PRIMARY RESEARCH

Design and development of an information technology fundamentals multimedia courseware for dynamic learning environment

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Abstract— This research proposed and developed a multimedia courseware in Information Technology (IT) Fundamentals based on the dynamic learning environment which provides self-paced learning material for IT Fundamentals students. Further, this study asked the participation of faculty members to contribute lecture materials and recommend presentation for each lecture material that were suggested while past students were tapped to contribute localized questions and problems that were included in the quiz database. In addition, this research addresses the challenges in creating a learning module that caters the needs of different types of learners in a student-centered environment employing educational materials that were displayed in various formats which enable students to interact with the materials being presented as needed in their own time. The proponents utilized the descriptive and developmental research design. Descriptive was used to define the needed requirements as an input in the development of the proposed multimedia courseware. These requirements were processed through different phases using developmental research namely: (1) planning phase, (2) development phase, (3) validation phase, (4) acceptance phase, and (5) output phase. The result of the validity and acceptability showed that faculty members and students agree on the content and features of the proposed multimedia courseware. The validity and acceptability test indicate positive acceptance from both faculty members and students, however, there are still rooms for improvement before gaining maximum acceptance from the students.

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I. INTRODUCTION

Information Technology (IT) -based learning module, especially dynamic multimedia courseware is generally useful as teaching material in a self-paced learning environment. Findings suggest that technology can change and improve the quality of learning outcomes if designed to support knowledge construction in a learner-centered learning environment [1]. These technologies permit Student-Centered Learning (SCL), wherein students learn at their own pace, time, and ability. The SCL model places the learner at the center of the learning process utilizing a wide variety of educational programs, learning experiences, instructional approaches, and academic-support strategies that are intended to address the distinct learning needs, interests, aspirations, or cultural backgrounds of individual students and groups of students. While instructor provides students with opportunities to learn independently and from one another and coaches them the skills they need to enable them to perform their tasks effectively. Properly implemented SCI can lead to increase motivation to learn, greater retention of knowledge, deeper understanding, and more positive attitudes towards the subject being taught [2].

To facilitate student-centered learning, many authors suggest the use of media and technology [3]. In adopting a student-centered learning, it is recommended to embed the use of information technology in the learning environment. However, technologies should be utilized for information resources, a social medium to support learning through collaboration and interaction, and intellectual part-

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ners to support learning by reflecting [4]. Arguably giving students more choice on the way in which they learn will give them more empowerment to take more responsibility for their own outcomes. Thus, dynamic learning provides student-centered activities in the learning process, enables students to participate in their learning process and become autonomous and independent while the teacher acts as a facilitator, supporting the students in their learning process, facilitating social interactions and communications between students, and encouraging collaborative and co-operative learning. In such an activity, student-centered learning can be cultivated because the students will engage in collaborative activities with their team members, as well as with the instructor, who acts as a facilitator and guides the students [5], [6].

In recent years, connection between student learning and teacher learning has become the focus for collaborative learning in the Philippines education system. Teachers are asked to develop learning materials that will give students the opportunity to learn independently through self-paced learning. Furthermore, they are provided the opportunity to apply the alternative approach to design educational learning materials using media and technology or popularly known as multimedia. [7] stated that, "multimedia provides means to supplement a presenter's effort to garner attention, increase retention, improve comprehension, and to bring an audience into agreement". Further, it offers an excellent alternative to traditional teaching, by allowing the students to explore and learn the different paces since every student has the opportunity to learn at his or her full potential. Multimedia is now penetrating the field of education and changing the ways teachers teach and students learn.

With the advent of multimedia and technology in the classrooms, teachers can equip themselves with these technological skills and become better communicators of their content, materials, thus enabling the students to learn in a more productive way [8]. This research proposed a multimedia courseware in IT Fundamentals based on the dynamic learning environment which provides self-paced learning material for students taking IT Fundamentals course. Furthermore, this research addresses the challenges in creating a learning module that caters the needs of the different types of learners in a student-centered environment. This research involved the participation of IT Fundamentals faculty members, current and former students in the development of the proposed multimedia courseware. Faculty members were asked to contribute lessons and mode of presentation while students were also requested to contribute questions to generate a quiz database with localized problems.

A. Statement of the Problem

This study aimed to develop a dynamic courseware in IT Fundamentals utilizing the participation of faculty members handling IT Fundamental subjects and students who have taken and passed the said subject. Specifically, it answered the following queries: 1. How to develop a dynamic courseware utilizing the suggestions of faculty members and students? 2. What is the validity and acceptability level of the developed courseware?

II. RELATED LITERATURE

The use of multimedia technology has offered an alternative way of delivering instruction. With the gradual increase in the integration of computer and multimedia technology in educational activities, there is a need to consider not only the unique opportunities they bring to learning and learners, but also the benefits that may be derived from their use [9]. One of the benefits that can be derived using multimedia applications as stated by [10], is that teachers are given an excellent chance to demonstrate and visualize subject matter more clearly and more comprehensibly, as well as enabling them to prepare study material for students which optimizes their study habits. In addition, multimedia technology provides an alternative method of teaching and was found out to be effective and enhance learning [11]. [12], [13] claimed that multimedia used in the right direction has succeeded in psychomotor development and strengthening of visual processing of the intended users. With the benefits that can be derived from the use of multimedia technology, it is necessary to design and build a multimedia courseware that can effectively improve the teaching quality. [14] suggested that a good multimedia teaching courseware should fully express good innovative textbook content and rich creative elements. A good design will allow students to: (1) visualize difficult and naturally dynamic concepts, (2) promote active learning, problem-solving and critical thinking with interactive simulations and virtual environments, (3) interact with the content with self-quizzes and (4) access content anytime, anywhere, at any pace. Also, Sponder and Hilgenfeld's study (as cited in [15], reported that most experts advise teachers

to make their multimedia software interactive, motivating, and relevant with plenty of action and novelty. In the study conducted by [12] and [16], it was stated that simulations, models and media rich study materials like still and animated graphics, video and audio should be integrated in a structured manner to facilitate learning of new knowledge much more attractively and effectively. It also gives more flexibility to learners to adapt to individual learning strategy.

Multimedia must be extremely well-designed by combining the various elements of the cognitive processes and the best quality of the technology. The multimedia courseware characteristics presented were incorporated in the design and development of the Multimedia Courseware in IT Fundamentals to ensure the quality of the courseware. With the use of the developed multimedia courseware, the university would be able to promote independent learning which would enable students to voluntarily choose their learning activities and set their own learning goals. According to [17] configurable multimedia courseware can be adapted to meet the needs and characteristics of different lecturers, students and contexts.

III. METHODOLOGY

A. Research Setting and Participants

The proponents utilized the descriptive and developmental research design. Descriptive was used to define the needed requirements as an input in the development of the proposed multimedia courseware. These requirements were processed through different stages using developmental research. A multimedia courseware for IT Fundamentals was designed and developed for Pangasinan State University –Urdaneta City Campus. The content of the application was based on the class lecture in the IT Fundamentals course of the Bachelor of Science in Information Technology (BSIT) Curriculum. The participants of this study are faculty members who are handling IT Fundamental subjects and their past and current students. Faculty members were asked to contribute lecture materials needed in the coursework. Further, they were asked to recommend the teaching method for each lecture material to be taught. In the case of students' participation, past students were tapped to contribute localized questions and problems that can be included in the quiz database. The questions were validated by faculty members who are teaching IT Fundamentals.

B. Theoretical and Practical Contribution

The findings of this study and the output of proposed courseware can be utilized as prototype for other multimedia learning materials. Furthermore, the results served as basis in assisting instructional planners and designers in choosing an effective multimedia program suitable to the needs of the learners. In addition, the proposed multimedia courseware is an alternative solution to enhance the traditional method of teaching in a student-centered dynamic learning environment. Further, students will learn IT Fundamentals at their own pace and time through the use of an effective interactive multimedia courseware where its content is congruent with the learning activities found in the syllabus and fully accepted by student testers.

C. Selection of Participants

Purposive sampling was used to identify the faculty member participants, such that only faculty members who teach IT Fundamentals will be surveyed. In the case of the student participants, former IT fundamental students were randomly selected and requested to answer the acceptability survey. Slovin's formula at .05 margin of error was utilized to determine the student participants' sample size. In addition, only 2nd year students who finished the subject were utilized to answer the survey due to their knowledge on the subject matter.

TABLE 1
PARTICIPANTS OF THE STUDY

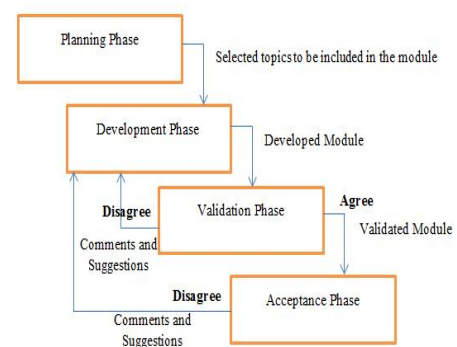| Participants/	Number of Participant
Faculty (Validator)	6
Students (Acceptability)	50

Fig. 1 . Process of developing an IT fundamental multimedia courseware for dynamic leaning environment

The design and development of the courseware underwent different phases of development namely: (1) planning phase, (2) development phase, (3) validation phase, (4) acceptance phase, and (5) output phase. The figure below shows the design and development of the proposed courseware.

Planning Phase: The first phase of content development begins with planning. It refers to the gathering of information about one's audience, the tasks to be completed, and the project's overall goals. The proponents have classified the information to make the content more applicable and successful. In this phase, the proponents with the help of experts in Pangasinan State University selected the topics to be included in the multimedia courseware by undergoing in-depth analysis of the knowledge and skills needed in IT Fundamentals as defined in the course syllabus. Likewise, an analysis of the detailed specification of the courseware as to their format and technical details was conducted. In addition, further examination was conducted concerning the method of teaching IT Fundamentals by the proponents. Another survey was conducted to analyze the opinions of faculty members and former students in IT Fundamentals on how to deliver specific topics. The answers from the questions provided information to the proponents about their nature of learning in IT Fundamentals using interactive multimedia based on the theory of learning and teaching.
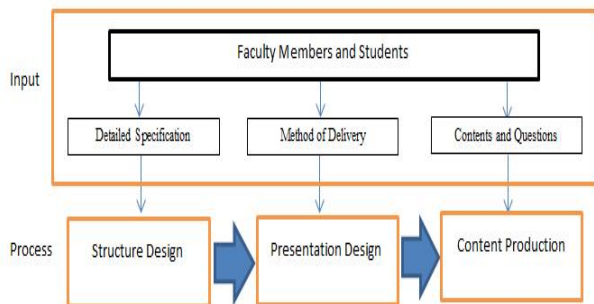

Fig. 2 . Development phase process

Development Phas: In this phase, instructional designers begun to create their project. Information gathered from the analysis phase, in conjunction with the theories and models of instructional design, is meant to explain how the learning was acquired. It is also where the blueprints were assembled. The proponents in this phase began developing the overall objectives for the course and descriptions of the various techniques, methods, and instructional styles to be

incorporated with the multimedia courseware. In the construction of the module, a format based on the recommendations of the faculty members and students was followed. The proponents developed the module to be interactive to give a dynamic learning environment based on the process below.

The structure design focused on the relationship and integration of the courseware components. The structures were completed by adding main menu, sub menus and buttons that define the relations between the components.
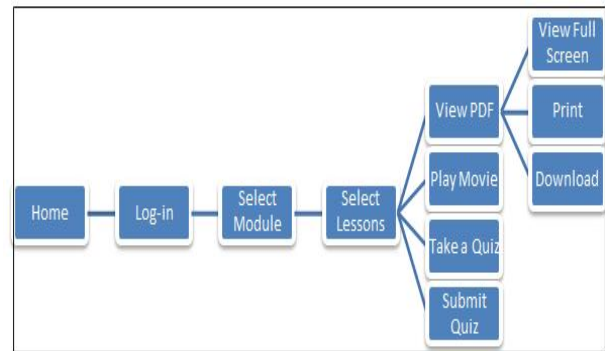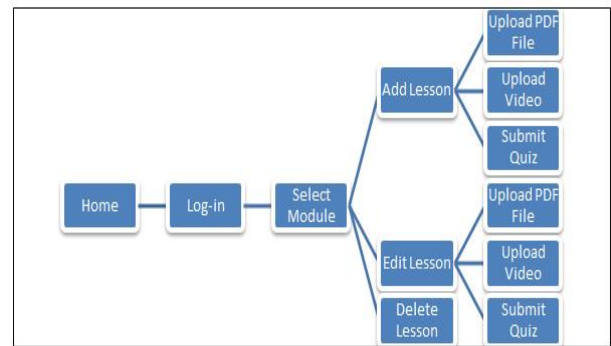

Fig. 3 . Menus for students

Fig. 4 . Menus for the instructors

The presentation phase deals with the courseware appearance to the faculty members and students. It describes how the topics were presented and how users interacted with the courseware. The method of presenting topics was suggested by IT Fundamentals faculty members and former students. The courseware combined appropriate multimedia elements such as text, audio, video, and image in the presentation of topics.

The content production phase focused on the encoding of course content, exercises and questions. This phase was considered as a partial implementation of the course.

Validation Phase: The validation phase is where the modules are evaluated for their content validity. The propo-

nents in this phase presented the developed modules to the faculty members for assessment. The assessment checklist was distributed to the faculty members for validation. Revisions of the modules were based on the opinions and suggestions of the faculty members of PSU-Urdaneta City Campus. The proponents used the survey questionnaire checklist adapted from Jono, Asarani, Ibrahim, and Aziz's study for the validity and acceptability test.

The content is divided into several topics according to the syllabus. Respondents' assessment focused on the content, objectives, accuracy of the existing syllabus, descriptions, examples and a few other things. In completing the assessment tool, respondents were required to choose either strongly agree with the questions provided, or agree, or not agree, or disagree, or strongly disagree. The proposed questions are as follows:

a) Clear content framework
b) Clear learning objectives
c) Delivered content meets curriculum
d) Content arranged in order and clear
e) Sufficient content explanation
f) Sufficient content examples
g) Additional material / support provided
h) Contents help to better understand the lesson
i) Content enables to easily revise lessons
j) Overall applications satisfy you

To validate the courseware, its content should be congruent with the learning activities found in the syllabus in Introduction to IT Fundamentals subject.

Acceptance Phase: After the faculty members had validated the content of the modules, the proposed module was presented to the former students of IT Fundamentals course

to test the acceptability. In this phase, the students used an assessment checklist and the result defines the acceptability of the proposed courseware in terms of attractiveness, effectiveness, use of multimedia and presentation. In completing the questionnaire, student participants were required to choose either strongly agree with the questions provided, or agree, or not agree, or disagree, or strongly disagree. Here are the questions proposed:

a) Attractive screen designs
b) Clear text and can be read
c) Attractive and effective graphic
d) Effective use of colors
e) Effective use of multimedia
e.1. Effective use of audio
e.2. Effective use of video
e.3. The animation used supports learning
e.4. Adequate interactivity
e.5. Icons are clear and understandable
f) The presentation does not need facilitators

These questions of acceptability were associated with the overall presentation of topics concerning attractiveness and effectiveness of the courseware.

Output Phase: After undergoing planning, development, validation and acceptance phases, the final output of this study was utilized by the IT students of PSU-Urdaneta City Campus. The proposed courseware can be used by the faculty members and students in the process of teaching and learning of IT Fundamentals course. The students can use the developed courseware based on their learning pace as well as their preferred learning styles. The following figures show the interfaces of the developed multimedia courseware.

Fig. 5 . Home tab of the multimedia courseware

Fig. 6 . Interface of the courseware where the faculty could contribute lecture materials

Figure 5 shows the Home tab of the multimedia courseware which serves as the entry point for the faculty and students. The user clicks the start button to enable the log-in tab where he would be asked to enter his username and password. Once the log-in is successful, the user can already use the system.

Figure 6 shows the interface of the courseware where the faculty members could contribute lecture materials that could be included in the multimedia courseware.

The faculty members should log-in to the system before they could be able to manage the lessons. The interface shows that the faculty selects the subjects that represent the module where the lessons are to be included. To add a lesson, the faculty enters the topic on the textbox beside the Lesson label and clicks the Add button to upload the PDF file of the lecture and a video that is used to replace text as a tool to explain the contents of the lecture.
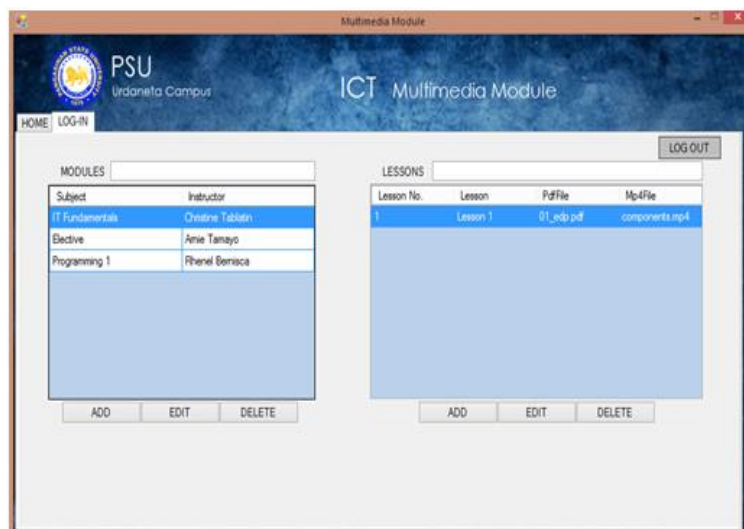

Fig. 7 . Interface of the courseware where the students can view the lessons

In Figure 7, a lecture in PDF format and a video are provided for every lesson uploaded by the faculty members who are handling IT Fundamentals course. The interface gives students options on how the lesson would be presented to them. The PDF lecture can be viewed in full screen and has a corresponding audio which reads the lecture.

Therefore, it allows the students to study without the need to look at the monitor. The video on the other hand, is useful for teachers to supplement the lecture presented in the PDF format. The students could be able to clearly see a scenario and could enhance their understanding in the subject matter through the use of a video. This innovative part of the courseware combines a few types of multimedia elements such as text, audio, video, and image which make a dynamic learning environment.

IV. RESULTS AND DISCUSSION

The data were collected and analyzed to determine whether the proposed system is accepted in terms of content validation and acceptability. Included in the survey was open-ended comments and suggestions from faculty members to elicit more in-depth feedback on their perception towards the content of the proposed courseware. Faculty members were encouraged to give truthful and honest feedback regarding their perception on the proposed courseware.

TABLE 2
RESULT OF FACULTY VALIDATION

Criteria	WM	Description
a) Clear content framework	4.15	A
b) Clear learning objectives	4.15	A
c) Delivered content meets curriculum	4.15	A
d) Content arranged in order and clear	4.15	A
e) Sufficient content explanation	3.80	A
f) Sufficient content examples	4.00	A
g) Additional material / support provided	4.00	A
h) Contents help to better understand the lesson	4.00	A
i) The Content enables to easily revise lessons	4.15	A
j) Overall applications satisfy you	4.15	A
Average Weighted Mean	4.03	A

Faculty members' comments and suggestion on
the proposed courseware:
"Exercises at least 3 types"
"Entry of the lesson should not accept duplication"
3. "Additional learning materials may be included
by the admin to support the students in the areas of
difficulty".

Legend :

Description	Range
5–Strongly Agree(SA)	4.21 - 5.00
4–Agree (A)	3.41 - 4.20
3–Not Agree (NA)	2.61 - 3.40
2– Disagree (D)	1.81 - 2.60
1 – Strongly Disagree (SD)	1.0 - 1.80

Table 2 reveals that faculty members agree on the content of the proposed model based on the overall result validity mean score of 4.03. This shows that the content, objectives, delivery and exercises were aligned with the existing IT fundamentals syllabus. Majority of the criteria obtained a mean rating of 4.15, meaning the validators agree with the content, objectives, topic delivery, arrangement and satisfaction. However, sufficient content explanation got the lowest mean rating of 3.8 which means that the courseware needs additional material to support learning.

A. Acceptability Result

Table 3 reveals that the result of the mean score for

all areas being evaluated is 4.20 which signifies that the student participants agree to accept the proposed courseware in terms of its design, attractiveness, effectiveness and the presentation. Students reported that they strongly agree on the features of the proposed courseware: attractive screen, effective use of multimedia and attractive and

effective graphics. Clear text and can be read obtained the lowest mean rating of 4.16 which indicates that the proposed system should employ readable text such as utilizing bigger font size. Further, this result was also parallel to the comments coming from the validators that "additional materials/exercises should be provided".

TABLE 3
RESULTS OF STUDENT ACCEPTABILITY

Criteria	WM	Description
a) Attractive screen designs	4.22	SA
b) Clear text and can be read	4.16	A
c) Attractive and effective graphic	4.24	SA
d) Effective use of color	4.18	A
e) Effective use of multimedia		
e.1. Effective use of audio	4.34	SA
e.2. Effective use of video	4.46	SA
e.3. The animation used supports learning	4.52	SA
e.4. Adequate interactivity	4.18	A
e.5. Icons are clear and understandable	4.30	SA
	4.36	SA
f) The presentation does not need facilitators	4.20	A
Average Weighted Mean	4.20	A

Students' comments and feedback on the proposed courseware:
1. "Use bigger fonts when presenting to make it more readable"
2. "The video should maximize for better viewing"
3. "Must be attractive and should be easy to access"
by the admin to support the students in the areas of difficulty".

Legend :

Description	Range
5 – Strongly Agree(SA)	4.21-5.00
4 – Agree (A)	3.41-4.20
3 – Not Agree (NA)	2.61-3.40
2 – Disagree (D)	1.81-2.60
1 – Strongly Disagree (SD)	1.0-1.80

V. CONCLUSION

Dynamic courseware for IT Fundamentals offers benefits over traditional methods of delivering educational materials and information. This research proposed a multimedia courseware in IT Fundamentals based on the dynamic learning environment which provides self-paced learning material for IT Fundamentals students. Furthermore, this research addresses the challenges in creating a learning module that caters the needs of different types of learners in a student-centered environment. This research involved the participation of IT Fundamentals faculty members and their current and former students in the

development of the proposed multimedia courseware. Furthermore, educational materials are displayed in various formats that enable students to interact with the materials being presented as needed in their own time.

The result of the validity and acceptability has shown that faculty members and students agree on the content and features of the proposed multimedia courseware. The validity and acceptability test indicates positive acceptance from both faculty members and students, however, there are still rooms for improvement before gaining maximum acceptance from the students.

The invention of multimedia technology into the

learning process provides an opportunity to reconsider teaching strategies to be adopted in a student-centered environment. This alternative option addresses the opportunities for promoting the efficiency and effectiveness of learning through the use of this multimedia technology. Hence, a variety of courseware materials have been developed primarily to replace traditional methods of teaching.

In future work, the proponents plan to determine the effectiveness of the proposed multimedia courseware. The proposed courseware will be experimented to determine its difference from the traditional method of teaching IT Fundamentals course.

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— This article does not have any appendix. —