

A MODEL TO SUPPORT THE IMPLEMENTATION OF COURSES USING INFORMATION AND COMMUNICATION TECHNOLOGIES IN HIGHER EDUCATION INSTITUTIONS

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Abstract

Higher Education Institutions (HEIs) should promote the Teaching and Learning (TL) activities through student involvement in the construction of their own knowledge in a more autonomous way. In this context, Information and Communication Technologies (ICTs) can have an important role in supporting this new paradigm, improving the TL process. The professor should then assume the role of a mentor, providing the learning environment that allows the referred process going beyond the physical classroom space. In this work a model to help professors in planning and developing courses with the most appropriate ICTs is presented. This model which is composed by five phases, namely Analysis, Design, Development, Implementation, and Evaluation, is based on the ADDIE model. In the development of the actual work, there were also considered the best practices of top world universities. It is hoped that the resultant model will be a flexible and versatile way to support the planning and development of an educational program in HEIs. The outcomes of this work are expected to be valuable for researchers on ICTs use in HEI and may help professors implementing courses in their own environment.

Keywords: Learning Management Systems (LMS), Web 2.0, Massive Open Online Courses (MOOCs), ADDIE model, Higher Education.

1 INTRODUCTION

The use of Information and Communication Technologies (ICT) has grown in education allowing an easier and more convenient access to information. The diversity of interactive and multimedia equipments and the availability of broadband communication networks make available to participants in the Teaching-Learning (TL) process a large set of information, as well as various teaching methods. Students own and use a diversity of technologies, but institutions and instructors have yet to seize opportunities to create innovative learning experiences [1], [2].

The main technologies used in the TL context can be classified according to the three technological generations that support the Teaching/Learning process: Learning Management Systems (LMS), Web 2.0 technologies and Massive Open Online Courses (MOOCs).

Traditional LMS are applications used in the TL process that allow the use of various methods to impart information, skills and competences [3]. These systems, such as Moodle, integrate a set of activities as content creation, content organization, content delivery, communication, collaboration or assessment [4].

The Web 2.0 technologies are more interactive and collaborative than LMS. The functionalities of the Web 2.0 (construction, interaction, collaboration, communication) provide users with the mechanisms to create digital contents and assessment materials. Blogs, Wikis, Social Networks, and Media Sharing, represent some of the most popular tools [5].

MOOC platform is an “integrated application software developed for the purpose of providing direct or indirect support for internet service-based teaching learning processes where a large number of learners mutually participate” [6]. These platforms have the following integrated functions: course recommendation and attraction of participation, course opening and operation, instructional design and contents creation, teaching/learning and community, and evaluation and learning outcome management [6]. Coursera and EdX are the most mentioned MOOCs platforms in the literature. The number of universities that use these platforms have been increasing over the years, as well as the number of courses offered [7].

The skills that students must achieve in their learning can be improved or facilitated through pedagogical methods that use ICTs. However, when it is intended to use some technologies in the TL process, professors must consider their integration into a pedagogical perspective.

Professors today should be prepared to use ICTs as part of their skills. The increasing number of students and their diversity, which were accompanied by the development of ICTs, have created new forms of Distance Education (DE) for which academics have to be prepared. The fact that Higher education has been accessible to more people has stimulated the interest in DE [8]. Computer-mediated and direct contact with the instructor (based on Web via videoconference or e-mail) are part of a combination of instructional techniques that can help the TL process becoming more effective [8].

In this context, professors should be careful when selecting the type of activities to be developed using technologies and establish the objectives of the activities and the rules of engagement with their students. In order to support TL process, instruction models can help defining strategies to design learning activities that allow the building of skills and knowledge [9].

Instruction models involve the planning, development and use of methods, techniques, activities, materials, events and educational products in specific teaching situations in order to facilitate learning [9]. The ADDIE (Analysis, Design, Development, Implementation, Evaluation) model is the most used [10], [11], [12] and popular [13], [14] instruction model and integrates the referred five phases.

There are several versions of the ADDIE model [14] that reflect the changes it took over time. Its first version appeared in 1975 and was created by the Center for Educational Technology at the Florida State University for the US Army. Later it was adopted by all US armed forces [15], [16]. This version is a linear model, represented in Figure 1.

The version presented in Figure 2, is a dynamic and interactive model, in which the evaluation phase is divided into formative and summative evaluation [17].

Another version, which can be seen in Figure 3 provides a valuable tool for training specialists in creating and delivering effective programs [14], providing an organized approach to all the process of training programs [14].

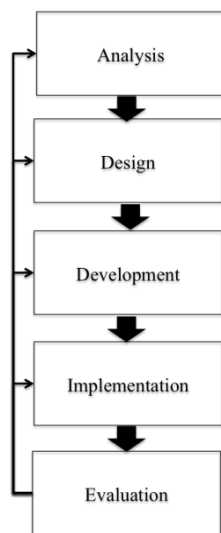


Figure 1. Version of the ADDIE model of Branson et al. [15].

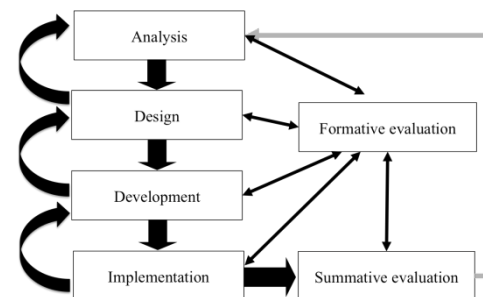


Figure 2. Version of the ADDIE model of McGriff [17].

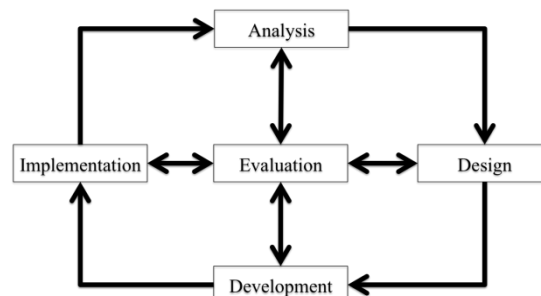


Figure 3. Version of the ADDIE model of Myers et al. [14].

In general, ADDIE models are step-by-step processes that are used to plan and create training programs [18]. These models represent iterative instructional processes, where the output of one phase is the input of the next one [12] and the result of formative evaluation of each training phase can direct the instructor back to any earlier one, in order to redefine it [17]. The phases of ADDIE allow

(i) the identification of training needs, (ii) the definition of learning tasks, (iii) the establishment of performance measures, (iv) the selection of the appropriate method of course delivery, and (v) the assessment of students' performance [19]. ADDIE can provide a structured guide for the entire training project [14].

2 METHODOLOGY

The methodology used in this work integrates two components: (i) The identification of the best practices of the top world universities in what relates to the use of technologic platforms in the TL process, and (ii) the development of a model adapted from the ADDIE Model which aims to assist the teacher in the TL process. This adapted model took into account both the best practices reported in the literature and the results of the first component.

The analyses of the main technological platforms used by top Higher Educational Institutions (HEIs) were performed through content analyses of the Websites of these HEIs. The top HEI were selected through the rankings: (i) Times Higher Education World University Rankings, (ii) Shanghai Rankings, (iii) QS World University Rankings, and (iv) Web Ranking of Universities, which are considered the most popular ones (see, for example, Aguillo et al. [20] and Anowar et al. [21]).

The model proposed was based on the ADDIE model and is intended to be a guide for the decision-making professor to select the most appropriate technologies, to plan activities in the TL context and to implement them.

3 RESULTS

As stated in the Methodology, the model developed, presented in section 3.2, takes into account the best practices of the top world universities, which Websites contents' were explored. In order to identify those institutions, an analysis based on the most relevant rankings was performed. This analysis is described in section 3.1.

3.1 Identification of the top world universities

3.1.1 Brief explanation of the rankings considered

The global rankings first appeared in 2003 with the Academic Ranking of World Universities (ARWU), also known as ARWU [22]. The ARWU published by Shanghai Jiao Tong University, and the first ranking was published in 2003 [22], [23]. This ranking uses internationally recognized academic performance and accomplishments as key indicators to rank thousand universities worldwide [23]. ARWU "considers every university that has any Nobel Laureates, Fields Medalists, Highly Cited Researchers, or papers published in Nature or Science journals" [24].

The Times Higher Education/QS World University Rankings (THE-QS) released by the Britain's Times Higher Education Supplement in 2004, covering 200 universities [23]. This ranking was split in 2009 giving birth to two new rankings: QS World University Ranking (QS ranking) and Times Higher Education (THE) World University Ranking [22]. QS ranking is based on citations data in Scopus, and academic and employer surveys [25]. THE World University Ranking, has partnered with Thomson Reuters since 2010 [22] uses "the world's largest invitation-only academic opinion survey" [26].

The Webometrics Ranking of World Universities (Web ranking) was published by Cybermetrics Lab, *Consejo Superior de Investigaciones Científicas* in Spain in 2004 [23] and provides "reliable, multidimensional, updated and useful information about the performance of universities from all over the world based on their web presence and impact" [27].

3.1.2 Selection of Higher Education Institutions

An analysis of the rankings according to the list of HEIs published from 2012 to 2015 (THE World University Ranking: 2014/2015, 2013/2014, and 2012/2013; Shanghai Rankings: 2014, 2013, and 2012; QS World University Rankings: 2014/2015, 2013/2014, and 2012/2013; Web Ranking of Universities: January 2014, January 2013, and July 2014) was made. The institutions ranked as top 20 in each ranking are presented in Table1.

Table 1. List of the top global HEIs.

Top 20 – Global Institution	THE World University Rankings			Shanghai Rankings			QS World University Rankings			Web Ranking of Universities			Total position	Mean Score	
	2014/15	2013/14	2012/13	2014	2013	2012	2014/15	2013/14	2012/13	Jan. 2014	Jan. 2013	Jul.2012			
Harvard University	2	2	4	1	1	1	4	2	3	1	1	1	12	19	
Massachusetts Institute of Technology (MIT)	6	5	5	3	4	3	1	1	1	2	2	2	12	18	
Stanford University	4	4	3	2	2	2	7	7	15	3	3	3	12	16	
University of Cambridge	5	7	7	5	5	5	2	3	2	18	10	20	12	14	
University of Oxford	3	2	2	10	10	10	5	6	5	17	11	18	12	13	
California Institute of Technology (Caltech)	1	1	1	7	6	6	8	10	10				9	12	
Princeton University	7	6	6	6	7	7	9	10	9		16	19	11	11	
University of California, Berkeley	8	8	9	4	3	4				6	6	4	9	11	
Yale University	9	11	11	11	11	11	10	8	7	16	11	14	12	10	
Columbia University	14	13	14	8	8	8	14	14	11	7	5	11	12	10	
University of Chicago	11	9	10	9	9	9	11	9	8				9	9	
Cornell University	19	19	18	13	13	13	19	15	14	4	4	8	12	8	
University of Pennsylvania	16	16	15	16	15	14	13	13	12	10	7	10	12	8	
University of California, Los Angeles (UCLA)	12	12	13	12	12	12				14	8	5	9	7	
Imperial College London	9	10	8				3	5	6				6	7	
University College London (UCL)			17	20			6	4	4				5	5	
ETH Zürich – Swiss Federal Institute of Technology Zürich	13	14	12	19	20		12	12	13				8	4	
University of Michigan	17	18	20						17	5	20	7	7	4	
Johns Hopkins University	15	15	16	17	17	17	14	16	16		14		10	4	
University of Washington				15	16	16				7		6	5	4	
University of Wisconsin – Madison					19	19				12		14	4	2	
University of California, San Diego				14	14	15							3	2	
University of California, San Francisco				18	18	18					9		4	2	
University of Minnesota										9		9	2	2	
University of Texas Austin										11	13	17	3	2	
University of Toronto	20	20					20	17	19	15			6	1	
Duke University	18	17							20				3	1	
Pennsylvania State University										13		12	2	1	
King's College London (KCL)							16	20					2	1	
University of Edinburgh							17	17					2	1	
Texas A&M University										20	15		2	1	
University of Arizona												13	1	1	
Ecole Polytechnique Fédérale de Lausanne (EPFL)							18	19					2	0	
McGill University											18		1	0	
Northwestern University			19										1	0	
Purdue University										19	19		2	0	
The University of Tokyo						20							1	0	
University of Utah												17	1	0	
University of Florida												18	1	0	
University of British Columbia													16	1	0

Legend: The 1st column presents the HEIs that are in the top 20 of the three editions of the four rankings. The following 12 columns are the ordinal numbers corresponding the position of each university in each edition of each ranking. The 14th column (Total position) shows the number of times that the university appears in one of three editions of the four rankings (maximum 12). The 15th column (Mean score) is the average score (the score is attributed according to the ranking of top 20, that is, the 1st place corresponds to 20 points and the 20th place corresponds to one point) for each university. The last column corresponds to the average score of the Web ranking.

In a first phase, there were selected the HEIs that were present in the three editions of the four rankings, which means that had a total position score value of 12 (14th column – Table 1):

- Harvard University;
- Massachusetts Institute of Technology (MIT);
- Stanford University;
- University of Cambridge;
- University of Oxford;
- Columbia University;
- Yale University;
- University of Pennsylvania;
- Cornell University.

In a second phase, there considered four more HEIs that had a mean score higher than 8 (15th column – Table 1):

- California Institute of Technology (Caltech);
- University of California, Berkeley;
- Princeton University;
- University of Chicago.

The Websites of the 13 HEIs just identified were analysed and their best practices were incorporated in the proposed model.

3.2 Proposed model

The model proposed on this work is adapted from the ADDIE Model and is based on technological platforms that are intended to assist the teacher in the TL process. It is a model for planning and developing courses that can be of various types (curricular units, training courses or TL activities). This model, as referred in the Methodology section, took into account the on best practices reported in the literature and observed in the sites of some top world universities. The courses planed with this model can be carried out in face-to-face, e-learning or b-learning modalities.

A high level representation of the proposed model is presented in Figure 4.

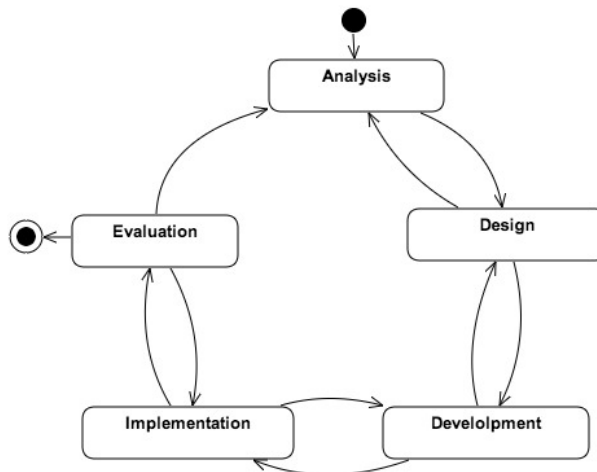


Figure 4. Adapted ADDIE Model for courses' planning and development.

The proposed adapted ADDIE model is cyclical and dynamic, beginning with the Analysis phase and ending with the Evaluation one. Nevertheless, whenever a new course edition is planned, the results of the Evaluation phase of the last edition should be incorporated in the Analysis phase of the next cycle.

At the end of each phase there is the needed to evaluate the activities and it may be required to adapt and / or review the activities of the previous phase. Following, a briefly description of each of the model's phases is presented.

Analysis phase – in this phase, the training needs are identified, and the designation, the learner profile [14], [17], the duration, the start date, and the modality (face to face or not face to face) of the course are established [14]. This information should be available to students when promoting / disseminating the course.

Design phase – in this phase the general objectives [17], [19], specific objectives, and course content are stated [14]. If there are prerequisites for the course, the teacher needs to define them and to evaluate the need to apply a diagnostic test to determine the knowledge level of the students. The professor should then associate the objectives and contents to each of the sessions and estimate the self-study hours that students need. Following the evaluation (type, form and evaluation moments) should be defined [28]. In accordance with its modality, the type of technologies to support the course (Web 2.0, LMS, or MOOC platforms) has to be decided [17]. During the execution of this phase, it can be necessary to review or redefine activities of the previous one. The activities of the Design phase are detailed in the activity diagram presented in Figure 5.

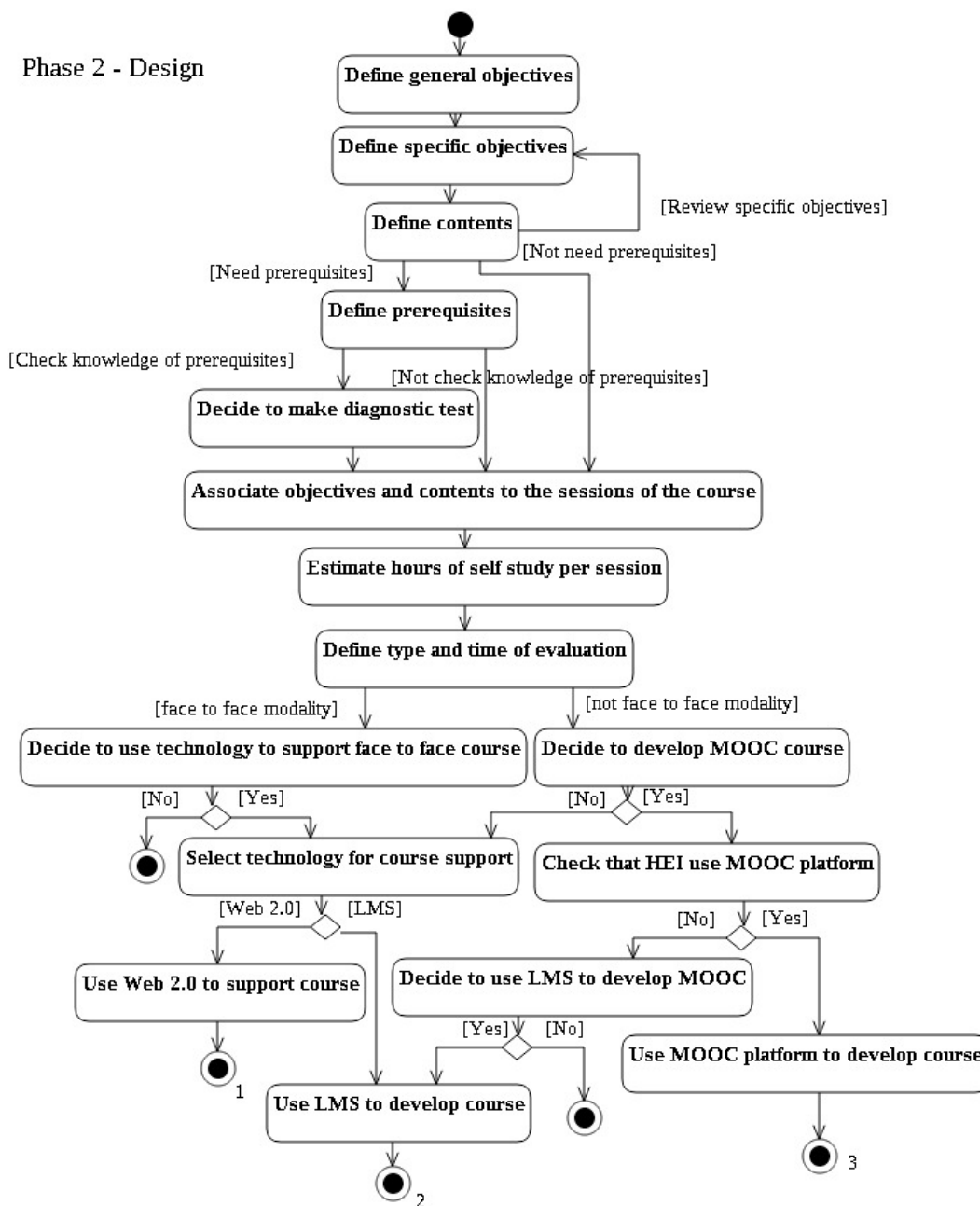


Figure 5. Design phase of the adapted ADDIE Model.

Development phase – in this phase all the resources and materials needed to implement the course, (documents, videos, assessment test) are developed and created [11], [14], [17], [19], [28]. The most appropriate technologies should be chosen according to their availability in the HEI (Web 2.0, LMS or MOOC platform). The use of Web 2.0 tools (Wikis, Blogs, Video Sharing, Photo Sharing, and Social Networking) can also be performed using LMS or MOOC platform. The activities of this phase are represented in the diagram of Figure 6.

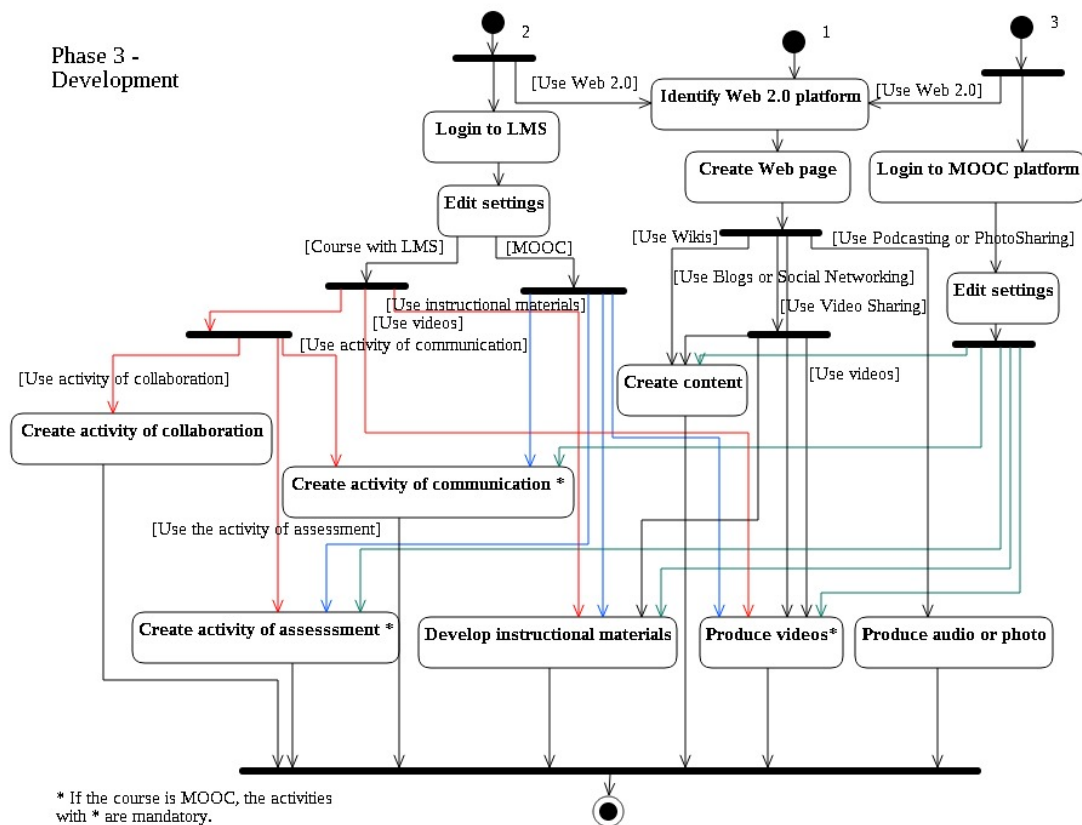


Figure 6. Development phase of the adapted ADDIE Model.

Implementation phase – in this phase, the course is delivered and managed according to the plan defined in the previous phases [11], [14], [17], [19], which include the modality of the course [17], [28].

Throughout the course, the teacher will make available to students the contents created (videos, documents, other material) and lead the activities (the spaces of communication and collaboration and assessment tools). The management of contents and activities can be done over the course sessions, allowing the adaptation to content and/or materials if necessary, reducing drop-out rates. Thus, this phase will have iteration with the previous phase, especially if the teacher prepares or adapts the materials during the sessions.

Evaluation phase – in this phase, the course is assessed based on students' performance, participation and satisfaction [11], [14], [19]. The teacher should also make a self-assessment of the course. Based on this information, the teacher should determine if there is need for revision of the course [15], [17], what type of revision to perform, and eventually prepare a revised plan for a future edition of the course [15]. The activities of this phase are represented in the diagram of Figure 7.

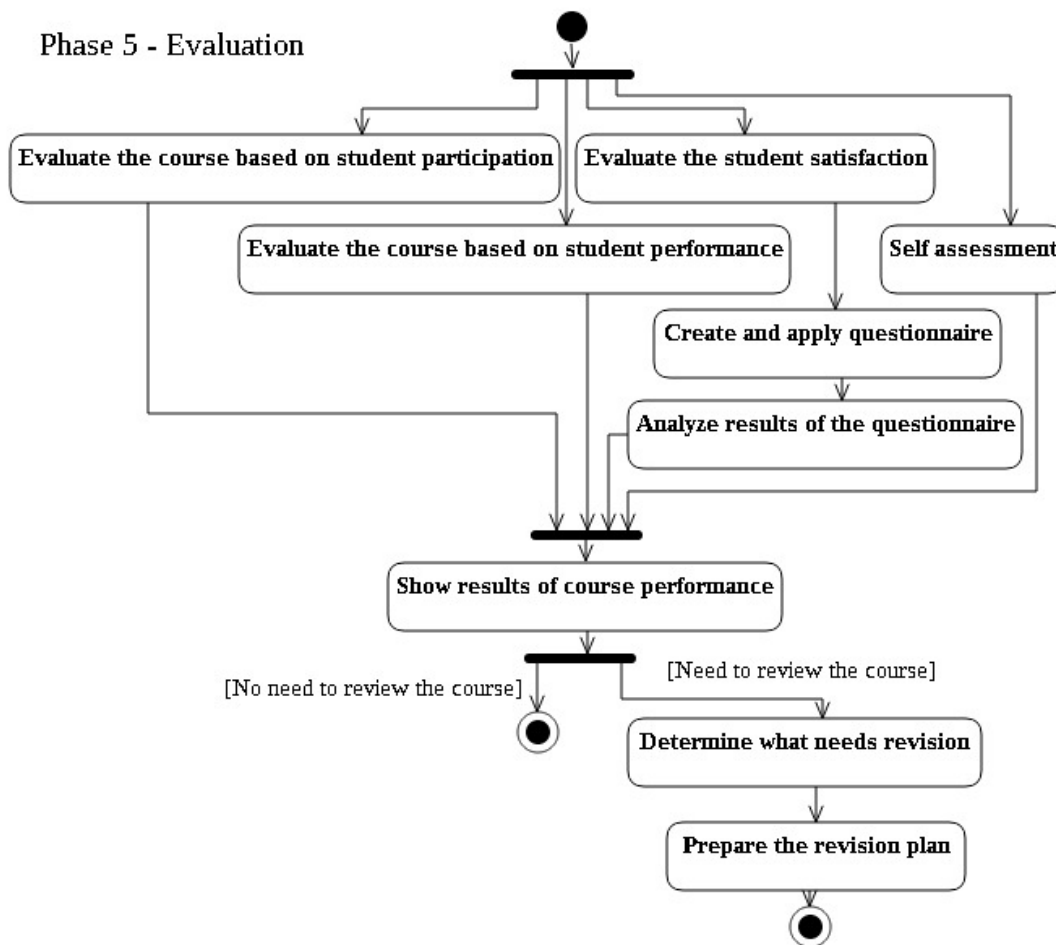


Figure 7. Evaluation phase of the adapted ADDIE Model.

This model also aims to be flexible and versatile to support the teacher in the planning and development of any educational program. Note the technologies' selection shall always depend on their availability in the HEI that promotes the course.

4 CONCLUSIONS

A model to support teachers planning TL activities and implementing courses using technologies in Higher Education Institutions was proposed.

This model which is composed by five phases, namely Analysis, Design, Development, Implementation, and Evaluation, is based on the ADDIE model. In the development of the actual work, there were also considered the best practices of top world universities.

In order to be easy to understood and use, the proposed model is presented as a set of guidelines for planning and developing courses that can be, for example, curricular units, training courses or TL activities. These courses can be implemented using the modalities of face-to-face, e-learning, b learning or m-learning.

The outcomes of this work are expected to be valuable for researchers on ICT use in HEI and for professors that want to implement courses using ICTs in their own environment.

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