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# Disaster readiness and risk reduction management module using Kolb's model

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**ABSTRACT**

Disaster risk reduction and management (DRRM) as a course in basic education aims to raise the student's awareness of what to do before, during, and after a disaster using contextualized modules. The contextualization and validation of these modules considered legal bases and statutory standards in terms of learning competency, content, language, assessment, format, and technical specifications. The student's performance and end users' feedback and suggestions were used as bases for evaluating the developed modules. The descriptive method thru the instrumentation technique of research followed the process of module development from the planning phase to the evaluation stages as analysis, design, development, implementation, and evaluation (ADDIE) model while the module sections used the Kolb's model. The respondents were senior high school students in the Science curricular program of Echague National High School and Isabela State University, Isabela, Philippines. The findings showed a good agreement among experts' ratings and ascertained compliance with the learning resources guidelines of the Department of Education, Philippines. The student's performance on their post-test was significantly higher than their pre-test scores. The student's interests and learning engagement were very high as shown in their performance in activities and assessments. The contextualized DRRM modules are recommended for classroom use for on-site and distance learning modalities.



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## 1. INTRODUCTION

Natural disasters frequently follow natural hazards, and their severity is determined by the impact on society and the environment. Early planning and management of hazards can result in a safer community and environment. Consequently, the education sector plays an important role in preparing society for disasters and reducing the impact on humans and nature [1]. This includes a conceptual understanding of disaster readiness and risk reduction management (DRRM) as well as the practice of lowering disaster risks by systematically analyzing and reducing disaster-causing elements [2], [3]. Disciplines in disaster risk reduction include disaster preparedness, disaster management, and disaster mitigation [4]. Furthermore, disaster risk reduction is part of any country's long-term development goals [5], and as a global concern, the intergovernmental panel on climate change [6] encourages serious preparations as a result of climate change.

Being responsive to the needed preparations for the results of climate change, Philippine schools now teach DRRM [7] and one of the challenges in teaching DRRM subjects in the classroom setting is the

insufficient learning modules contextualized for each of the most essential learning competencies. Contextualized learning modules make learning effective since knowledge is taken from the context of experiences that unfold prior understanding of the learners [8], [9]. In this manner, teachers can better facilitate the recall of previous experiences related to learning and connect to learners' practical skills [10]. Such types of previous knowledge are needed now to have a link with the real world [11]. The kinds of disasters that normally happen in the region, as well as the consideration of the topography and geography of a place as compared with the other regions in the country, necessitates the creation of contextualized DRRM modules citing familiar events, places, and cultural beliefs, to make learning meaningful and effective [3].

The management of disasters and reduction of risks are global concerns, hence, the United Nations (UN) Resolution No. 46/182 issued during the 78th UN plenary meeting on December 19, 1991, recognized the need for a holistic framework in managing disasters encompassing prevention, and preparation for disaster risks including reduction and mitigation actions [11], [12]. On January 18-22, 2005, The Hyogo framework for action (HFA) during the world conference on disaster reduction in Kobe, Hyogo, Japan was adopted [13], [14]. Sustainable development goals (SDG) say it is time to rethink sustainable pathways for our planet [15]. In Vientiane, Lao people's democratic Republic, the agreement on disaster management and emergency response (AADMER) was signed by the foreign ministers and the Association of South-East Asian Nations (ASEAN) on July 26, 2005 [16] and was enforced on December 24, 2009. In the Philippines, the republic acts 9729 was passed by the 14th Philippine congress also known as the climate change act of 2009, the Philippine disaster risk reduction and management act (DRRM Act) of 2010 or the Republic Act 10121, in response to these global concerns. Accordingly, the UNESCO 2030 agenda for sustainable development goals address this problem by urging countries to get started on achieving these goals and targets [16]. The education sector has a big role in achieving some of these goals which are specifically identified as SDG number 4, quality education, and SDG13 on climate change [12]. These goals are expected to meet the requirements of individuals in both developed and developing countries, ensuring that no one is left behind on those target SDGs [17].

In the Philippines, different disasters are prominent such as typhoons, floods, landslides, earthquakes, thunderstorms, and fires [18]. The Philippine education sector has been mandated to take part in addressing these disasters as provided in Republic Act 10121 Sec. 14 (PDRRM Act of 2010) for Department of Education (DepEd), Commission on Higher Education (CHED), and the technical education and skills development authority (TESDA) to include disaster risk reduction and management (DRRM) integration in the school curriculum [19], [20]. In response, the Department of Education has designated DRRM education as a separate subject for senior high school learners [7]. Relative to the SDG in the education milieu, the researcher developed the contextualized DRRM modules using Kolb's model to make learning lifelong and useful for students [21], [22] amid the pandemic. Once they encounter disasters and are assumed responsive in understanding, students may be equipped to act corresponding to the four important phases of the DRRM subject such as preparedness, response to natural disasters, mitigation or disaster prevention, and recovery disaster rehabilitation recovery [23]. These four phases formed the core objectives to attain safety for Filipinos to be disaster-resistant, and adaptive communities working towards long-term development [5].

Consistent with the core objectives of the disaster risk reduction and management, the developed module used context-based learning experiences to enhance students' perception of the relevance of science learning for sustainable development [24]. The context-based learning experiences used in Science education require a paradigm shift toward the integration of realistic scenarios during a disaster in consideration of specific hazards in the locality which make learning more meaningful as proposed in Kolb's model as illustrated in the four-stage learning cycles: i) Concrete experience where the learner incorporates practical experiences; ii) Reflection and Observation allowing the learner to ponder on their newfound knowledge and apply them in investigations making use of use feelings, intuition, ideas, and options; iii) Abstract conceptualization making students analyze their introspection, observation then comes up with their analyzes, creating meaning from the experiences; and iv) Active experimentation which encourages students to put the findings to test in the future, preparing action and trying things out [25]. These four cycles work as a complementary process for knowledge creation. This learning process explains that when learners are intimately immersed in the learning process, they learn more effectively [26], [27]. If knowledge is to have any significance for the individual or make a difference in their conduct, it must be found by them. Hence, a person's dedication to learning is higher when they have the freedom to define their own learning goals and may actively pursue them with pre-conceived frameworks [23]. Thus, Kolb's model promotes a context-based learning approach that complements learner experiences in the four learning cycles as shown in Figure 1 making the teaching of DRRM lessons [23] develop learners' functional understanding of disasters and how to mitigate their effects [28]–[32].

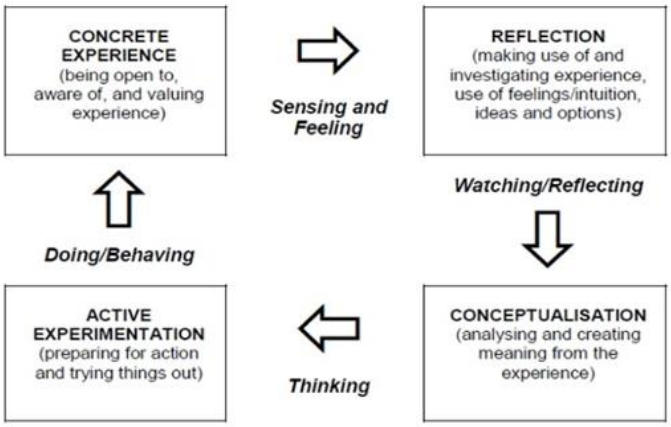


Figure 1. Four learning cycles of Kolb's model

## 2. RESEARCH METHOD

The descriptive method of research was utilized through the instrumentation technique of ADDIE model covering five phases which are analysis, design, development, implementation, and evaluation. The first phase was analysis which consisted of the selection of the content of learning modules based on most essential learning competencies (MELCS) and topics. Second, the design phase focused on the designing of DRRM modules based on Kolb's four learning cycles. The third phase was the development phase which consisted of writing, proofreading, editing, and printing of the learning modules, this phase also included the first revision of learning modules based on comments and suggestions of the adviser and the experts. The fourth was the implementation phase which consisted of the first pilot testing of modules, the second revision based on the first pilot testing, proofreading, editing, and printing, and the final revision of learning modules. The last phase of ADDIE instrumentation was the evaluation phase which involved the assessment of the learning modules based on the performance of the students and the feedback/suggestions of end users.

## 3. RESULTS AND DISCUSSION

The contextualized DRRM modules were developed to respond to the context of the locality and to the demands of the times in preparing learners to gain a relevant and functional understanding of disasters. The Kolb's model that employed learning experiences made learning context-based to truly enhance the development of goal setting for learning and knowledge formation along the four learning cycles. The identification of hazards specific to a place in an event of a disaster made the modules appeal to the attention of the learners because of the realistic scenarios that students can relate to effectively. This innovative approach to DRRM corroborates the findings of previous studies that proved experiential learning is the best for students to learn [33].

### 3.1. The contextualized DRRM modules using Kolb's model

The four learning cycles of Kolb's model suitably matched the learning patterns of instilling experience-based responses in the event of disasters as individuals normally respond to catastrophic situations based on prior experiences or exposures. This knowledge formation can be described in four stages, first, concrete experience, which is when the learners retrieve practical experience or practical exposure, second is reflection and observation, the learners ponder on their newly found knowledge connected with the experience, third, conceptualization, the learners analyze their introspection and observation then comes up with their findings or understanding, and last, active experimentation, the students will put these findings to test in the future. These four stages or cycles can be best described according to Kolb saying, "Learning is a process by which knowledge is formed via the transformation of experience." Whenever students apply the four cycles, learning will be achieved, and this could happen when they are intimately immersed in the learning process triggered by experiences or exposures to the familiar context of the situation, thus, they learn more effectively which could imply that individuals must discover knowledge based on context and experiences to have significance to them and their behavior. This knowledge formation also leads to a person's dedication to learning which becomes higher when he/she has the freedom to define his/her own learning goals and may actively pursue them with given frameworks [23].

### 3.2. Validation by experts' evaluation of the quality of DRRM module based on Kolb's model

The expert evaluators represented by the specialists in the discipline and authorities mandated to evaluate instructional materials made use of the criteria in evaluating teacher-made learning resources for use by the department of education (DepEd) region 02. As shown in Table 1, the average rating of 96.55% represents the high acceptability of the expert evaluators on the developed modules following Kolb's model. The agreement on all seven factors as learning competency, content, language, social content, assessment, format and technical specifications, and intellectual property rights as rated by the experts refer to the compliance to the standards of the department of education on learning resource development. These results are consistent with the student's satisfaction based on the content, format, and style of modules [34]. Modules earning a "passed" decision by the experts on all factors imply the favorable recommendation for approval to use in the basic education for public senior high schools in the region.

Table 1. Experts rating on the quality of module based on Kolb's model

| Factor | Sub-areas | Rating | Remark |
|---|---|---|---|
| Learning competency | Targeted DepEd learning competencies | 94.44 | Passed |
| | Achievement of the competency in the grade level | 94.44 | Passed |
| Content | Develops higher cognitive skills | 94.44 | Passed |
| | Is suited to the learners' level of development | 94.44 | Passed |
| | Reinforces, enriches, and/or leads to the mastery | 83.33 | Passed |
| | Logically developed and organized | 88.89 | Passed |
| | Provides motivational strategies | 94.44 | Passed |
| | Presents lessons that are clear to the target user | 94.44 | Passed |
| | Utilizes a variety of activities | 94.44 | Passed |
| | Is accurate and up to date | 88.89 | Passed |
| | Is free from computational errors | 94.44 | Passed |
| | Arouses interest of target learner/reader | 88.89 | Passed |
| Language | Is free from grammatical errors | 100.00 | Passed |
| | Adapts the level of target users | 100.00 | Passed |
| | Is engaging, interesting, and understandable | 100.00 | Passed |
| | Is logical and has a smooth flow of ideas | 94.44 | Passed |
| | Is suited to the level of the learner | 94.44 | Passed |
| | Introduces varied structures to the target reader | 94.44 | Passed |
| | Presents consistently good use of transition devices | 100.00 | Passed |
| Social content | Enhances the desirable values and traits | 100.00 | Passed |
| | Recognizes the different social institutions | 100.00 | Passed |
| | Portrays gender and sexual diversity | 94.44 | Passed |
| | Demonstrates the use of different forms of media and technology | 100.00 | Passed |
| | Provides adequate warning/cautionary notes | 94.44 | Passed |
| | Portrays efforts to protect the environment | 100.00 | Passed |
| Assessment | Is aligned with the specific objectives and contents | 94.44 | Passed |
| | Evaluate the learners' progress in mastering the target competencies | 100.00 | Passed |
| | Provides a variety of assessment types | 100.00 | Passed |
| Format and technical specifications | Prints: font style and size, spaces, printing quality | 100.00 | Passed |
| | Illustrations: simple, recognizable, and culturally relevant | 100.00 | Passed |
| | Design and layout: attractive and pleasing | 100.00 | Passed |
| | Paper and binding | 100.00 | Passed |
| | Size and weight of learning | 100.00 | Passed |
| Intellectual property rights | Originality of the work | 100.00 | Passed |
| | Copyright material information is properly cited | 100.00 | Passed |
| | All sources are properly acknowledged and verified | 100.00 | Passed |
| | The redesign and development are without infringement/offense from the original copyright | 100.00 | Passed |
| | Average | 96.55 | Passed |

(Evaluation tool-DepEd RO2 developed learning resources instrument)

### 3.3. Validation based on students' performance in the pre-and post-test

In the pilot testing and actual try-out of the developed contextualized DRRM modules based on Kolb's model, the post-test scores in all modules were significantly higher than the pretest scores as shown in Table 2 which means that students' performance was improved, and the modules were effective in instilling an experience-based conceptual understanding of the disaster risk reduction and management. The results indicating a probability value at p=0.001 imply a very high significant change in the performance of the students exposed to the DRRM modules. This result is supported by the study proving that experiential learning increases the academic performance and motivations of students [35].

Table 2. Descriptive and inferential statistics of the mean difference between the pre-and post-test scores of students involved in the try-out

| | Pretest | | Post-test | | Test of difference | | |
|---|---|---|---|---|---|---|---|
| | M[a] | SD | M[a] | SD | t[b] | p[b] | d |
| | | | Pilot-test | | | | |
| Module 1 | 6.75 | 2.03 | 9.42 | 1.44 | −6.91 | .001* | 1.20[L] |
| Module 2 | 6.67 | 1.79 | 8.83 | 1.36 | −6.91 | .001* | 1.10[L] |
| Module 3 | 8.19 | 2.04 | 9.92 | 0.37 | −4.82 | .001* | 0.81[L] |
| Module 4 | 7.14 | 1.38 | 9.06 | 1.29 | −6.64 | .001* | 1.12[L] |
| Module 5 | 7.69 | 1.22 | 9.56 | 0.94 | −7.60 | .001* | 1.21[L] |
| Overall | 7.29 | 1.80 | 9.36 | 1.20 | −14.41 | .001* | 1.07[L] |
| | | | Study proper | | | | |
| Module 1 | 7.10 | 1.22 | 9.23 | 1.31 | −8.75 | .001* | 1.54[L] |
| Module 2 | 7.10 | 0.87 | 9.16 | 1.53 | −7.68 | .001* | 1.35[L] |
| Module 3 | 7.74 | 1.29 | 9.87 | 0.43 | −7.59 | .001* | 1.38[L] |
| Module 4 | 7.71 | 1.16 | 9.58 | 1.09 | −8.76 | .001* | 1.52[L] |
| Module 5 | 8.10 | 1.27 | 10.00 | 0.00 | −8.30 | .001* | 1.52[L] |
| Overall | 7.55 | 1.22 | 9.57 | 1.08 | −18.66 | .001* | 1.46[L] |

Note: a-Highest possible score=10; b-Based on 1000 bootstrap samples
*Significant; L=Large difference

### 3.4. Students' evaluation of the DRRM modules

Table 3 shows a summary of students' evaluation of DRRM modules. The students from both groups identified as the pilot test participants (M is equal to 3.80, SD is equal to 0.33), and the final try-out participants (M is equal to 3.82, SD is equal to 0.37) gave very high ratings described as SA-strongly agree on the set criteria. The students' ratings with very small variance (SD) also tell the closeness or similarity of scores of the student raters upon the given criteria for evaluation. Overall, the end user's feedback strongly agrees on the objective, content, clarity, presentation, and relevance of learning modules implying that the developed DRRM modules based on Kolb's model befittingly respond to the learning needs of the students.

Table 3. Descriptive statistics of students' evaluation of the DRRM modules

| | Objective and content | | Clarity | | Presentation | | Relevance of the modules | | Overall evaluation | |
|---|---|---|---|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD | M | SD | M | SD |
| | | | | | Pilot-test | | | | | |
| Module 1 | 3.79[SA] | 0.30 | 3.74[SA] | 0.34 | 3.69[SA] | 0.39 | 3.62[SA] | 0.47 | 3.71[SA] | 0.34 |
| Module 2 | 3.78[SA] | 0.37 | 3.76[SA] | 0.39 | 3.81[SA] | 0.32 | 3.73[SA] | 0.49 | 3.77[SA] | 0.36 |
| Module 3 | 3.92[SA] | 0.26 | 3.93[SA] | 0.23 | 3.93[SA] | 0.25 | 3.89[SA] | 0.38 | 3.92[SA] | 0.27 |
| Module 4 | 3.76[SA] | 0.35 | 3.72[SA] | 0.39 | 3.76[SA] | 0.39 | 3.71[SA] | 0.45 | 3.74[SA] | 0.37 |
| Module 5 | 3.91[SA] | 0.23 | 3.87[SA] | 0.28 | 3.87[SA] | 0.27 | 3.86[SA] | 0.32 | 3.88[SA] | 0.25 |
| Overall | 3.83[SA] | 0.31 | 3.81[SA] | 0.34 | 3.81[SA] | 0.34 | 3.76[SA] | 0.43 | 3.80[SA] | 0.33 |
| | | | | | Final try-out | | | | | |
| Module 1 | 3.72[SA] | 0.47 | 3.75[SA] | 0.42 | 3.77[SA] | 0.48 | 3.64[SA] | 0.48 | 3.72[SA] | 0.43 |
| Module 2 | 3.75[SA] | 0.44 | 3.75[SA] | 0.41 | 3.78[SA] | 0.39 | 3.72[SA] | 0.51 | 3.75[SA] | 0.43 |
| Module 3 | 3.91[SA] | 0.26 | 3.88[SA] | 0.31 | 3.91[SA] | 0.27 | 3.89[SA] | 0.28 | 3.90[SA] | 0.27 |
| Module 4 | 3.89[SA] | 0.29 | 3.89[SA] | 0.29 | 3.90[SA] | 0.29 | 3.89[SA] | 0.31 | 3.90[SA] | 0.29 |
| Module 5 | 3.85[SA] | 0.37 | 3.85[SA] | 0.33 | 3.85[SA] | 0.37 | 3.82[SA] | 0.43 | 3.84[SA] | 0.37 |
| Overall | 3.83[SA] | 0.38 | 3.83[SA] | 0.36 | 3.84[SA] | 0.37 | 3.79[SA] | 0.42 | 3.82[SA] | 0.37 |

SA=Strongly agree

## 4. CONCLUSION

The developed modules in teaching DRRM using Kolb's model in the learning stages were suitable for presenting contextualized lessons in disaster risk reduction and management. The learning scenarios and activities that match with the stages of Kolb's model as concrete experience, reflection, conceptualization, and active experimentation support the improvement of student's performance on the learning competencies prescribed by the department of education. The learning modules evaluated by the experts using the evaluation tool for DepEd region 02 on developed learning resources in terms of learning competency, content, language, social content, assessment, format and technical specifications, and intellectual property rights prove the validity for use in delivery of the DRRM course among senior high school students in public schools. It can also be inferred that the developed contextualized DRRM modules using Kolb's model were compliant with the standards of the Philippine DepEd region 02 on specified guidelines of developed learning resources. Additionally, the developed and validated contextualized DRRM modules using Kolb's model are suitable to use as the main instructional material in achieving the most essential learning competencies in DRRM for the senior high school students in the STEM strand as they strongly support

students' performance and end users' feedback. Finally, contextualized DRRM modules can greatly facilitate conceptual understanding and skills-based response management of disasters.

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