

Extended ADDIE Model for improved Distance Learning Courses

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Abstract—With the widespread use of electronic devices such as laptops, smartphones and tablets, distance learning (DL) courses are increasingly being adopted by educational institutions. In order to conceive and execute such courses, different teaching models can be chosen. In this work, we overview the theoretical foundations related to the techniques of development of courses mediated by technologies from the Analysis, Design, Development, Implementation and Evaluation (ADDIE) model. We propose the extended ADDIE (X-ADDIE) for the elaboration of DL courses. In the proposed X-ADDIE, besides the execution step, a new step is added, defined as pilot experiment. All the X-ADDIE steps are tracked by a project management tool. We evaluate the proposed X-ADDIE model by means of a qualitative approach.

Index Terms—Distance Learning, Instructional Design, ADDIE model, X-ADDIE model.

I. INTRODUCTION

Among the various possibilities for continuing education in order to promote knowledge in specific areas, self-instructional courses are commonly used by educational institutions. In these courses a series of didactic activities for the self-directed study is organized, so that in general there is no space to socialize doubts and receive orientations. Learning, therefore, happens in an individualized way without interaction between the attendees involved in the process of teaching learning [1], [2].

The National School of Public Administration, in portuguese Escola Nacional de Administração Pública (Enap) is an example of an institution that uses self-instructional courses in order to achieve its goal of developing the skills of public agents. More than 90 % of the technology-mediated courses offered by this government school are self-instructional.

In order to develop and guarantee the quality of the technology-mediated courses, as well as the potential of Distance Learning (DL), Enap signed a technical cooperation agreement with the University of Brasília (UnB) in 2013. Resulting from this cooperation, Enap courses started to adopt the ADDIE model for the development of self-instructional courses.

This article aims to propose an Extended ADDIE (X-ADDIE) model in the elaboration of a self-instructional course,

evaluating the possibilities and practices of pedagogical mediation in the teaching-learning process. A qualitative approach was used in the evaluation of the proposed model. According to [5], [11], this type of approach is preferably used to answer questions such as how or why some social phenomenon works, pointing out that it is through this type of questioning that the case study becomes relevant. To validate the X-ADDIE, we consider the participant observation. The participant observation is a special mode of observation in which you are not simply a passive observer. Instead, you can take on various roles in the case study situation and actually participate in the events being studied [11]. During the research, the members of the pedagogical team in the role of Instructional Design made the observations. In contrast to [5], [11], the observations are not passive. Concomitantly, we conduct documentary research with the purpose of understanding Enap, its processes, guidelines and role in society.

This paper is divided in four sections, including this introduction. In Section 2, the traditional ADDIE model is presented, while in Section 3, the proposed X-ADDIE model and its application to the Enap data are shown. In Section 4, the conclusions are drawn.

II. ADDIE TRADITIONAL MODEL

The development process of DL courses addresses the idea of planning, organization, creation of didactic materials, pedagogical conceptions, and additional educational concepts and practices [6]. The set of methods, techniques and resources used in the development of a course and in its teaching-learning process is referred to as Instructional Design [2], [7].

The Instructional Design is a methodology based on procedures that facilitate the courses planning and educational materials with the purpose of identifying and solving an educational need, seeking a better efficiency and effectiveness in the development of projects [2], [8]. The most widely accepted Instructional Design process is the Instructional System Design (ISD) which proposes to divide the development of educational actions into phases presented in the following sequence: (1) analyze the need; (2) design the solution; (3) develop the solution; (4) implement the solution; and (5)

evaluate the solution [7], [8]. This phase division is also known as ADDIE (Analysis, Design, Development, Implementation and Evaluation) model. The five steps of the ADDIE model can be also concentrated into two parts: a) Conception, where the first three steps are located, and b) Execution, which contains the last two steps [9], [10]. The first three phases of the traditional ADDIE model are summarized in Subsection II-A, while the last two phases are overviewed in Subsection II-B.

A. Conception phase: Analysis, Design and Development

The analysis step consists basically of understanding the educational problem and designing an initial solution from the survey of the actual educational needs, the characterization of the students and the verification of restrictions [9].

The Drawing step starts after the problem exam. In this second step the planning is carried out and the pedagogical strategies of the education are defined, which consists in: identifying from the problem exam the types of skills and knowledge that instructors are intended to teach; select the most suitable media for the presentation of the content; organize the instructional sequence and the course content and to define the assessment [2], [9].

The instructional development step comprises the production and adaptation of resources and didactic materials printed and/or digital, the parameterization of virtual environments and the preparation of pedagogical, technological and administrative supports [7].

B. Execution phase: Implementation and Evaluation

The implementation step corresponds to the moment of putting the Instructional Design Systems (IDS) into practice. According to [7], the implementation step is subdivided into two sub-steps: publication and evaluation. The publication consists of uploading the contents, configuring the tools and making the learning units available to students. In the evaluation the students carry out the proposed activities, interacting with the content.

The results of the instruction are compared against the proposed objectives in the evaluation step. This occurs so that the didactic materials can be reviewed and improved. According to [7] this step includes considerations about the effectiveness of the proposed solution, as well as the review of the implemented strategies. In this step, both the educational solution and the learning outcomes of the students are evaluated, which ultimately reflects the appropriateness of the instructional design [2], [10].

III. PROPOSED EXTENDED ADDIE MODEL AND ITS APPLICATION TO THE ENAP SELF-INSTRUCTIONAL COURSES

An intrinsic characteristic of self-instructional courses mediated by technologies is the organization of a series of didactic activities for self-directed study. This is because its structure consists of presenting and making available the content to be studied and, at the end of each unit, in carrying out tests

to verify if the learning objectives were reached, thus not being in contrast with the courses with tutoring, a space to socialize doubts and receive guidelines. In this process, in which the learning happens in an individualized way, without interaction between the subjects involved in the teaching-learning process, the behaviorist perspective predominates. Contrary to this perspective, with great acceptance among education professionals, the constructivist and interactionist currents base most of the learning teaching processes and emphasize the importance of interaction and communication between teachers and students [1]. From this point of view there are many criticisms of self-instructional courses, which are beyond the scope of this article.

The implementation of the ADDIE model at Enap has brought significant advances in the production of self-instructional courses, allowing the processes for its five steps to be effectively executed. The model allied to the use of Redmine allows the tracking of the accomplished tasks.

For the development of courses, the teams of University of Brasília (UnB) and of the General Coordination of Distance Education, in portuguese Coordenação-Geral de Educação a Distância (CGEAD), of Enap have adapted and extended the ADDIE model adding the pilot execution stage.

The adaptation of ADDIE model has been described in the document as a guide to those involved in carrying out the Course Development Flow, in which unlike the five steps of the traditional ADDIE model, six steps are presented, as shown in Figure 1. The activities (sub-steps) of the extended ADDIE (X-ADDIE) development flow, related to each step of Figure 1, are presented in Figure 2. In the development flow, the production steps of the structuring documents are also indicated, namely, Context Analysis, Educational Activity Roadmap, Production Roadmap and the Pilot Class Assessment Report.

The first step of the flow illustrated in Figure 1, Analysis step (1), is oriented by the structuring document Contextual analysis. This document gathers guiding questions divided into 11 themes, which refer to items related to management and pedagogical aspects that determine the content's characteristics.

When analyzing the description of the first step of the ADDIE model at Enap, it is concluded that in the Enap the actions performed for the production of the self-instructional courses, within its limits, meet the educational guidelines of the document *Guidelines for the Educational Proposal of Enap* [13], in portuguese Referenciais Orientadores da Proposta Educacional da Enap, and educational theories that demonstrate that a course, even presenting the behaviorist structure, may contain constructivist aspects for learning. This is perceptible with the pedagogical data of the contextual analysis.

The Drawing step (2) in Figure 1 is the point at which a content expert is designated also known as the subject-matter expert. This professional is designated by the applicant institution of the course. The educational and content planner guides their work through the Teaching Activities Roadmap, an instrument that aims to assist in the planning of course

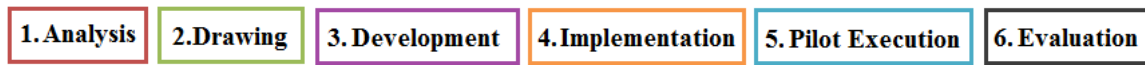


Fig. 1. Steps of the development flow proposed of new courses.

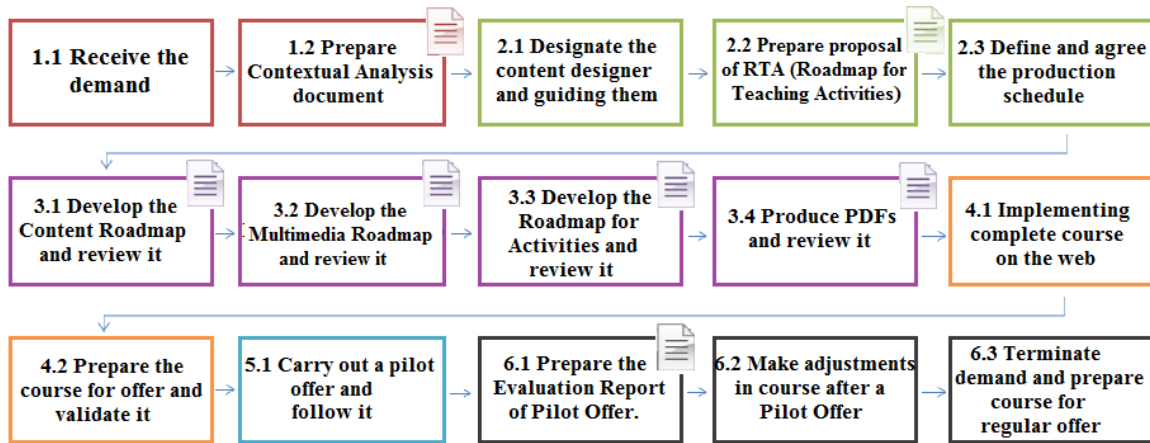


Fig. 2. Sub-steps of the development flow proposed of new courses.

development, since the content is presented in an organized and integrated way [3]. The Activity Roadmap is a guiding document for the development of learning activities. It presents the possibilities of activities available in the Learning Management System (LMS), as well as tables to fill in the information indispensable for the correct configuration of these activities in LMS. The options of activities can be forums, questions of multiple choice, right or wrong, among others. An important field to fill out is feedback for the student. The document is intended to describe how content and activities should be developed in accordance with the proposed objectives. In the preparation of the document, its information must be based on Contextual Analysis.

The general objective of the course should be established from the understanding of the educational problem, understood with the Contextual Analysis. Next, the specific objectives of learning are established, that are necessary to achieve the overall goal. In order to elaborate these objectives, the educational planner works with the subject-matter expert.

In the third step, Development step (3) in Figure 1, the elaboration of pedagogical resources begins: illustrative images, infographics, characters, animations and also the elaboration of course content. In order to organize and systematize the development of the courses in such a way that the different teams involved can be aligned in a common goal, was desolved the structured document Production Roadmap, consisting of three interconnected road maps and with the necessary informations for the different areas to produce the courses, defined as follows: a) Content Roadmap; b) Multimedia Roadmap; c) Activities Roadmap.

The Content Roadmap is the document that guides the content elaboration in an interactive and adapted to the DL. In the document there are guidelines to the subject-matter

expert and the educational planner for the formatting of the text and the use of the visual resources. The document is also a mechanism for Information Technology (IT) staff who, when implementing the course in the platform, uses the roadmap to apply the established definitions. In Figure 3 is illustrated an example of the formatting instruction of the Content Roadmap carried out by the subject-matter expert and its aesthetic results after implementation on the Moodle platform.

Then, in Figure 4 two examples are presented: in example 1, is shown the way an image is signaled in the Content Roadmap (red highlight color, with numbering and title). In example 2, are depicted the details of the image production in the Content Roadmap. The Multimedia Roadmap guides the elaboration of infographics, images, videos, animations, characters and banners.

The Activities Roadmap is the guiding document of development of the activities of learning. It presents the possibilities of activities available in the Learning Management System (LMS). It should be emphasized that the construction of a course happens in a complex way, approaching different facets simultaneously. In this way, the roadmaps cited are linked to each other and can be constructed and validated both sequentially and simultaneously. After all these substeps the production roadmap is sent to the responsible for creating the PDFs and for the IT team to implement the course.

In both design and development, steps in which the educational planner and the subject-matter expert work together, we can see that there is a convergence between what is realized in the Enap and what is proposed in the theory of [12]. According to these authors the preparation of a DL course requires a content specialist as well as an instructional professional to tailor the content to the theory and practice of learning. During the remarks, in the production of 11 courses at Enap, 10


	Content Roadmap	As it appears in the Virtual School
TIP - Brief advice or suggested recommendation.	Recalling that: art. 26 of Law No. 8.666/93 requires detailed reasons for all cases of inflexibility and for most cases of dispensation. The art. 26 [...]	 Recalling that: art. 26 of Law No. 8666/93 requires detailed reasons for all cases of non-enforceability and for most cases of dispensation. The art. 26 establishes the obligation to communicate to the higher authority, ratification and even publication of the act in the Official Press.

Fig. 3. Example of formatting instruction Content Roadmap

Example 1: Instruction of content roadmap:

PICTURE 1 - CHARACTER GIVIN WELCOME

Example 2: Multimedia Roadmap Instruction

General orientation for character production:

Indicate in the table below if there will be one or more characters for the course and what its characteristics - age, economic and social profile, profession, skin color, clothing, striking details, etc. [...]


Orientation for the production of scenes involving characters:		
Module 1 / Topic 1	Description of the scene / character	Dialogue or speech associated with the scene
	The character should be with animated expression, open smile, closed eyes and open arms, as in the inspiring image. 	Balloon on the left - Hello, welcome to the Course [...]

Fig. 4. Image illustration flagged in the Content Roadmap (Example 1) and the details of the image production in the Multimedia Roadmap (Example 2).

content managers did not have the knowledge of how a course is elaborated from a pedagogical point of view, not aware of how online learning occurs and they tend to reproduce in the Learning Management System (LMS) the format of a classroom lesson. According to the observations, the correction of this tendency occurs precisely in the performance of the educational planner.

In the fourth step of the flow illustrated in Figure 1, Implementation (4), the entire course production is completed and the work of the IT team begins, making all the necessary settings and adjustments to implement the proposal of the instructional design of the Production Roadmap. In this step, it is verified that the completed version of the Production Roadmap is a means that establishes a common language among all the teams involved in the development of the course. It is therefore found that when this document is filled correctly, the course is implemented as planned.

The fifth step of the Pilot Execution (5) flow in Figure 1 was an extension to the traditional ADDIE (X-ADDIE) model. It results from the adaptation of the ADDIE model carried out

by Enap, which consisted of the transformation of the sub-step Execution into a new step, the Pilot Execution. This step consists of the pilot offer of the course. The main benefit of this extension was to more accurately delineate the tasks of the IT team, which remained in the Implementation step, and the tasks of the pedagogical team, now focused on Pilot Execution. It constituted, therefore, another one-off organization that contributed to the systematization of the process as a whole. The inclusion of the step of Pilot Execution organized the actions directed to the course offer and the information collection through a Satisfaction Evaluation answered by the students, from which the possible remaining tasks or the necessary improvements of the Technology team of the Information (IT), pedagogical team and content managers. All steps of X-ADDIE can be tracked using a project manager tool. A qualitative approach is used to evaluate the X-ADDIE model.

According to Figure 1, the last step of the flow is the Evaluation (6). For the accomplishment of this phase, all the information of the Evaluation of Reaction is considered. This information is compiled in the Pilot Class Assessment Report.

IV. CONCLUSION

In this paper, we propose the extended ADDIE (X-ADDIE) for the elaboration of DL courses. In the proposed X-ADDIE, besides the execution step, a new step is added, defined as pilot experiment. The X-ADDIE steps are tracked by the project management tool Redmine. We evaluate the proposed X-ADDIE model by means of a qualitative approach for courses prepared by more than 20 professionals.

The experience of the course production in Enap shows that in the traditional ADDIE the implementation phase was considered as a finishing space in which only the planning established in the previous phases was executed. The new X-ADDIE organization has transferred this simple execution to the later phase (Pilot Execution), allowing a better systematization of the implementation actions and generating a space of experimentation and changes in the teaching platform from the point of view of the design, in the way content is presented to students. The Implementation phase has also become a space for searching for innovations since they have a concrete starting point on which they can be built: the content visualized on the platform.

With X-ADDIE, the courses became customized and no longer follow the traditional pattern of content organization on the platform. With the new phase of X-ADDIE the favoring of reflection and search for innovations to those involved in the process, excluding the mechanical and predetermined caratr of following established and routine processes, occurs. With this, there is a gain in relation to the production of sophisticated courses from a design point of view and visually more pleasant, also dimensioning the volume of information on a page with content, which makes it easier to learn. This experience allows us to conclude that the use of the X-ADDIE model allows the construction of quality self-instructional courses, maintaining a coherence relationship between the content, the target audience and their training needs. The use of the X-ADDIE allows the planning and development of an pedagogical mediation that leads to meaningful learning. In terms of management, it confers quality to the final result and the Redmine optimizes the fulfillment of the model steps.

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