

Learning Environment Model Based on the UDL Approach to Promote Inclusive Education

Modelo de entorno de aprendizaje basado en el enfoque DUA para promover la educación inclusiva

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Resumen. La educación inclusiva en el ámbito universitario sigue siendo un reto a la hora de proporcionar una educación equitativa a los estudiantes con necesidades diversas, incluso en la actualidad, ya que persisten las barreras de accesibilidad. El objetivo principal de esta investigación es basarse en el Diseño Universal para el Aprendizaje (UDL) para proponer un modelo de entornos de aprendizaje inclusivos, una guía para que las universidades alcancen la inclusión, analizar los servicios que ofrecen las universidades y determinar si, a través de este modelo, los estudiantes con cualquier necesidad pueden desarrollarse y tener acceso a los diversos servicios que ofrecen las universidades. La presente investigación se enmarca en una metodología mixta, ya que integra elementos cualitativos, cuantitativos y de diseño. Se analizó la posible aplicación del modelo a través de un estudio de caso en un grupo de 37 estudiantes, tres de los cuales tienen algún tipo de discapacidad, y su impacto en el proceso educativo. Los resultados ponen de relieve cómo el uso de tecnologías, materiales adaptados y personalizados contribuye a mejorar la autonomía de los estudiantes, su participación y su rendimiento académico.

Palabras clave: Educación inclusiva, Entorno de aprendizaje personal, Diseño universal para el aprendizaje, Centros de educación superior.

Summary. Inclusive education at the university level remains a challenge to provide equal education for students with different needs even today, as accessibility barriers persist. The main objective of this research is to be based on the Universal Design for Learning (UDL) to propose a model for inclusive learning environments, a guide for universities to reach inclusion, to analyze the services offered by universities and if through these model students with any need can develop and have access to the various services offered by universities. The present research is framed within a mixed methodology since it integrates qualitative, quantitative and design elements. The possible application of the model was analyzed through a case study scenario in a group of 37 students, three of whom have some type of disability, and its impact on the educational process. The results highlight how the use of technologies, adapted and personalized materials contribute to improving students' autonomy, participation and academic performance.

Keywords: Inclusive education, Personal learning environment, Universal design for learning, Higher education institutions.

1 Introduction

Inclusive education recognizes to note that students have different characteristics, one of the goals is to ensure that these students should be treated equally and with dignity so that they can achieve the expected learning and eliminate the barriers that limit them. Similarly, it seeks to reduce the barriers that hinder learning, through the participation and integration of different key actors that influence the student development such as teachers, students, managers, family and the academic community [1].

Globally, inclusive education in higher education institutions has gained relevance in recent years, since the objective is to guarantee quality training and education, regardless of the conditions of those who are already part of these institutions or those who are about to enter [2].

However, despite efforts to promote equitable access to higher education, research shows that there continues to be a high dropout rate among students with disabilities, who continue to face barriers in terms of infrastructure, lack of information, inaccessible technologies, and policies that are not effectively enforced [3].

1.1 Problem

University is currently seen as a complex place in terms of organization, policies and structure, where the implementation of inclusive education continues to represent a significant challenge, as pointed out by [3]. This is evidenced in existing literature, as well as in recent research. From the teachers' perspective, one of the main reasons inclusive education, has not advanced is the lack of experience and training in this area. It is recognized that the willingness and commitment of both teachers and managers are not enough, if they are not accompanied by programs and models that provide and adequately address the needs of people with different conditions.

Inclusion in higher education institutions continues to be a challenge, although it also represents an opportunity to guarantee equitable access to education. To effectively address the individual needs of students with different conditions and abilities, the implementation of adaptive models is indispensable [4].

One of the most relevant problems is the lack of learning environments that respond to these needs. Despite advances in inclusion policies, universities continue to show a lack of accessibility in the services they offer, since they cannot guarantee equal access to education and to the educational materials needed by students with disabilities [5]. In addition to this, the lack of accessibility to educational resources, limited access to assistive technologies, and synchronization between technology, academic advising, and learning strategies continue to create barriers to student development and learning.

This research presents a model of an inclusive personal learning environment based on the principles of universal design for learning (UDL), which integrates various subsystems aimed at providing support to students and thus facilitate their learning process. The main objective is to examine how this model helps students to access the different services offered by universities regardless of their conditions or needs. To illustrate the benefits of the model, a scenario was presented in which it is applied to a group of engineering students, including three students with hearing impairment, motor impairment and low vision. Likewise, the importance of the use of accessible technologies and platforms, as well as the participation of the key actors behind the subsystems and services offered, is emphasized.

2 Conceptual frameworks

2.1 Inclusive education

In the work of [6] the following definition of inclusive education is presented: "Inclusive education is a global change in the educational system, affecting all students with a double objective: to achieve the success of all, without exception, in school; and to fight against any cause or reason for exclusion, segregation or discrimination".

According to [7] university students become aware of some deficiencies in their learning process in the first semesters of their professional education, interferes with their academic progress, from this perspective, higher education institutions must ensure the acquisition of new learning, skills and above all the independence of students.

For their part, [8] points out that university education for people with learning disabilities is a right. However, it is not enough to ensure the admission of this group of students to this educational level, but strategies must be implemented to help all students to be successful in their professional education.

2.2 Universal design for learning

A definition of Universal design for learning appears in [9]: “It is an approach designed to provide equal opportunities for students with disabilities to learn in inclusive environments. Through flexible curricular approaches, within the framework of a human rights-based education”.

According to [10] UDL is supported by a set of standards that can be incorporated in almost all learning environments, the implementation of UDL has to do with content and supports various forms of instructional design, in addition, they consider that most educational systems are underutilizing technological resources to address the diversity of student learning effectively.

For [11] the philosophy of UDL is based on three general principles: multiple means of participation, multiple means of content representation and multiple means of expression of knowledge and comprehension.

2.3 Personal learning environments

A definition of a PLE is found in the work of [13]: “The set of tools, information sources, connections and activities that each person assiduously uses to learn”. According to [14], the configuration of an EPA is based on the students, in such a way that it promotes participatory, free and configurable learning on the part of the learners.

However, these authors consider that studies on EPA have not been sufficient in the Mexican context. In turn, [15] mentions that when the term EPA is used, it is implicitly associated with students' self-learning, where ICT is a basic resource to carry out their academic actions, in such a way that it is the students who evaluate these resources, and they are chosen by the students according to what they consider useful and convenient.

3 Methodology and proposed model

The present research is developed under a mixed methodology incorporating qualitative, quantitative and design components.

- From the quantitative perspective, the future collection and academic analysis of students is contemplated once the model is developed and implemented; this will be evaluated to show the benefits obtained from its application.
- As for the qualitative approach, the perceptions and opinions of the teaching staff, administrative staff and students are considered fundamental. These inputs will help evaluate the approach and the outcomes expected from this research work.
- The design component is reflected in the presentation of a conceptual model that will serve as the basis for developing technological and pedagogical solutions. This structure will allow validation of the model through its application in a real educational context.

It's important to mention that quantitative and qualitative results will be got it once the personal learning environment model be implemented, for this first paper about this research, we implement a scenery to show how will work a personal learning environment model based on UDL principles.

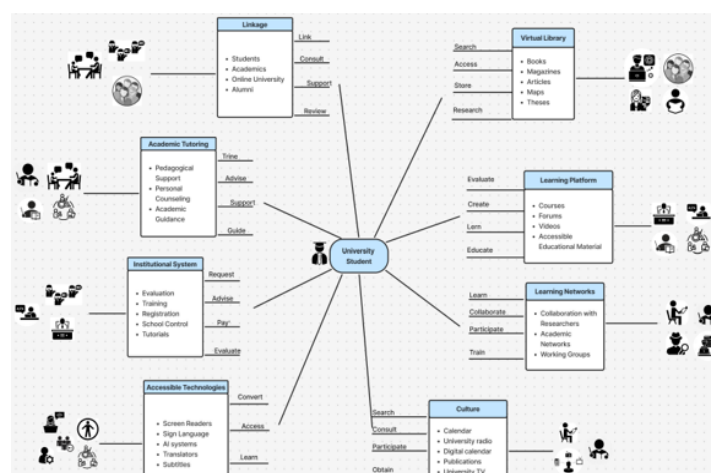


Figure 1. Inclusive personal learning environment model for university students.

Based on the above, a model of an inclusive personal learning environment for university students is proposed, as shown in Figure 1. The purpose of this model is to offer an inclusive environment that allows students to have access to various services regardless of their needs or conditions. Fig. 1 shows how the student within his environment accesses different services which he uses for his learning. The model is made up of eight subsystems, which operate in synchrony to improve the students' learning experience. Each one of them fulfills specific functions, which are described below:

Virtual Library: Its objective is to facilitate access to academic resources in accessible formats, such as books, journals, articles, theses and maps. In this way, research, self-learning and the adaptation of academic content are favored. Among the actors that manage this subsystem are librarians, coordinators, administrators and directors. This component applies the SAD in terms of the “What of Learning” since materials can be offered in different formats (audiobooks, text, documents in Braille).

- **Learning Platform:** This subsystem allows the creation and management of accessible content, courses, videos, and other accessible educational materials, providing the student with a way to learn and manage their activities autonomously.
- **Accessible Technologies:** Its main function is to provide technological tools that eliminate barriers to information access, such as screen readers, subtitles and voice recognition software, thus allowing students with hearing and visual disabilities.
- **Learning Networks:** Promotes collaboration and exchange of knowledge among students and teachers through work groups and participation in projects, thus strengthening the construction of academic networks.
- **Institutional System:** Provides administrative and academic support through academic orientation, tutoring, evaluations, school control and training reinforcing academic support to students throughout their learning process.
- **Academic Tutoring:** Offers personalized tutoring through personal counseling and provides pedagogical support and guidance to students.
- **Linkage:** This subsystem promotes interaction between students, professors, alumni and the university community in general, enriching the educational experience and facilitating access to academic materials in accessible formats, such as books, journals, articles, theses, maps.
- **Culture:** Contributes to the integral formation of students through participation in cultural activities, as well as promoting inclusion through these activities.

The UDL is applied in each subsystem through its three principles:

- **What? of learning:** The objective is that the information and contents are represented in different formats that are accessible to all students.
- **How? of learning:** It involves providing multiple forms of expression so that students can demonstrate their learning in different ways or in the way that best suits them.
- **Why? of learning:** Providing multiple forms of involvement refers to the fact that all students can be motivated and engaged in the learning process.

4 Results

It is a priority to mention that the model proposed in this study is useful for the entire student population of the Universidad Autónoma de Aguascalientes (UAA) that demands inclusive educational needs and not only for this group of students, this model is also useful for the regular student population, since inclusive education considers all students without exception, in the same way the UDL helps to personalize the learning process, in this way each student with and without disability improves their learning experience. Finally, it is clarified that the model proposed in this research was applied in the UAA, but this model can be adapted to any higher education institution, even at any educational level.

Each school year, UAA conducts a study of the traits of the student population at the undergraduate level. According to [16] in 2022 the UAA student population was distributed as follows: of a total of 13,391 students, 13,164 do not have a disability and 227 do have a disability, 98% and 2% respectively. Of the 227 who have a disability, by type of disability, they are distributed as follows: hearing 10, deaf 3, intellectual 14, motor 27, multiple, 5, psychosocial 13, psychosocial 13, motor 27 and psychosocial 13. 5, psychosocial 13, low vision 13 and blindness 22.

To apply the proposed model in this research, the following scenario is presented: Teacher López is a full-time professor in the Department of Information Systems at the UAA. This semester she teaches the subject of programming logic to students of the Computer Systems Engineering program.

This is a group of 37 students, and in this group, there are 3 students with learning deficits: Luisa has a moderate hearing problem in both ears. José has used a wheelchair since he was a child; his motor skills are considered intermediate. Jesús has low vision, which has been increasing throughout his semesters at the university.

Figure 2 shows some general indicators related to the learning process of Luisa, José and Jesús: accessibility support, level of interactive dependence, meaningful learning, and failure rate, to mention a few. These indicators, currently at UAA and without the implementation of the solution proposed in this work, suggest that these three students have a high probability of failing this and other subjects, and there is even the possibility that they will not conclude their higher education studies.

Learning situation before proposed model implementation		
	College student Luisa Learning deficit Mild hearing loss	Learning barriers "With the current educational platform in UAA I have difficulty to understand correctly auditive content"
	College student José Learning deficit Low motricity	Learning barriers "Every time I should go to the computer lab I feel very bad, because the use of the normal mouse or mousepad from computer lab equipment implies a great effort to me"
	College student Jesús Learning deficit Low vision	Learning barriers "I really suffer in team tasks, because I always have troubles to read text with a small size fonts and identify figures in images, this situation delay delivery team task to all my partners"

Figure 2. Learning indicators of students with disabilities prior to implementation of the proposed.

To provide technological support to these students in relation to their individual learning needs, an instance of the model in Fig. 1 is implemented using elements, applications, and currently available resources at UAA. These are used to exemplify each of the modules that make up the model, enabling the three undergraduate students to access Teacher Lopez's online course under the best possible conditions, in accordance with inclusive education. Fig. 3 shows how negative learning indicators, such as the risk of failing the course or not completing their degree, improved after the implementation of the model proposed in this research at UAA.

Learning situation after proposed model implementation		
	College student Luisa Learning deficit Mild hearing loss	Learning barriers "Thanks to applications like uSound and content with subtitles I've improved my audition and now I understand my learning topics in an easy way"
	College student José Learning deficit Low motricity	Learning barriers "With the support of special mouses, like eye tracking mouse or head mouse and thanks yo the new model of my PLE now I can interact with my learning content with a major velocity"
	College student Jesús Learning deficit Low vision	Learning barriers "Understant what are my learning activities and do it them is very simple now, because my new PLE have apps like NVDA screenreaders and content magnifiers"

Figure 3. Learning indicators of students with disabilities after implementing the proposed model.

Jesus has achieved a high degree of self-confidence, dependence on his peers has decreased, he has achieved a better level of educational independence with the support of assistive technologies, and he wishes to continue and complete his college degree. Jose has improved his participation in his learning environment as his mood has improved, and he is now confident of becoming a professional software developer. Luisa, with the support of assistive technology, has also improved her academic performance in all other subjects; she now feels good about herself and accepted in the group.

5 Conclusions

5.1 A Subsection Sample

The inclusive personal learning environment model for university students represents a significant improvement in terms of accessibility and quality of learning, as it allows students to access the resources, they require using adapted technologies and tools. This integration favors equality of opportunity and learning in higher education.

In the proposed scenario, after the implementation of the model, there was evidence of progress in equitable access to educational resources, as well as in the understanding of content and the development of student autonomy. These achievements were possible thanks to the resources that were adapted, since they can now access them and have greater autonomy and participation in learning.

The above leads to the conclusion that it is essential to personalize educational environments and promote flexibility in the teaching-learning processes to adequately respond to the needs of students. The application of the UDL generates multiple benefits such as equal access to education, autonomy in the learning process, promotion of inclusion and diversity within the university environment, and the development of a more flexible learning environment.

6 Future work

6.1 A Subsection Sample

Attending reviews suggestions, in a next research we can improve all recommendations done about the recent studies of UDL in higher education, instruments used and applied measurements strategies, respect to results, we put only three students because, there are just three student with a kind of disability, of course we

can increment the number of the students groups to have more students with disabilities and be in position to make comparisons but it will also in future papers.

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