manifestation of acute schistosomiasis (Katayama fever)?

A. Cough
B. Diarrhea
C. Tooth Ache
D. Abdominal Pain

19. Which of the following demonstrates effective control measures for the disease schistosomiasis?

A. Dumping of human waste to open streams.
B. Runoff from pastures should be drain in an open canals and rivers.
C. Used strong chemicals to eliminate host snails and other species in the water.
D. Implement mass drug treatment for entire community especially the school-age children.

20. Which of the following is NOT a symptom of schistosomiasis?

A. Rash
B. Fever
C. Cough
D. Diarrhea

21. What is the primary means of controlling snail populations in schistosomiasis endemic areas?

A. Chemical spraying
B. Genetic modification
C. Draining water bodies
D. Introducing natural predators

22. Which of the following is NOT a preventive measure for schistosomiasis?

A. Avoiding swimming in freshwater bodies
B. Wearing protective clothing
C. Boiling drinking water
D. Eating raw fish

23. What is the most effective way to prevent schistosomiasis?

A. Vaccination
B. Antibiotic treatment
C. Use of insect repellent
D. Avoiding contact with contaminated water

24. Which areas are most commonly affected by schistosomiasis transmission?

A. Urban areas with high population density
B. Coastal regions with polluted water bodies

C. Mountainous regions with clean water sources
D. Rural communities with inadequate sanitation and water access

25. What are some of the challenges faced by individuals affected by schistosomiasis?

i. Stigma and discrimination
ii. Impaired cognitive function
iii. Limited access to healthcare

A. I and II only
B. I and III only
C. II and III only
D. I, II, and III

26. How can design thinking be applied to develop solutions for schistosomiasis prevention and control?

I. By brainstorming creative ideas
II. By prototyping and testing solutions
III. By empathizing with affected communities

A. I and II only
B. II and III only
C. I and III only
D. I, II, and III

27. In which region is schistosomiasis most prevalent?

A. Arctic
B. North America
C. Western Europe
D. Sub-Saharan Africa

28. What is the main source of contamination with schistosome eggs?

A. Polluted air
B. Animal urine
C. Human feces
D. Contaminated soil

29. What is the name of the test used to diagnose schistosomiasis?

A. Blood culture
B. Tuberculosis skin test
C. Malaria rapid diagnostic test
D. Stool examination for ova and parasites

30. How can mass drug administration contribute to schistosomiasis control efforts?

i. By targeting high-risk populations
ii. By interrupting the transmission cycle
iii. By reducing the prevalence of infection
iv. By getting profit and recognition from drug sales

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A. I, II, and III
B. I, II, and IV
C. II, III, and IV
D. I, II, III, and IV

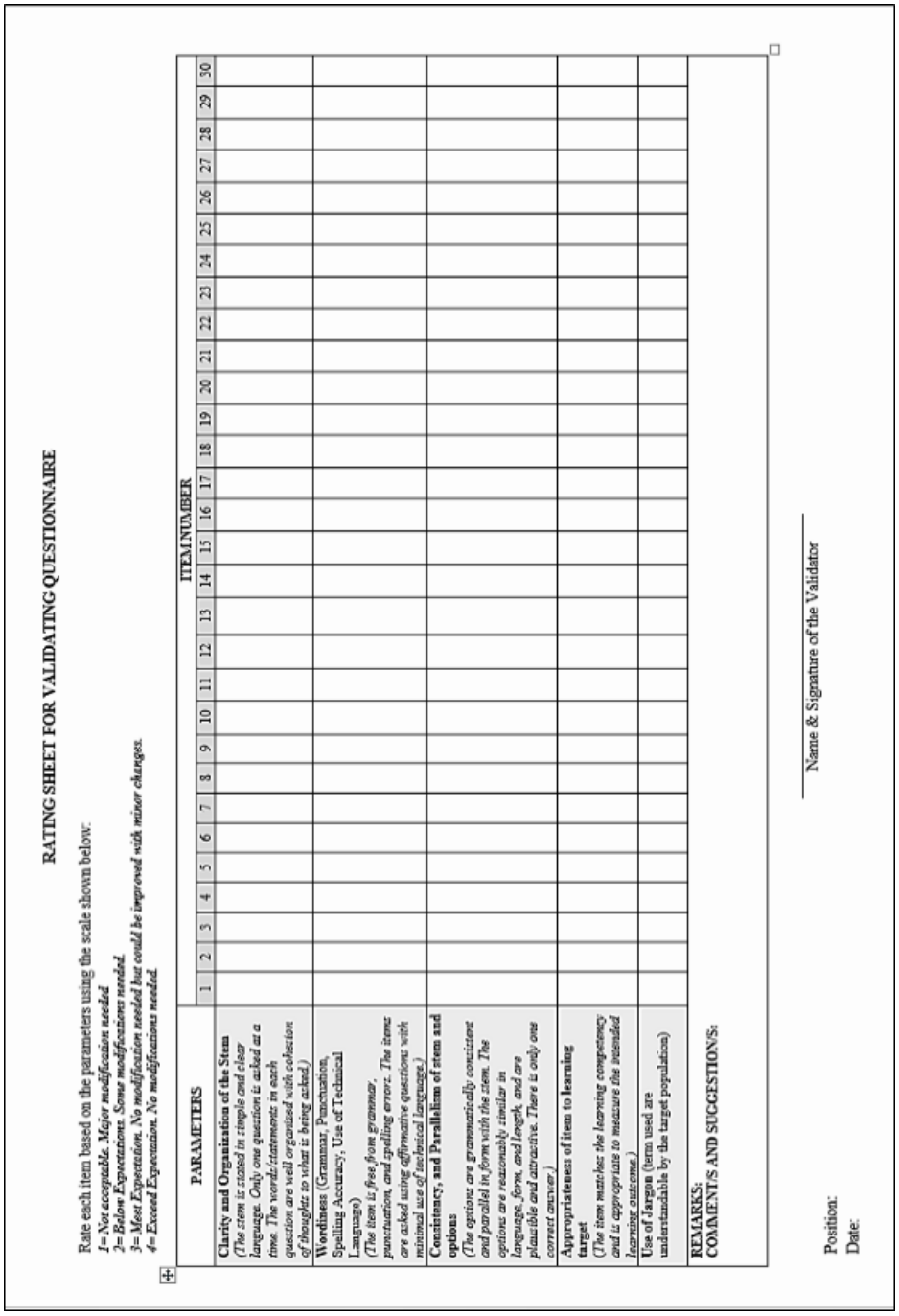
APPENDIX D

TABLE OF SPECIFICATIONS (TOS)

OBJECTIVES	NO. OF SESSIONS	LOWER-ORDER THINKING SKILLS (LOTS)			HIGHER-ORDER THINKING SKILLS (HOTS)			POINTS	%
		REMEBERING	UNDERSTANDING	APPLLYING	ANALYZING	EVALUATING	CREATING		
Describe the lifecycle of the parasitic worms responsible for schistosomiasis transmission.	2	1,2,5,6,7,8,11,13	3,4,9,10,12,14	15				15	50
Identify areas and communities most affected by the disease in the locality.	1	27,28,29	24	25,26	30			7	23.33
Recognize the experiences and challenges faced by individuals affected by schistosomiasis.	1		20,23	18,21	16,17,22	19		8	26.67
Total	4	LOTS: 25/30 = 83.33%			HOTS: 5/30 = 16.67%				
		11 = 44%	9 = 36%	5 = 20%	4 = 80%	1 = 20%	0	30	100

APPENDIX E

Rubric for Validating Questionnaire



RATING SHEET FOR VALIDATING QUESTIONNAIRE

Rate each item based on the parameters using the scale shown below:

1= Not acceptable. Major modification needed
2= Below Expectations. Some modifications needed.
3= Meet Expectation. No modification needed but could be improved with minor changes.
4= Exceed Expectation. No modifications needed.

PARAMETERS	ITEM NUMBER																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Clarity and Organization of the Stem *(The stem is stated in simple and clear language. Only one question is asked at a time. The words/statements in each question are well organised with cohesion of thoughts to what is being asked.)*																														
Wordiness (Grammar, Punctuation, Spelling Accuracy, Use of Technical Language) *(The item is free from grammar, punctuation, and spelling errors. The items are asked using affirmative questions with minimal use of technical language.)*																														
Consistency, and Parallelism of stem and options *(The options are grammatically consistent and parallel in form with the stem. The options are reasonably similar in language, form, and length, and are plausible and attractive. There is only one correct answer.)*																														
Appropriateness of item to learning target *(The item matches the learning competency and is appropriate to measure the intended learning outcome.)*																														
Use of Jargon (term used are understandable by the target population)																														
REMARKS: COMMENT/S AND SUGGESTION/S:																														

Name & Signature of the Validator

Position:
Date:

APPENDIX F

PRETEST AND POSTTEST SCORES (PILOT TEST)

Respondent's Code	Pretest Score	Posttest Score
CU-G12STEM1	21	25
CU-G12STEM2	21	24
CU-G12STEM3	21	25
CU-G12STEM4	21	23

CU-G12STEM5	21	22
CU-G12STEM6	21	24
CU-G12STEM7	20	23
CU-G12STEM8	20	24
CU-G12STEM9	19	22
CU-G12STEM10	20	23
CU-G12STEM11	18	21
CU-G12STEM12	18	23
CU-G12STEM13	16	20
CU-G12STEM14	17	20
CU-G12STEM15	16	19
CU-G12STEM16	15	18
CU-G12STEM17	14	18
CU-G12STEM18	16	19
CU-G12STEM19	14	18
CU-G12STEM20	17	22
CU-G12STEM21	16	20
CU-G12STEM22	15	19
CU-G12STEM23	15	18
CU-G12STEM24	15	18
CU-G12STEM25	19	23
CU-G12STEM26	14	17
CU-G12STEM27	14	18
CU-G12STEM28	14	19
CU-G12STEM29	13	16
CU-G12STEM30	14	17

APPENDIX F (Contd.)

Respondent's Code	Pretest Score	Posttest Score
CU-G12STEM31	14	18
CU-G12STEM32	14	19
CU-G12STEM33	12	16
CU-G12STEM34	11	15
CU-G12STEM35	12	17
CU-G12STEM36	12	16
CU-G12STEM37	11	15
CU-G12STEM38	12	18
CU-G12STEM39	9	14
CU-G12STEM40	11	16
CU-G12STEM41	8	14
CU-G12STEM42	11	16
CU-G12STEM43	9	16
CU-G12STEM44	7	16

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CU-G12STEM45	7	17
CU-G12STEM46	9	17
CU-G12STEM47	10	17
CU-G12STEM48	7	15
CU-G12STEM49	7	17
CU-G12STEM50	9	16
CU-G12STEM51	8	18
CU-G12STEM52	9	17
CU-G12STEM53	7	16
CU-G12STEM54	6	14
CU-G12STEM55	6	15