Article **Journal Information Technology**
December, 2023 Vol.10 No.30 16-26

ADDIE model as a methodology for the design of distance courses

Modelo ADDIE como metodología para el diseño de cursos a distancia

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DOI: 10.35429/JIT.2023.30.10.16.26 Received: August 10, 2023; Accepted December 20, 2023

Abstract

The ADDIE model is an iterative approach aimed at designing and implementing distance learning courses that are adaptable to the needs and characteristics of students. It allows for improvements and adjustments in each of its phases, ensuring a quality learning experience for students immersed in virtual environments. This article reflects on the experience of designing distance courses for a postgraduate educational program using this methodology, highlighting the advantages and challenges that arose during the process.

Virtual learning environments, ADDIE Model, Instructional Design, LMS, Chamilo, Virtual Classrooms

Resumen

El modelo ADDIE es un enfoque iterativo orientado al diseño e implementación de cursos a distancia adaptables a las necesidades y características de los estudiantes, permite mejoras y ajustes en cada una de las fases que lo conforman lo que garantiza una experiencia de aprendizaje de calidad para los estudiantes que se encuentran inmersos en los ambientes virtuales. El presente artículo hace una reflexión luego de la experiencia de diseñar cursos a distancia para un programa educativo de posgrado siguiendo esta metodología destacando las ventajas y desafíos que surgieron durante el proceso

Entornos virtuales de aprendizaje, Modelo ADDIE, Diseño Instruccional, LMS, Chamilo, Aulas Virtuales

Citation: SANCHEZ-GARCÍA, Judith Ruby, GALEANA-VICTORIA, Luis Gustavo, FLORES-AZCANIO, Nancy Patricia and SÁNCHEZ-VÁZQUEZ, Elizabeth. ADDIE model as a methodology for the design of distance courses. Journal Information Technology. 2023. 10-30: 16-26

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1. Introduction

During the months of April and May 2020, an educational technology project was developed based on the implementation of an emerging virtual learning ecosystem using the LMS (Learning Management System) Chamilo platform, so that students of the master's degree in Image and Creativity in Education at the Institute for Cultural Integration in the municipality of Tultepec in the State of Mexico could continue with their studies; at first, there were no definite plans to transfer face-to-face education to an online environment, the necessary training was not available for managers and academics, and time was something that had to be considered. The confinement caused by COVID-19 established a series of restrictions that permeated the delivery of face-to-face courses, so it was urgent to move all academic management to a virtual environment (Cencia Crispín, Carreño Colchado, Eche Querevalú, Barrantes Morales, & Cárdenas Baldeón, 2021).

To achieve the above, a strategy based on the ADDIE methodology was adopted, which consists of a systematic approach covering the phases of analysis, design, development, implementation and evaluation (Branch, 2010a), each of these representing a critical stage in the process of designing and developing a course or learning programme for an online environment. In the design of distance learning courses it is fundamental to follow a methodology that guarantees an effective and meaningful learning experience for students, if in addition to this it is considered that there are situations in which time is an important factor for its rapid implementation, the challenge takes a direction towards innovation and creativity (Ruipérez & García, 2020).

The ADDIE methodology was developed in the 1970s by the United States Air Force Training Projects Agency. Although its origin is in the military, its systematic approach and effectiveness for course design have led to its adoption in various fields, including education, corporate training and online course development. This methodology has been widely used for the development of distance learning courses due to its systematic and structured approach, which allows for the creation of high quality learning materials and their adaptation to the needs of the target audience.

Its stages are analysis, design, development, implementation and evaluation and the first letters form the meaning of ADDIE (Guerra Genskowsky & Carrasco Medanic, 2009). It is important to note that the ADDIE methodology is highly flexible and adaptable. This means that it can be adjusted according to the specific needs of each educational project, allowing the incorporation of emerging approaches and innovative technologies for the creation of distance learning courses (Branch, 2010a) (Carrillo & Roa, 2018).

1.1 Advantages of the ADDIE methodology

The systematic approach of the ADDIE model considers a structured and systematic approach to instructional design. Each phase (analysis, design, development, implementation and evaluation) (Pacheco, 2020) is addressed in a sequential manner which ensures that each aspect of the design process is carefully considered. Some advantages of the model are listed below:

– Adaptability: ADDIE is highly adaptable and can be applied in a variety of educational contexts and for different audiences. It can be adjusted to the specific needs of each project, making it a versatile model for the design of distance learning courses.

– Focus on results: The ADDIE methodology focuses on the achievement of specific learning outcomes. By constantly analysing and evaluating course design and implementation, it ensures that learning objectives are effectively achieved.

– Continuous Improvement: The ADDIE model promotes a continuous improvement approach to course design. Through the Evaluation phase, valuable feedback is obtained from learners and areas for improvement are identified, allowing adjustments to be made and the quality of the course to be optimised in future iterations.

ISSN: 2410-4000

– Learner-centred approach: ADDIE places emphasis on understanding the needs and characteristics of the target audience. This allows for the development of content and teaching strategies that are tailored to the learning preferences of the learners, which can improve the effectiveness of the course.

There are other models that can be used as a reference for the design of distance learning courses in virtual classrooms, Among the most prominent are the SAM (Succesive Approximation Model) which focuses on rapid interaction and continuous revision of the design which makes early versions of the course experimental and learning experiences diverse across generational cuts of learners.

The Dick and Carey model follows a sequential approach, but tends to be more prescriptive and detailed in the planning and development of instructional design and the Kemp model, which focuses on constructivist learning principles, while sharing some elements with ADDIE is not as popular (Walter & O Carey, 2014).

The ADDIE model is chosen for this project, which is part of a series of works aimed at finding different strategies and methodologies that promote and boost the learning process through the use of information and communication technologies. (Sanchez-García, Flores-Azcanio, & Galeana-Victoria, 2022) The model was selected for the theoretical reference identified at the time and for the facilities provided by the Chamilo platform. At this stage of the project, the virtual classrooms were developed, so the main objective of this research is to present the results obtained after implementation, as well as the reflections obtained during the process.

2. Theoretical framework

2.1 Context of distance education and its relevance in the digital age

Distance education experienced a significant transformation in today's digital age, also known as online education or e-learning, refers to the mode of delivery that allows students to access educational content and engage in learning activities without the need to be physically present in a traditional classroom.

The Horizon reports produced by the NMC (New Media Consortium) and EDUCAUSE Learning Interactive are constantly referenced for their stance of promoting an objective and analytical view of educational trends and from there a series of E-learning characteristics are mentioned such as access to education without geographical barriers, flexibility and self-management of learning, variety of educational resources and technologies, personalisation of learning, collaborative learning and knowledge networks, continuous training and professional updating (Johnson *et al*., 2016) (Ruipérez & García, 2020) (Salinas Ibáñez, 2004).

The pandemic of 2020 accelerated the adoption of distance education worldwide (Redacción, 2020) and educational institutions found it necessary to adapt quickly to virtual environments to ensure continuity of learning. Over time it has brought profound changes in the way students access education and how the teaching and learning process takes place.

The relevance of distance education lies in its ability to provide broad and flexible access to education, allowing individuals to train and update their knowledge continuously and in line with the demands of today's world of work (Ibarra, Ortega, & Ortiz, 2003).

2.2 Learning theories and methodologies in the design of distance learning courses

The theory of behaviourism has as a fundamental principle that learning is the result of the interaction between external stimuli and observable responses of the individual, emphasising the use of positive and negative reinforcement to encourage desired learning behaviours (Aparicio Gómez & Ostos Ortiz, 2018). Course design based on this theory focuses on clear presentation of content, repetition and practice to reinforce learning, activities and assessments are structured to measure observable student performance (Van Merriënboer & Sweller, 2005). On the other hand; constructivist theory views learning as an active process in which the student constructs meaning from their experiences and prior knowledge, meaningful learning is promoted through problem solving.

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Project-based learning and active student participation in the educational process in course design encourages the creation of collaborative learning environments where students can share ideas, reflect on their experiences and build knowledge together (Ortiz Granja, 2015).

Connectivism theory describes that knowledge is distributed in a network of connections and information systems. Learning is about connecting to this network and knowing how to access relevant information, and course design under this approach incorporates digital technologies and tools that enable students to access resources and subject matter experts, fostering lifelong learning and the ability to filter, evaluate and create information in the digital age (Quintana, Vidal, Torres, Castrillejo, & Nodos, 2006). Learning theories vary according to the learning objectives being pursued, and it is common for instructional design approaches to combine several theories to suit different learner needs or different educational contexts. An overview of learning theories is described in Table 1.

Aspect	Behaviourism	Constructivism	Connectivism
Fundamental principle	Learning based on external stimuli and observable responses.	Learning is an active process where the learner constructs meaning from his or her experiences and prior knowledge.	Knowledge is distributed and learning occurs through network connections.
Educational approach	Reinforcement and practice to encourage desired behaviours.	Problem solving, project-based learning and active student participation.	Access to relevant information and learning through online connections.
Role of the learner	Passive receiver of information and stimuli.	Active knowledge builder through interaction and reflection.	Network connector, seeking and sharing information and resources.
Role of the teacher	Transmitter of knowledge and organiser of learning.	Facilitator of learning, guide and support in the process of knowledge construction.	Designer of networked learning experiences and facilitator of connections.
Learning environment	Structured and focused on observable outcomes.	Collaborative, flexible and student-centred.	Networked, enriched by technology and online interaction.
Teaching strategies	Direct instruction, repetition and reinforcement.	Collaborative learning, projects and reflection.	Use of technology and social networks to access and share information.
Assessment	Measurement of observable outcomes and conditioned responses.	Assessment of meaningful learning and deep understanding.	Assessment of access to relevant information and ability to connect online.

Table 1 Comparative table between the different learning theories that serve as the main focus for instructional design

Instructional design is a systematic and planned approach to the creation and development of effective learning experiences. It aims to design courses, programmes or educational materials in a strategic and structured way, ensuring that learning objectives are achieved in an effective and meaningful way for learners (Smith & Ragan, 1999). The process involves several stages which may vary according to the approach or theory of learning used:

– Needs analysis: Identifying the learning needs of the target audience and the objectives to be achieved.

– Content design: Creation of a teaching and learning plan, including the selection of pedagogical strategies, learning activities, assessments and educational resources.

– Development: Creation of educational materials and resources, such as presentations, videos, exercises, etc.

– Implementation. Implementation of the course or educational programme, ensuring that it follows the designed plan.

– Evaluation. Evaluation of the instructional design and student learning to determine if the objectives were achieved and to make improvements in future interactions.

Throughout the history of instructional design since its inception in 1960 by Robert Gagné (Al-Eraky, 2012) its use has been promoted by various experts in education and pedagogy, in the 1960s a number of principles for effective teaching were developed and applied in various teaching materials. Some influential (most influential) authors were Benjamin Bloom, who developed a taxonomy of educational objectives that classifies learning objectives into different cognitive levels (Guskey, 2005). David Merril proposed a model called Component Display Theory which focuses on presenting educational content in a clear and sequential manner. Robert Mager developed the Objective-Based Approach model that focuses on establishing clear and measurable objectives before designing the course content.

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Finally, we remember Dick and Carey who proposed a systematic model of instructional design that follows 9 stages for course planning and development (Walter & O Carey, 2014).

Instructional design and the ADDIE model are closely related, as instructional design is a methodological approach used to guide and structure the process of designing learning experiences, in the ADDIE model instructional design provides a theoretical and practical framework for planning and developing effective learning experiences that conforms to the sequential structure of the model.

2.3. Stages of the ADDIE model and the role of instructional design

Instructional design plays a key role in each of the phases of the ADDIE model, according to the text Instructional design: The Addie approach by Robert Maribe Branch describes the 5 stages of the model (Branch, 2010a) that allow an efficient digital content production, being the evaluation the one that allows the possibility to update, expand or improve the contents for a better adaptation to the learning conditions and needs.

– *Analysis:* In this stage, instructional design focuses on identifying learning needs, target audience and specific educational objectives. An assessment is made of the characteristics of the audience, the resources available and the constraints of the educational environment.

– *Design:* This is where instructional design comes into play by establishing the overall structure of the course or learning experience. It determines the pedagogical strategies, instructional resources, learning activities and assessment methods that align with the learning objectives identified in the analysis phase.

– *Development:* During this phase, the instructional design is materialised through the creation of the educational content and resources. Learning theories, best pedagogical practices and appropriate methodologies are used to develop materials that facilitate the achievement of the learning objectives.

– *Implementation:* The implementation of the instructional design is carried out by putting into practice the course or learning experience created. Here the structure and pedagogical strategies previously defined in the instructional design are followed.

– *Evaluation:* Finally, the instructional design relates to the evaluation phase by analysing the effectiveness and efficiency of the course or learning experience. Data are collected to measure the achievement of the learning objectives and identify areas of improvement for future iterations.

There are some advantages to combining the ADDIE model with instructional design, firstly, there is a systematic and structured approach to the design of learning experiences which ensures careful planning and consistent alignment with educational objectives. The learner-centred approach that exclusively focuses on understanding the needs and characteristics of the target audience ensures that the learning experience is relevant and meaningful to learners. A third advantage is the adaptability that emphasises the relationship between instructional design and the ADDIE model allowing for the adaptation and customisation of learning experiences for different contexts and audiences, which optimises the effectiveness of the design and finally the continuous improvement that aligns with the evaluation phase of the model (Carrillo & Roa, 2018) (Branch, 2010b).

3. Methodology

As part of the methodology used for the development of this article, we opted for a mixed methodology that combines qualitative and quantitative approaches (Hernández-Sampieri, Fernández-Collado, & Baptista-Lucio, 1991) in order to obtain the most complete and enriching vision possible of the impacts and effectiveness of the ADDIE model in the design of distance learning courses and the experience of implementing the model at the Institute for Cultural Integration to promote the educational offer of the Master's degree in Innovation and Creativity in Education.

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In general terms, the activities carried out included the design of the study, which basically consisted of defining the research objectives, which were to analyse the application of the ADDIE methodology in the design of distance courses on the Chamilo platform in order to promote the educational offer of the Master's degree in Innovation and Creativity in Education at the Institute for Cultural Integration. For the above, once the distance courses were used by the students, we proceeded to collect data through a survey to evaluate the experience obtained, in addition to some interviews with teachers, managers and collaborators involved in the design and teaching process of the distance course. The next step was the analysis of the quantitative and qualitative data for subsequent comparison and understanding to help draw a series of conclusions and reflections. The aim of using this methodology is also to get a holistic picture of how the ADDIE model influenced the distance learning course design process.

3.1 Steps of the ADDIE model applied during the process of designing distance learning courses for the Master of Innovation and Creativity in Education

For the purpose of documenting this article, we took into consideration the experience obtained with the development of distance courses of the subjects of the first and second semesters of the Master's Degree in Innovation and Creativity in Education, such as: current learning theories, teacher training and creativity, philosophy of new technologies, educational context of the 21st century, didactic use of the Internet and degree seminar I. Once the respective educational programmes, syllabuses and reference bibliographies for each one had been consulted, the didactic materials produced at the time of the confinement during the COVID-19 pandemic began to be reviewed, which meant the beginning of the monitoring of the model in the stages, the whole process being as follows:

– *Analysis:* In this stage, a comprehensive analysis of the learning needs and educational objectives set out in the programmes was carried out. The profile of the students enrolled in the 2019-2021 programme was identified, their characteristics and specific requirements to be considered during the design of each course and to be adjusted to their needs.

– *Design:* Entering the second stage of the model, the general structure of each of the distance learning courses is established. The topics or modules to be addressed were determined, as well as the necessary educational resources made up of links, electronic documents, video materials, podcasts, infographics, among others. The Chamilo system has modules dedicated to the capture of information regarding the syllabus, learning objectives and assessment strategies.

– *Development:* In this phase, educational content was created and learning materials were developed for the most important topics, shared electronic presentations, videos, interactive activities and online assessments were produced. Multimedia resources were used to enhance the learning experience in the virtual environment, they were set up in each virtual classroom enabling interaction functionalities such as discussion forums, sending and receiving private messages, collaborative wiki sites and chats.

– *Implementation:* Once the materials and resources were ready, the publication and configuration of each virtual classroom began, the platform allowed the configuration of lessons, activities, tasks and internal repositories for the publication of documents and support materials that teachers can manage with the group privately. The site administrator organised the registration and management of users by making a number of adjustments to the overall configuration to ensure data security, flexibility and resource utilisation. Teacher training was key as part of the implementation process, a 10-hour training course was organised for teachers to learn about the management of their content, the assessment process, the assignment of tasks and the design of knowledge assessment activities or tests. An email address was provided for login through the address https://iictultepec.edu.mx to be able to log in from a web browser from a personal computer or a mobile phone.

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– *Evaluation:* The evaluation phase was crucial to measure the effectiveness of the course. Data was collected on student performance, learning satisfaction and the effectiveness of the educational materials. This data is used to make improvements in future iterations of the course and to ensure that the learning objectives are achieved and formed the basis for the publication of this article.

3.2 Evaluation of courses developed and results obtained in students

In order to collect data on the students' experience, a survey-type evaluation instrument was designed, consisting of 15 items that sought to determine the level of satisfaction with the learning needs, the quality of the content, learning time of the virtual classroom functionalities, communication with the course teacher and technical support, and feedback during learning, among other points.

The type of survey collected numerical data on a Likert scale (from 1 to 5) was entitled Evaluation of the Distance Learning Course in the Master's Degree in Innovation and Creativity in Education and had the following instructions at the beginning: Answer the following questions about your experience of the distance course. Use a scale from 1 to 5 to indicate your level of agreement with each statement, where 1 means strongly disagree and 5 means strongly agree. You may optionally provide additional comments at the end of the survey.

1. The course content was relevant to my learning needs.
2. The course design facilitated my understanding of the topics presented.
3. The learning activities enabled me to apply the concepts in a practical way.
4. The resources provided were useful to my learning process.
5. The pace of the course was adequate and allowed me to progress at my own pace.
6. Communication with the instructor was clear and timely.
7. The assessments and feedback were relevant to my learning.
8. The platform or tool used for the course was easy to use.
9. The graphic design and presentation of the content was appealing.
10. The course provided me with new skills or knowledge useful for my personal or professional development.
11. The interaction with other students in forums and activities was enriching.
12. The time allotted to complete the activities was sufficient.
13. I would recommend this course to others interested in the subject.
14. The technical support and assistance was effective in case of problems or doubts.
15. Do you have any additional comments or suggestions for improving the course?

The instrument included a drop-down list to select any of the courses Current Learning Theories, Teacher Education and Creativity, Philosophy of New Technologies, Educational Context of the 21st Century, Didactic Use of the Internet and Degree Seminar I to issue an evaluation for each course. The students were told that at the end of their respective courses they should answer the closing survey, with 27 participants providing the necessary data.

Figure 1 shows the results of the survey for the didactic use of the Internet course, which shows the general concentration of questions with the answers obtained, in question number 8 The platform or tool used for the course was easy to use shows a low result, then in figure 2 the teacher training and creativity course has a number of differences over the previous one as the clarity of the platform and the time allocated were not satisfactory while figure 3 shows a trend that the pace of the course and communication with the advisor was not adequate.

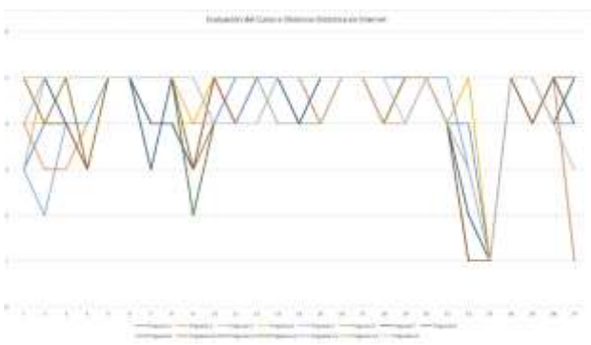

Figure 1 Evaluation of the Distance Learning Course Educational Use of the Internet

ISSN: 2410-4000

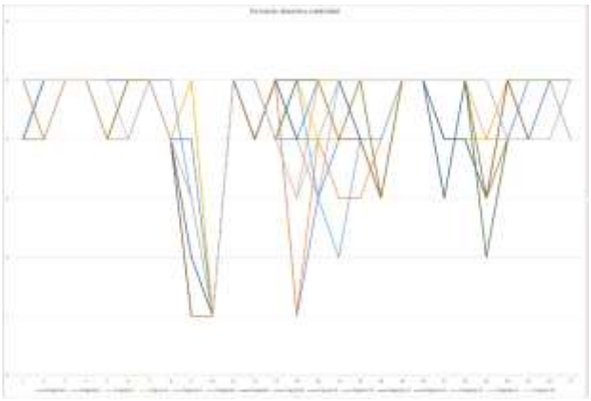

Figure 2 Evaluation of the Teacher Training and Creativity course

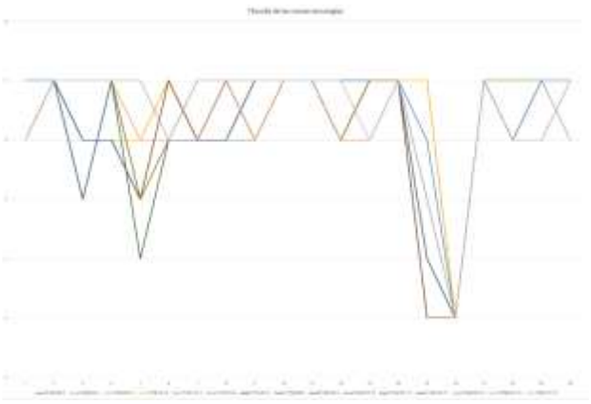

Figure 3 Course evaluation Philosophies of new technologies

It should be noted that the design of distance learning courses following the ADDIE methodology involved analysing in a general and emergent way the needs that arose given the conditions of distance work, as well as the learning objectives that were previously established for all the courses that were being taught, the characteristics of the student community, the limitations in terms of the use and management of computer resources, and the limitations in terms of the use and management of computer resources.

One of the advantages offered by the methodology is the ability to adapt content in a sequential manner, divided into phases such as knowledge survey questionnaires or diagnostic assessments, comprehension activities, readings, discussion and reflection forums, debates and the possibility of generating a small wiki site, practice questionnaires and a final assessment that will allow the accreditation of the course in general. The students carried out their feedback questionnaire considering the overall learning experience.

3.3 Collection of qualitative data from teachers and administrative staff

1. In the case of the teachers and administrators, five personalised interviews were conducted via video conference with the aim of finding out their general impressions, comments and teaching experience, reflecting on the training received for the mastery of the platform, functionalities and problem solving to the possibility of creating content, assessing learning and monitoring each student, during the training the teachers identified the basic functionalities such as the announcement sections, assessments, tasks, forums, wiki, links among others.

During the interviews for each teacher and academic administrator, trends were detected in the opinions that pointed out that the platform was confusing in a certain sense at the beginning, as for the assignment and evaluation of tasks they mentioned in general that it was not possible to give extended times to students for the delivery of tasks individually and the visualisation of them was not comfortable in mobile devices and even in web browsers. However, the simplification of the topics in lessons, the possibility to show transparency in the evaluation process and the generation of evidence is very intuitive compared to other platforms. It was also commented that the use of other external resources such as video conferencing tools, interactive content, electronic documents and multimedia resources help to make the learning experience sequential and orderly.

Once the video lectures were completed, they were stored in a repository for analysis and a narrative report was produced describing the comments collected, as a summary, the main ones are shown below: the following were presented:

– "The platform is not clear in the management of tasks".
– "I had a hard time setting up the Wiki site, the students did not manage to complete the activity and I could not find a way to evaluate it".
– I ended up uploading almost all the class material in the files section".
– I liked the fact that I was able to do face-to-face assessments and assign grades".

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- "The evaluation section does not allow many adjustments on the progress of the course, before possible contingencies you cannot modify much".
- "I liked the platform, I will most likely continue to use it once we return to the classroom".
- I really enjoyed the lessons section".
- The experience on mobile devices is very slow and confusing".

Results

It is important to keep in mind that, although Chamilo offers a solid platform for the implementation of virtual classrooms, it is necessary to have an adequate planning and instructional design methodology to guarantee an effective learning experience. The ADDIE methodology allows to personalise the learning experience in a simple and emergent way, giving meaning and sense to the fact of using an electronic platform. The MA in Educational Innovation and Creativity now has an alternative that worked during the period of confinement. After the release of distance learning courses, it was essential to have adequate training for educators, students and academic administrators as well as the technical support necessary to ensure smooth operation.

As with any open licence system, it is important to emphasise that the system's smooth operation depends on a number of technical and infrastructure considerations that must be addressed at the time, and that it is essential to have a technical support person to provide advice, training and attend to incidents at all times so that the number of failures, forgotten passwords and general queries can be dealt with efficiently.

Teachers require very punctual and specific training, in addition to the fact that the teacher's disposition must be constant. Let's remember that during the COVID-19 pandemic, many teachers had to learn several tools in a short time, which led many of them to drop out and only comply with the minimum necessary.

According to the students, the overall experience is good, although the confusion in the interface at the beginning caused difficulties at the end of the course and everyone knew how to identify the main functions of the platform, the production of content had no problems so the ADDIE methodology worked in this case, according to the results of the surveys in terms of content design there were no problems or comments about it so that in a next project is now planned to adapt the contents to the hybrid mode.

Acknowledgement

In a general way, we would like to extend a special recognition and thanks to the Instituto de Integración Cultural IIC for the facilities and trust in the realisation of this project, to the students of this institute for their continuous feedback as well as to M. en G. Luis Gustavo Galeana Victoria and Dr. Nancy Patricia Flores Azcanio, members of the Cuerpo Académico Tecnologías Emergentes of the Universidad Politécnica del Valle de México, for their constant enthusiasm and important contributions for the realisation of all the works that have been carried out up to the moment.

Conclusions

- The ADDIE procedure for the creation of emerging courses for distance education in a hybrid model, allows the optimisation of rapid content production, coherent structure and sequence as well as the possibility of continuous improvement.
- Instructional designers find a viable alternative for the production of virtual learning classrooms by creating techno-pedagogical scripts, SCORM lessons in less time following the methodology.
- Positive evaluation by the postgraduate students in general.

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