

Development of SSI-Based Learning Modules in the Functional Relationship of Animal Organ Systems

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ABSTRACT

This study aimed to develop SSI-based learning modules to improve the conceptual understanding of Grade 11 learners of the functional relationships among different organ systems in animal survival. The modified needs assessment questionnaires were assessed through the content, development, format, organization, structure, and grammar. Overall, the modified questionnaire earned excellent ratings in all areas. In addition, the validation process indicated that the evaluators did not require any revisions. The needs assessment was then conducted with the science teachers and revealed that teaching the functional relationships of the different organ systems is a very challenging topic to discuss, as it requires a foundation in the different organ systems. Teachers were familiar with contextualization and localization, but they lack knowledge of what SSI-based instruction is, and there is a need for training and seminars on both contextualization and SSI-based learning. The SSI-based module validation received an excellent rating and an overall validation result of 96.53% and was recommended by five (5) in-service teachers.

Keywords: biology education, needs assessment, SSI-based module

INTRODUCTION

Integrating real-life issues into the classroom has become essential in enhancing the students' understanding and engagement with the relevance of science in our daily lives. It helps learners connect the concepts to the situations and problems that they may encounter in the future. Socio-scientific issues (SSI) are controversial scientific topics that require the learners to be involved in dialogue, discussion, and debate that involve social, moral reasoning, and ethical considerations (Badeo & Duque, 2022). According to Magtibay et al. (2024), environmental issues were the most common SSI identified in the science course curriculum.

Global health issues are a universal concept that involves many factors such as cultural, economic, environmental, and social factors that focus on the health needs of people around the world (American University of the Caribbean School of Medicine, 2023). The UN's 2030 Agenda for Sustainable Development, adopted in 2015, is a global plan for peace and prosperity for people and the planet, with its core being the 17 Sustainable Development Goals (SDGs), a call to action for all countries (United Nations, n.d.). The relevant sustainable development goals included in the study are the following: Good Health and Well-being (SDG 3), Quality Education (SDG 4), Clean Water and Sanitation (SDG 6), and Climate Action (SDG 13). Good Health and Well-being focuses on ensuring a healthy being that relates to understanding the different organ systems of the body and some diseases that are associated with it. For the quality of education, it will enhance the learner's knowledge in animal physiology. Clean and water Sanitation highlights the importance of maintaining a healthy circulatory and excretory system and the impact of climate in relation to the environmental factors that affect the overall organ systems' health.

Despite the literature on SSI-based instruction, there remains a notable gap in its application, particularly within the Senior High School context in the Philippines. Moreover, learners often struggle to understand interrelated functions of organ systems. Bahri et. al (2021) observed that learners struggle to extract key concepts during lectures and have difficulty retaining the topic due to the complexity of human

organ systems. In addition to the conceptual understanding, the current level of the learners' decision-making skills remains at a developing stage, making teachers implement varied instructional strategies and teaching methods (Araya, 2024).

In summary, while there is existing research that highlights the significance of socio-scientific issues in science education, there are gaps in integrating health-related SSI's; while environmental SSIs are well present, there is a limited focus on health. Additionally, there is a lack of efficient teaching methods in teaching human anatomy and physiology since students struggle with the complex concepts, and teachers, though they showed interest and willingness to implement SSI, but struggle by a lack of training and materials. Given also the Philippines' low performance in science education, there is a need for further studies to develop SSI-based instructional material that can enhance the learners' understanding of the different organ systems. Furthermore, addressing these gaps will not only improve science education but also contribute to achieving the health and quality of education that is aligned to the Sustainable Development Goals (SDGs) of the United Nations (UN).

METHODOLOGY

This section describes the descriptive-correlational design, the participants, the research instruments, and the procedures used to collect and analyze quantitative and qualitative data.

Research Design and Participants

The development of the SSI-based module involves a panel of evaluators who validated the following instruments: the needs assessment questionnaire and the SSI-based module. The evaluators who validated the needs assessment questionnaire were purposively selected based on a specific criterion. Each evaluator has earned a master's or doctoral degree and has relevant teaching experience in teaching the subject area, specifically in the functional relationship between the different organ systems of the body. Then, the validated needs assessment questionnaire was answered by five science teachers, and the result serves as the basis for the design, development, and revision of the SSI-based module. The developed SSI-based module was then assessed and evaluated by another set of five science teachers who were handling the Grade 11 Earth and Life Science subject.

Instruments

- A needs assessment survey questionnaire for Science Teachers was adapted and modified from the study of Allonar et al., and Guiritan et al., 2023. The survey questionnaire that was utilized by the researcher was based on the work of Bontilao et al. (2021).
- Adapted a standardized rubric from the Department of Education, Guidelines and Processes for LRMDs Assessment and Evaluation (2009)- specifically the Evaluation Rating Sheet for Non-Print Materials.

RESULTS AND DISCUSSION

This section presents the findings on the needs assessment and module development of SSI-based module.

Development of SSI-based Module

The development of the module follows the Successive Approximation Model (SAM) the composed of three stages: Preparation Phase, Iterative Design Phase, and Iterative Development Phase.

Preparation Phase

The learning objectives were identified based on the MELCs in the Earth and Life Science Subject, results in PISA, and the needs assessment survey questionnaire provided the foundation for creating the module. This also ensured the alignment with the lesson in the Department of Education learners' grade level, performance standards, and content requirements.

Table 1. Selection of Topics in DepEd’s Most Essential Learning Competencies (MELCs) for the 2nd Quarter

Content Standard The learners demonstrate understanding of...	Performance Standard The learners should be able to...	Most Essential Learning Competencies	Duration and K to 12 CG Codes
1. nutrition: getting food to cells 2. gas exchange with the environment 3. circulation: the internal transport system 4. the need for homeostasis 5. salt and water balance and waste removal 6. the immune system: defense from disease 7. how hormones govern body activities 8. the nervous system 9. the body in motion	make a presentation of some diseases that are associated with the various organ systems	-Describe the general and unique characteristics of the different organ systems in representative animals -Analyze and appreciate the functional relationships of the different organ systems in ensuring animal survival	Week 5 S11/12LT-IIIaj- 22

The study utilized the objectives as seen in Table 1, which outlines the content standard, performance standard, most essential learning competencies, duration, and the K to 12 CG Codes. It focused particularly on the two most essential learning competencies: (1) “*describe the general and unique characteristics of the different organ systems in representative animals*” and (2) “*analyze and appreciate the functional relationships of the different organ systems in ensuring animal survival.*” With the help of the needs assessment result, the researcher can identify which of the two competencies requires the most emphasis.

Validation and Utilization of the Needs Assessment Survey Questionnaire

In addition to the Most Essential Learning Competencies (MELCs), the needs assessment survey questionnaire was also utilized in guiding the development of the module to identify learners’ needs, difficulties, and gaps in knowledge and skills of the teachers. For this study, the researcher adapted and modified the needs assessment survey questionnaire from the study of Allonar et al. and Guiritan et al. (2023).

Table 2. Needs Assessment Questionnaire Validation Results by Evaluators

Components	Mean	Description
Content and Development	3.37	Excellent
Format, Organization, and Structure	3.33	Excellent
Grammar	3.4	Excellent

Note: 3.25- 4.00 Excellent 1.75-2.49 Good

2.50- 3.24 Very Good 1.00- 1.74 Needs Improvement

Table 2 shows the evaluators' ratings of the adapted and modified needs assessment questionnaires. It was assessed through its content, development, format, organization, structure, and grammar. Overall, the modified questionnaire earned excellent ratings in all areas. In addition, the validation process indicated that the evaluators did not require any revisions.

Summary and Results from the Needs Assessment Interviews with Key Informants

The needs assessment interviews were used as one of the bases for conceptualizing the SSI-based module. The respondents were five (5) in-service teachers, and their participation served as the basis for the design, development, and revision of the module. They voluntarily participated and signed the consent forms.

The following tables: Table 3.3, 3.4, and 3.5 represent the informants' responses with three categories, namely the challenges, interventions, contextualization, and localization in teaching the functional relationship of the different organ systems in animal survival, and their responses about the SSI-based module, respectively.

Table 3. Summary of Key Informants' Response on Challenges and Interventions in Teaching Functional Relationships of Different Organ Systems in Animal Survival.

Themes	Code	Sample Responses
Misconceptions on Organ System Relationships	Difficulty understanding interconnected systems	"The learners are used to learn organ systems in isolation and not as interconnectedness of the function of the systems." STR1
Learning Gaps and Instructional Challenges among Learners	Weak prerequisite knowledge Lack of conceptual foundation	"Prior knowledge of the topic." STR1 "Knowledge gap." STR2
Complexity and Resource Challenges in Teaching Functional Relationships	Difficulty teaching abstract concepts Need for visual learning support Insufficient teaching resources	"It is hard because the topic is challenging to teach since it lacks practical applications." STR1 "Since they cannot visualize it." STR2
Innovative and Reinforcement-Based Teaching Strategies	Technology-assisted instruction Interactive learning approach	"I did look for online simulations that shows the connection of the different body systems." STR1 "Using models like human torso to help them engage with the topic." STR3

Table 3 presents the themes on the challenges and interventions the teachers experience in teaching different organ systems. These responses were divided into four (4) different themes that reflect the challenges of both teachers and learners about the topic.

One of the identified themes was the misconceptions about the organ relationship, which was vital in learning the complexity of the topic. The teacher emphasized that learners learn that the organ systems work separately and not as integrated systems. Learning human anatomy is challenging due to the large quantity of material, complex terms, and the overall processes, and varying difficulty levels among organ systems (Lieu et al., 2018). The themes that were also mentioned were the knowledge gap, as well as the complexity and the

resources of teaching the topic. The complexity of the topic makes it challenging for the learners to comprehend (Gregoric & Torkar, 2022).

The teachers address those difficulties that were mentioned in the innovative teaching strategies theme through utilizing online simulations and models, such as a human torso. Though learning anatomy is becoming more digital, no single digital tool works best for all areas of learning anatomy (Adnan & Xiao, 2023).

Table 4. Summary of Key Informants' Response on Contextualization and Localization in Teaching Functional Relationships of Different Organ Systems in Animal Survival.

Themes	Code	Sample Responses
Benefits of Contextualized and Learner-Centered Teaching	Learner-centered teaching	"Through giving examples and activities that are relatable to the learners that will make the lesson more engaging." STR1
	Active learner participation	"The learners were more engaged." STR2
	Enhanced classroom interaction	"A lot of them participate more." STR3
Importance of Contextualization in Enhancing Meaningful Learning	Improved concept acquisition	"It will then be easier for them to follow the concept." STR2
	Experiential learning	"They can use it through practical applications." STR3
	Learner motivation	"They will be more motivated to learn." STR5

Table 4 presents the summary of teachers' responses on contextualization and localization of the material. It revealed that teachers acknowledged the benefits and importance of contextualizing.

The theme identified was the benefits of contextualized and learner-centered teaching. According to the participants, giving real-life examples and activities that were relatable would result in a more engaging teaching and learning process. Another theme that emerged was the importance of contextualization in enhancing meaningful learning. The teachers emphasized that learners were able to apply the concepts to practical applications and were more motivated to learn. Localization and contextualization should be utilized in the teaching and learning process in all subject areas, as it has an impact on students' engagement, motivation, and attitude towards teaching (Bello et al., 2023).

Table 5. Summary of Key Informants' Response on the SSI-based Module

Themes	Code	Sample Responses
Limited Knowledge and Awareness of SSI-Based Instruction	Lack of SSI familiarity	"I cannot say yet since I don't really know this one." STR4

Limited Understanding of SSI	Limited awareness of SSI Limited awareness Absence of conceptual knowledge	“No idea.” STR5 “Haven’t heard yet.” STR3 “I don’t know.” STR4
Positive Perception and Emerging Acceptance of SSI-Based Instruction	Authentic and meaningful science learning	“It is a good strategy because it takes the ‘abstracts’ internal functions of an animal and connects them to real world, high stake scenarios.” STR1

Table 5 presents the theme regarding the teachers’ response to the SSI-based module. The findings highlighted three (3) main themes: limited knowledge and awareness of the SSI-based instruction, limited understanding of SSI, and positive perception and emerging acceptance of SSI-based instruction. SSI highlights the importance of addressing societal problems, but there are factors that need to be considered, such as the abstract nature of content, lack of awareness of what SSI is, and its need for appropriate teaching strategies (Purisima & Celedonio, 2024). Overall, the results implied that the awareness of what SSI-based instruction is currently limited, but it is evident that teachers have a positive outlook on the potential of SSI in enhancing the complex biological concepts.

Competency Mapping of the SSI-based Module

The first part of the needs assessment questionnaire is the teacher’s response to the learners’ difficulty among the two most essential learning competencies. The result can be found in Table 3.6 below.

Table 6. Summary of the Teachers’ Response to the Learners’ Difficulty among the identified MELCs

Competency	Frequency (n)	Percentage (%)	Comments/Remarks	Interpretation
A. Describe the general and unique characteristics of different organ systems in representative animals (S11/12LT-IIIaj-21)	0	0%	No responses indicating difficulty in this competency	Not identified as a major difficulty
B. Analyze and appreciate the functional relationships of the different organ systems in ensuring animal survival (S11/12LT-IIIaj-22)	5	100%	“The learners are used to learn organ systems in isolation and not as interconnectedness of the function of the systems.”	Identified as the most difficult competency due to learners’ misconception of organ systems being learned separately rather than as interconnected systems

Table 6 shows that all key informants (100%) identified competency B (Analyze and appreciate the functional relationships of the different organ systems in ensuring animal survival (S11/12LT-IIIaj-22) as the most difficult competency for the learners. Since the majority choose competency B, in line with this, competency B will be the basis for the development of the module.

The developed SSI-based module was divided into two lessons. The learning competencies were unpacked to make them more specific and organized, which also helps identify the specific concepts and skills necessary for the development of the module.

Table 7. Learning Competency Mapping and Learning Activities in the SSI-based Module

Learning Competency	Topic	Specific Learning Objectives	Activities
Describe the general and unique characteristics of the different organ systems in representative animals Analyze and appreciate the functional relationships of the different organ systems in ensuring animal survival.	Lesson 1 Functional Relationship of the Different Organ Systems in Maintaining Homeostasis	Identify the different functions of the organ systems. Explain how the different organ systems work together to maintain homeostasis.	• Getting to Know the Interactions of the Different Body Systems • Body System Buddies! • What's More: System Synergy! • Map it Out! • A Day in my Life with my Body Systems
	Lesson 2 How Socio-scientific Issues affects the Functional Relationship of the Different Organ Systems	Evaluate the impact of different human activities including pollution, climate change, deforestation, mining, teenage pregnancy, vaping/smoking and illegal use of drugs to the different systems of the body. Propose evidence-based solutions to mitigate the effects of environmental degradation to health using media and technology.	• Chain Reaction: Cause and Effect Relationship of Socio-scientific Issues on Organ Systems • News Flash: Body System at Risk! • My Lifestyle Choices and Health • Creating a Comic Strip

The mapping and unpacking of competencies according to the DepEd's Most Essential Learning Competencies, as seen in Table 7. The module is divided into two lessons and composed of different learning activities that are patterned to the DepEd's learning modules of Alternative Delivery Mode (ADM). These lessons were subdivided into different parts per lesson, namely: What I Need to Know, What's In, What's New,

What Is It, What's More, What I Have Learned, and What Can I Do. The module was also designed based on the SSI teaching and learning framework by Sadler et. al. (2017), which emphasizes interrelated elements to design an effective Socio-scientific issues (SSI) teaching. These elements were as follows: design elements, learner experience, classroom environment, and teacher attributes.

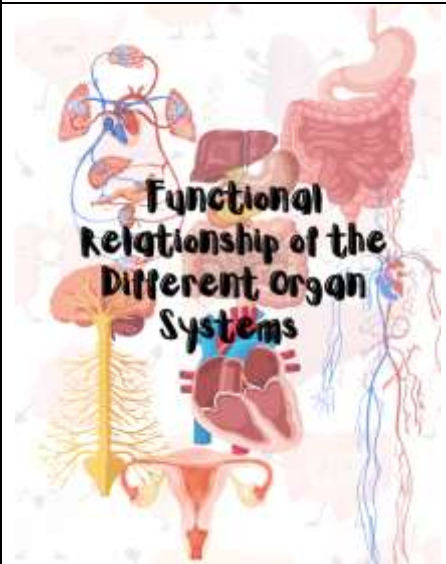
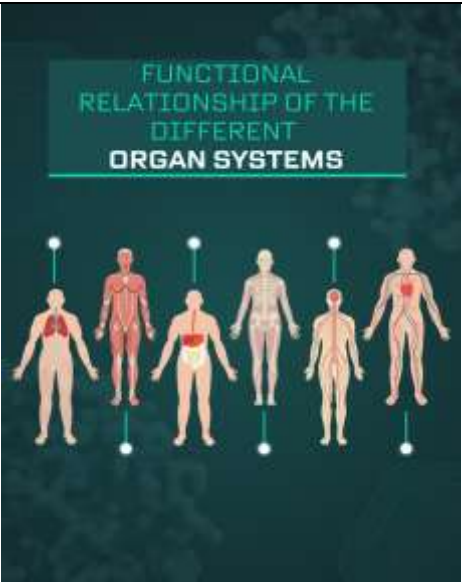
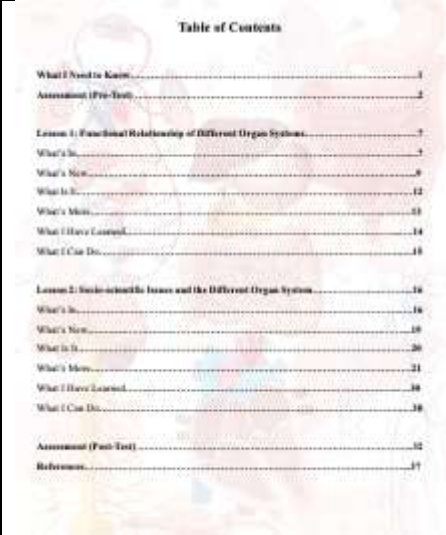
Iterative Design Phase

The second phase, the outline of the module, was developed based on the gathered data from the needs assessment and other factors mentioned. This outline was created and evaluated by panel members and five in-service teachers.

Revision of the SSI-based Module

The revision underwent was based on a face validation by the thesis advisers, a set of panel members, and in-service teachers. The comments and suggestions received were carefully considered to improve the developed module.

Table 8. Comments and Suggestions on the Developed SSI-based Module

BEFORE	Comments and Suggestions	After
	- Edit the cover page it's too crowded - Remove the watermark design in the inside pages	
	- Add a short introduction followed by the table of contents - Edit the font and font size	What This Module is About Introductory Message: Welcome to the Earth and Life Science module on functional relationships of the different organ systems in ensuring animal survival. To the teachers: This module was developed to assist the learners to meet the standard that was set by the K-12 Curriculum based on the most essential learning competencies. As a facilitator, you are expected to guide and give further instructions to the learners on how to do the activities in this module for them to easily understand the topic. To the parents: As parents, your support and guidance are needed by the learners to successfully accomplish this module. We encourage you to monitor your children's progress as he/she answers the activities in this module. To the learners: This module will keep you engage in a guided and independent learning activities. The activities are designed at your own pacing. This is designed based on accessibility and availability ensuring that you can accomplish the lessons. This module will help you to continue learning even without the face-to-face learning.

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Table 8 summarizes all the comments and suggestions of the advisers, panel members, and in-service teachers. It displays the revision done by the researchers in the first and last columns. Most of the suggestions were about the visual of the module, table, and format.

Table 9. SSI-based Module Summary of Evaluation per Factor

Factor	Percentage (%)	Interpretation	Remarks
Content	96.43%	Excellent	Passed
Format	94.17%	Very Good	Passed
Presentation and Organization	100.00%	Excellent	Passed
Accuracy and Up-to-datedness of Information	100.00%	Excellent	Passed
Overall Validation Result	96.53%	Excellent	Recommended

Table 9 presents a summary of ratings from the in-service teachers who rated the SSI-based module. The ratings were based on the criteria for evaluating the feasibility of a module based on a standardized rubric from the Department of Education, Guidelines and Processes for LRMDs Assessment and Evaluation (2009)-specifically the Evaluation Rating Sheet for Non-Print Materials. The developed module received an excellent rating and an overall validation result of 96.53% and was recommended by five (5) in-service teachers.

CONCLUSION

The needs assessment conducted with the science teachers revealed that teaching the functional relationships of the different organ systems is a very challenging topic to discuss, as it requires a foundation in the different organ systems. Teachers were familiar with contextualization and localization, but they lack knowledge of what SSI-based instruction is, and there is a need for training and seminars on both contextualization and SSI-based learning.

2. SSI-based module validation received an excellent rating and an overall validation result of 96.53% and was recommended by five (5) in-service teachers. Served as an important instrument in the study.

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