

Acceptability and efficacy of IEC materials integrated with CCA and DRR concepts in science teaching

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Abstract - The study determined the acceptability and efficacy of the IEC Materials integrated with CCA and DRR concepts in science teaching. It determined whether the material is acceptable to the expected users as well as effective in improving CCA and DRR concept of teacher and student respondents.

Acceptability of the IEC material in teaching and in integrating CCA and DRR concepts was determined by submitting it for evaluation by the expected users guided by a researcher made evaluation instrument. Efficacy was measured by the change in the level of awareness and development of attitudes among the respondents. Level of awareness was determined using a survey instrument administered before and after the intervention. Development of attitude was assessed by requiring an essay expressing knowledge and concern on the climate change issue.

Results indicated acceptability of all the modules to the users. It was likewise found to promote awareness and development of attitudes on CCA and DRR among the respondent teachers and students. The IEC materials are acceptable to the users and can effectively serve as a tool in integrating CCA and DRR concepts in science teaching.

Index Terms: CCA and DRR Concept Integration; IEC materials; Science teaching

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INTRODUCTION

Climate change is widely regarded as one of the most serious challenges the world faces with consequences that go far beyond the effects on the environment. Natural disasters are becoming more frequent, deadly and costly [1]. Within the period of 1900-2010, there have been a five-fold increase in the number of natural disasters reported, taking its peak within the 2000-2010 period [2].

Schools play a major role in the education of tomorrow's decision makers. The education sector is an opportunity and arm in solving societal problems like those that concerns the environment. How people are educated and the content of education provides the knowledge and skills needed to make informed decisions [3] on how to adapt individual lives, as well as ecological, social, and economic systems in a changing environment.

The Hyogo Framework for Action 2005-2015 is all about building the resilience of nations and communities to disasters [4]. It stipulated a) the integration of disaster risk reduction into sustainable development policies and planning; b) development and strengthening of institutions, mechanisms and capacities to build resilience to hazards; and c) systematic incorporation of risk reduction approaches into the implementation of response and

recovery programs. The education sector may be tapped as key player in the implementation of the Hyogo Framework for Action.

Climate change education will not only empower citizens to tackle future challenges, including climate change adaptation and disaster risk reduction, but it will also ultimately empower citizens to achieve climate-resilient sustainable development [5].

Use of knowledge, innovation and education to build a culture of safety and resilience at all levels was one among the priorities for action in the Hyogo Framework for Action 2005-2015[4]. It recognizes the important role of the education sector in the promotion of the culture of safety and resilience. Helping students understand climate change, its impacts and its solutions prepares them to take an active role in making good choices for both society and the environment. Making disaster risk reduction education part of the education curricula fosters awareness and better understanding of the immediate environment in which the students and their families live. Their awareness empowers the learners to take actions that reduce their vulnerability and turn them from disaster victims into agents of behavioral change.

One of the important concerns in education is the development of tools for meaningful learning

[6]. Mr. Gilbert Forbes of the Department of Education recognizes the need to develop instructional materials particularly on the core subjects. He pointed out that teachers must be trained and be given financial support in the development of more instructional materials such as modules, standardized tests, textbooks and others [7]. These materials will ease the work of a teacher and will consequently serve as means to improve the quality of education we are offering to our students. Ideal teaching learning process is considered interactive when learner, teacher and instructional materials interact with one another [8]. Instructional materials are necessary to facilitate understanding of concepts.

Modular instruction is one teaching modality used by many educators to ensure teaching-learning success [9] [10][11] [12]. With module as the guide in instruction, the teacher can effectively promote individualized learning. With students allowed to learn at their own pace, success of instructional delivery is attained.

With concept of modular instruction, and the most pressing societal concerns on climate change, the researcher developed learning module in teaching selected General Education Courses (GEC) for tertiary education integrated with climate change adaptation (CCA) and disaster risk reduction concepts (DRR). The learning module was perceived to be a tool in mainstreaming CCA and DRR concepts in school curriculum. Determination of the acceptability and effectiveness of developed IEC materials integrated with CCA and DRR concepts needs to be established, thus this study.

METHODOLOGY

Descriptive-evaluative method was used in the study. It involved description of the status of the respondents as regards to their awareness and attitude towards the current climate change concerns particularly on CCA and DRR, and development of modules integrated with CCA and DRR to be used in mainstreaming it in teaching. Evaluation of the developed tool was conducted to establish its acceptability and effectiveness.

Development and Experts Evaluation.

The development of the IEC materials included conduct of a Training-Workshop on Module Writing with integration of CCA and DRR participated by science teachers from selected State Colleges and Universities (SUC's) in the Bicol Region to a) develop learning modules for specific topic in various learning areas in science; b) oral evaluation of the developed modules by experts together with the participants which was done after the workshop on module development. Participants were required to present their output for oral evaluation involving the expert/speakers and other participants for further improvement of the developed module.

Validation.

This process looked into the jurors' evaluation of the IEC materials and its acceptability to the expected users. It likewise involved determination of its effectiveness in improving level of awareness of the teacher and student respondents.

Quality and acceptability of the module as an instructional material in teaching and in integrating CCA and DRR was determined by submitting it for evaluation by the expected users. A researcher made evaluation instrument was used for this purpose.

Level of Awareness of the respondents on CCA and DRR before and after the intervention was determined using a survey instrument. Development of attitude towards CCA and DRR on the other hand, were assessed by requiring them to submit an essay expressing their knowledge and concern on the climate change issue as well as their plan of action. A rubric with a scale of 1 to 3 corresponding to receiving, responding and acting respectively, was used to evaluate the essays.

Respondents and Sampling Design

There were two groups of respondent in the study. The first group was the expected users of the module requested to evaluate its acceptability. They were teachers knowledgeable both in content and module development. There were a total of fifteen

(15) jurors who evaluated the IEC materials. The second group was composed of students in a try-out class. They were used in the pilot testing of the module.

Data Gathering Procedure

At the start of the study a survey questionnaire on the level of knowledge was given as pretest, the same test was used at the end of the experiment duration as post-test. Scores of respondents in the tests were taken as raw data that were organized and analyzed as bases of students' level of awareness on CCA and DRR concepts after the try-out.

A Juror's Evaluation Instrument (JEI)[13] was likewise used in gathering data in the validation of the IEC Materials particularly to determine the acceptability and content validity of the modules.

The required essay was evaluated using a rubric[14] based on the Krathwohl's Taxonomy of Affective Domains to categorize the attitudes developed on the students after the modular instruction with Climate Change Adaptation CCA and Disaster Risk Reduction DRR concepts integration.

Research Instrument

There were two (2) research instruments used in the study. One was the survey questionnaire on the level of knowledge, reflecting a list of CCA and DRR concepts, requiring the respondents to check their level knowledge on specified concepts at the time of the survey. The second instrument was a Juror's Evaluation Instrument (JEI) consist of two (2) major component such as the content and technical aspects. Content component was used in evaluating and verifying correctness of concepts discussed in the IEC Materials while the technical aspect pertains to the general format and aesthetics of the material.

Statistical Treatment

The statistical method used in the treatment of data was the mean to describe the results of the

survey on the level of knowledge and development of attitudes.

RESULTS AND DISCUSSION

This section presents the discussions which were focused on a) the IEC materials evaluated and its Features; b) evaluation of the acceptability of the IEC material by experts and users; and d) effectiveness of the material in enhancing level of awareness, attitudes and preparedness of the respondents/users.

The IEC Materials Developed and Evaluated

Modular instruction is one mode of teaching that is gaining popularity [15] among teachers and students because it promotes individualized instruction that allows learning at one's own convenient time [16]. It is an effective and efficient tool to help students learn and considered as a modern approach of development [17] [18].

The instructional material developed in this study is a compilation of learning modules on chosen topics in selected science subjects. Each learning module contains the basic part such as introduction; objectives; flow of instruction; pre-test; learning activities and exercises; discussion of concepts covered; integration of climate change adaptation and disaster risk reduction concepts; post-test; suggested readings; glossary of important terms and references.

The *introduction* describes what the module is about. It specifies the level and the kind of students for which it is directed as well as the topic to be covered. The *objectives* introduces the expected outcomes or learning behavior that will take place after completing the modular instruction. It likewise specifies the competencies that will be learned. *Flow of instruction* reflects the contents and the sequencing of the presentation. *Pretest and posttest* intends to measure the learning outcomes as a result of the instructional task. The *activities and exercises* were provided for concept learning. *Glossary* provides definition of key terms for

comprehension. *List of references* will lead users to the source of data and information for verification.

The integration of CCA and DRR concepts in the learning modules is an important feature of the instructional material, it's the feature that makes the material unique. Box 1 presents a sample CCA DRR concept integration.



Box 1: A Sample CCA and DRR concept Integration

Let's Think About This

Acting on the issue: Climate change adaptation

Adaptation has been defined in different ways.

- actions taken to help communities and ecosystems cope with changing climate condition.
- describes it as adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.
- calls it a process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, and implemented.
- defines it as the process or outcome of a process that leads to a reduction in harm or risk of harm, or realization of benefits associated with climate variability and climate change.
- regards it as consisting of actions undertaken to reduce the adverse consequences of climate change, as well as to harness any beneficial opportunities.
- adapting to climate change is about taking deliberate and considered actions to avoid, manage or reduce the consequences of a hotter, drier and more extreme climate and to take advantage of the opportunities that such changes may generate.

Climate change impacts, like stronger and more frequent typhoons, increase natural hazards in many areas in the Philippines—places that are already prone to disasters because the country is a typhoon path and is located in the earthquake and volcanic belt. With the increasing vulnerability of many communities, the need for disaster risk reduction (DRR) and climate change adaptation (CCA) has become more urgent. These two (DRR and CCA) are complementary approaches that can be integrated to achieve the ultimate aim of development work—poverty reduction.

Climate change-ready rice

Planting high-yielding and stress-tolerant varieties suitable to the area is the frontline defense against climate

change. The following rice varieties developed by IRRI (International Rice Research Institute) can withstand conditions forecast to become more frequent and intense with climate change. This includes drought, flood, heat, cold, and soil problems like high salt and iron toxicity.

Environmental stresses constrain rice production, affecting about 30% of the 700 million poor in Asia alone who live in rain fed rice-growing areas. These stresses can be caused by extreme climatic changes like drought, flooding, or rising sea levels. While some can be inherent like high iron toxicity in the soil. Our breeding programs aim to develop rice types that can survive in these harsh environments.

Along with improved crop management, proper use of technology through extension work and the support of national institutions, these improved varieties or “climate change-ready rice” are showing substantial, positive impacts in the lives of poor farmers.

A. Drought-tolerant Rice

Drought is the most widespread and damaging of all environmental stresses, affecting 23 million hectares of rainfed rice in South and Southeast Asia. IRRI has developed drought-tolerant varieties which have been released in several countries and are now being planted by farmers.

IRRI scientists have identified several key regions of the rice genome—called quantitative trait loci (QTLs)—that give the rice drought tolerance and improve rice grain yield under such conditions. IRRI is working towards introducing drought tolerance into popular high-yielding rice varieties including IR64, Swarna, and Vandna. They are also studying what the molecular and physiological processes that these drought-tolerant QTL provide to get a better insight into this complex trait.



B. Submergence-tolerant Rice

Submergence can affect rice crops at any stage of growth, either short-term (flash floods) or long-term (stagnant flooding). The chances of survival are extremely low when completely submerged during the crop's vegetative

stage. In 2006, the Philippines lost harvests worth \$65 million to floods.

During flooding, the rice plant elongates its leaves and stems to escape submergence. Deepwater rice varieties are able to do this rapidly enough to survive. High-yielding modern varieties cannot elongate enough. If floods last for more than a few days, the rice plants expend so much energy trying unsuccessfully to escape that they are unable to recover



Plant breeders have discovered that a single gene, the SUB1 gene, confers resistance to submergence of up to 14 days. Scientists were able to isolate the SUB1A gene, derived from an Indian rice variety, and identify the genetic code that controls submergence tolerance. The SUB1A gene activates when the plant is submerged, making it dormant and conserves its energy until the floodwater recedes.

Improved varieties incorporated with the SUB1 gene have shown a yield advantage of 1–3 tons following flooding for 10–15 days. Flood-tolerant varieties that have been released and are now being planted include Swarna Sub1 in India, Samba Mahsuri in Bangladesh, and IR64-Sub1 in the Philippines.

C. Cold-tolerant Rice

Frequently occurring low temperature causes more than 50% yield loss. Diseases such as blast and sheath brown rot adds to the damage especially when it attacks at the plant's early vegetative stage.

Cold tolerance is a complex trait controlled by many genes. IRRI scientists have identified three regions of the rice genome that have a direct link to cold tolerance at the plant's reproductive stage.



Using this line, IRRI crossed cold-tolerant and cold-sensitive rice lines and evaluated the progeny under two separate stress conditions – cold water in the field and cool air temperature in the greenhouse. After the experiment, they selected some promising cold tolerant lines that also have desirable spikelet fertility and early maturity traits.

D. Heat-tolerant Rice

Global warming has a significant effect on rice production. Though rice originates from the tropics, high temperatures of more than 35 °C during the reproductive stages reduces rice production, especially when the rice plant flowers when the high temperature occurs because it causes



low seed setting and low yield. Higher night temperatures during the ripening stage also decrease rice yield and grain quality. Further, even at the vegetative growth stage, heat stress can cause leaf yellowing and accelerated development, leading to low yield potential in sensitive rice varieties.

Rice plants are most sensitive at the flowering and ripening stages. Both yield and grain quality are adversely affected. IRRI scientists are looking for rice that can tolerate high temperatures by screening improved and traditional rice varieties. These donors are used in a crossing program to incorporate tolerance of high temperature into elite rice lines that are then tested for heat tolerance in 'hot and dry' and 'hot and humid' countries.

Another mechanism for rice heat tolerance is early-morning flowering, which escapes the high temperature at

midday. It was found that *O. glaberrima*, a wild species of rice, is a useful genetic source since it has a habit of early-morning flowering and high transpiration with sufficient water, both of which are convenient traits for avoiding heat stress. IRRI scientists are looking into the causes of this useful trait through physiological and genetic studies.

The sample CCA and DRR concepts integration in box 1 showed the integration of the concepts in teaching the structure and function of the DNA (Deoxyribonucleic Acid), a topic being discussed in Biology subject. The application of the concept discussed in class to climate change adaptation is clearly manifested in the integration presented. It showed greater possibility of the academe to take part in promoting CCA and DRR awareness.

Teachers' competence in teaching and in developing instructional materials that can aid in teaching can effectively be utilized in promoting CCA and DRR awareness. Instructional materials development, like the module produced in this study is a sure step of mainstreaming CCA and DRR in school curriculum. A ready available guide such as a teaching module with CCA and DRR concept integration can motivate teachers and other educators to integrate the concepts in their teaching because the module will make the task easy [11] [12] [15] [17] [18].

The CCA and DRR concepts integration in the different subject areas of science were varied. Each developer had his/her own style of integration but is noted to be dependent on the kind of topic being discussed. The integration was often done in the application part of the lesson. It leads learners to connect concepts presented in class to the issues or problems faced in the real world.

Education is at the very core of basic issues that confront human society [19]. It plays an important role in all societal concerns and thus greatly affects our future. Educators have a responsibility to contribute to the difficult but necessary effort of developing philosophy of education suited to our needs but at the same time worthy of the broad purposes of human development. One way to resolve this concern is to adopt teaching approaches and develop instructional materials that continuously evolved and respond to

the needs of the changing times. These approaches and instructional materials must be able to provide quality instruction and also address global problems. The school and its curricula can be a powerful tool in promoting environmental safety. Climate change adaptation and disaster risk reduction concepts integration in teaching was found very possible by this study and can be implemented not only in teaching science subjects but also in teaching other fields of specialization.

Instructional materials are indispensable tools in teaching [19]. It is used in support of the curriculum as valuable resources to promote student learning and quality teaching. Learning of CCA and DRR concepts can surely take place if the teacher will integrate it in teaching because instructional materials influence student achievement. It was found to provide the physical media through which the intent of the curriculum are experienced [21]. Chemistry is one subject where CCA and DRR concept has been successfully integrated through Computer Assisted Instruction [14]. It only need teacher's creativity to come up with an appropriate mode of integration. The learning modules with CCA and DRR concepts integration can bring about awareness and concern of the major environmental issue and will surely be a powerful tool in mainstreaming CCA and DRR concepts in school curriculum.

Indeed, the IEC materials developed by the study bear basic concepts and information on climate change and how people can effectively respond to the problem. Interview of the users/readers revealed that they were informed on how they can act appropriately to the issue.

Evaluation of the IEC Materials by Experts and Users

Comments and suggestions on the developed modules were given by evaluators after the oral presentation. Eight (8) modules were presented during the oral evaluation. Majority of the modules conform with guidelines on module writing, there were however some suggestions for improvement like the inclusion of graphics for clarity and motivational purposes, avoiding lengthy discussions and use of highly technical words which

are difficult to understand, and integration of CCA and DRR concepts must not sacrifice the main concepts to be catered.

Table 1: Results of Users Evaluation

Module Title	Overall Rating	Descriptive Rating
Disaster Preparedness for Veterinary Practices	3.611111	Moderately acceptable
Photosynthesis;	4.111111	Highly acceptable
The Cell and It's Environment	4.083333	Highly acceptable
The things Around You	3.888889	Moderately acceptable
Structure and Function of the DNA	4.194444	Highly acceptable
Broiler Production	3.916667	Moderately acceptable

Legend: 1-1.99- not acceptable; 2-2.99- fairly acceptable; 3-3.99 – moderately acceptable; 4-4.99- highly acceptable

Revisions were made in the light of the suggestions, and final drafts were submitted for evaluation by the expected users. There were at least six modules, finalized and submitted by the participants that included 1) Disaster Preparedness for Veterinary Practices; 2) Photosynthesis; 3) The Cell and It's Environment; 4) The Things Around You; 5) Structure and Function of the DNA; and 6) Broiler Production. Each module was evaluated in the light of a researcher-made survey instrument. Users' evaluations on the acceptability of the modules are given in table 1.

Results in table 1, indicated acceptability of all the modules to the users. Three of the six (50%) modules developed were highly acceptable and the remaining three (50%) were moderately acceptable. It strongly suggest that the modules developed on selected Science subjects integrated with CCA and DRR concepts are fit to be used in teaching not only the basic concepts of the subject but also in teaching CCA and DRR with acceptability ranging from fairly acceptable to highly acceptable. It can serve

as a tool in mainstreaming CCA and DRR concepts in school curriculum.

Efficacy of the Developed IEC Materials

On Developing Level of Awareness in CCA and DRR. The modules were pilot tested in their respective classes. A questionnaire on the level of knowledge was administered to respondent teachers and students before and after the intervention to assess their level of awareness. Overall results are given in tables 2 and 3.

Table 2: Level of Awareness on CCA and DRR of Teachers Before and After the Intervention

Ave. Level of Awareness Before	Description	Average level of Awareness After	Description
1.05	Not Knowledgeable	2.82	Moderately Knowledgeable

Legend: 0.51-1.5 not knowledgeable; 1.6-2.5 slightly knowledgeable; 2.6-3.5 moderately knowledgeable; 3.6-4.0 highly knowledgeable

Findings of the study proved the significance of the developed instructional material in promoting awareness and improving level of knowledge on CCA and DRR among the respondent teachers. From generally not knowledgeable, they became moderately knowledgeable after integrating the concepts in their teaching. The added instructional task made easy by the available guide had motivated teachers to upgrade their competence on the concepts thereby improving their level of knowledge.

Table 3: Level of Awareness on CCA and DRR of Students Before and After the Intervention

Ave. Level of Awareness Before	Description	Average level of Awareness After	Description

0.74	Not Knowledgeable	2.71	Moderately Knowledgeable
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Legend: 0.51-1.5 not knowledgeable; 1.6-2.5 slightly knowledgeable; 2.6-3.5 moderately knowledgeable; 3.6-4.0 highly knowledgeable

The survey on level of CCA and DRR concepts awareness among students showed similar trend. The progress in the level of awareness among student respondents is presented in table 3. Though not knowledgeable before the concepts integration in their classes, the students had shown improvement and became moderately knowledgeable after the intervention.

The foregoing findings were found consistent with the learning theories. Blooms Teaching for Mastery Methods presents that students can master a subject matter if there is a proper design of materials combined with frequent evaluation tests that give feedback to their progress [3]. The modular instruction used in the CCA and DRR concept integration in teaching allows independent learning [16] resulting into improved level of awareness.

Developing Attitudes on Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR). Students' essays were evaluated in the light of the Krathwohl's Taxonomy of Affective Domains. Results in table 4 revealed a significant change in their attitudes after the intervention.

Table 4: Evaluation of Student's Essay on Attitude Towards CCA and DRR

Average Rating of Students' Essay	Attitude
1.9	Responding

Legend: 1-1.4 Receiving; 1.5-2.4 Responding; 2.5-3.0 Acting

Data in table 4 likewise presented that majority of them are already responding to the issue after being exposed to learning sessions with integration of CCA and DRR concepts. The results proved the potentials of the IEC materials as a tool to mainstream climate change adaptation and disaster risk reduction in school curriculum,

particularly in developing a responding attitude towards the issue.

CONCLUSION AND RECOMMENDATION

Results showed favorable effects of integrating CCA and DRR concepts in teaching. Developing IEC materials that will serve as tool in teaching is one strategy to mainstream it in school curriculum. Findings of the study revealed that the use of IEC materials integrated with CCA and DRR concepts in teaching can improve level of awareness of respondents on the concepts and developed a responding attitude towards the issue.

Mainstreaming of CCA and DRR concepts in school curriculum must be given preferential attention by educators and policy makers. Integrating it in teaching must be encouraged and training-workshop on IEC materials development be conducted involving many educators covering more fields of specialization.

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