

Hyflex: approach in higher education in Mexico

Hyflex: aproximación en la educación superior en México

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Abstract

This study aims to investigate if the HyFlex (Hybrid and Flexible) model is an effective teaching approach for higher education in Mexico among the student population. HyFlex is a teaching-learning model that is developed in person and online. This strategy is an innovative didactic experience, with some implications about technology, didactics, sociology, finances, and more. First, to achieve the purpose, the background and origins of the concept were identified, and some problems to implemented. Second, a scientific literature review has been reached which is based on the connective theory, and recent studies reviewed the effectiveness of the Hyflex model. Third, a qualitative approach is based on an opinion survey method, with a convenience sample of 20 students, data collection applied a survey from Google Forms. Fourth, the results are shown and discussed based on a content analysis. The results of these surveys shown that 50 % of students prefer Hyflex. The 70% consider that the institution cannot support Hyflex. The 50% of the sample argue that the Hyflex is not for Mexico. But Hyflex is an effective strategic model. Finally, conclusions and recommendations are presented.

Hyflex, Higher education, Mexico, Teaching learning model

Resumen

Este artículo tiene como propósito obtener la percepción en la comunidad estudiantil si el modelo HyFlex (Híbrido y Flexible) es una estrategia de enseñanza aprendizaje eficiente para la educación superior en México. HyFlex es un modelo de enseñanza aprendizaje que se desarrolla bajo una modalidad presencial, y a la vez se retransmite en modalidad virtual. Si bien esta estrategia resulta una experiencia innovadora también tiene una serie de implicaciones relacionadas con la tecnología, didáctica, sociología, financieras, entre otros. Por lo anterior, para lograr el propósito primero se plantearon los antecedentes y orígenes del concepto, grosso modo se exponen algunas problemáticas a las que se enfrentan quienes deciden implementar este modelo. Segundo, se hizo una revisión de literatura sobre la teoría conectivista, así también se revisaron estudios recientes mediante los cuales surgen diversas preguntas sobre la efectividad del modelo Hyflex. Tercero, el estudio se planteó desde un enfoque cualitativo, basado en un método exploratorio, mediante una encuesta de opinión. Cuarto, los resultados muestran que el 50% de la comunidad estudiantil prefiere usar Hyflex. El 70% de los encuestados consideran que la institución no puede financiar el modelo. El 50% piensa que el modelo no está diseñado para la educación superior en México. Hyflex es un modelo estratégico efectivo en otros contextos. Finalmente, se exponen las conclusiones y recomendaciones del estudio.

Hyflex, Educación superior, Mexico, Estrategia de enseñanza aprendizaje

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Introduction

The Hyflex (Hybrid and Flexible) model is a current concept with various theoretical, practical and scientific implications. Theoretically, it is an educational model that works with technological and didactic infrastructure. These characteristics are part of the needs that are required to meet the challenges of modernity in education. From a practical perspective, the Hyflex model responds to various needs, but one is a consequence of the growth of humanity, another is related to the post-pandemic COVID-19 era. Consequently, the scientific implications are a manifestation that responds, or so it is intended, to the unresolved problems, but with a more rigorous and above all scientific approach.

At this juncture, this initiative arises to explore in the student community whether the HyFlex (Hybrid and Flexible) model is an efficient teaching strategy for higher education in Mexico; in order to make an approximation of the term, analyse the characteristics and consider the efficiency in the application of the model. To achieve this purpose, this review first addressed a theoretical framework supported by connectivist theory and multimedia, to understand recent studies or gaps in the literature, as well as to establish questions that respond to the study. Subsequently, the methodological design was based on the exploratory method, through an opinion survey that allowed us to locate the information from different databases, and thus present the results of the research to establish the discussion section contrasting references versus results, and finally generate conclusions and recommendations.

Referential framework

Connectivist theory

The concept of theory is fundamental, in order to identify the characteristics that make it unique. One of the elements that appears behind every theory is the philosophical perspective. Schuh and Sacha (2007) argue that the philosophical perspective reflects assumptions regarding the nature of the world and how we come to know the world. A theory is a principle developed to explain aspects of the nature of the world. In the field of education, it attempts to decipher how the teaching-learning process is conceived, which is why it is inexhaustible to study.

One theory that links education and technology in teaching and learning processes is connectivism. Siemens (2005) argues that technology and connections in learning activities belong to a digital age. Connectivism, first of all, defines learning as a process that occurs within unknown environments with oscillating core elements, without the control of the individual (Siemens, 2005).

This definition determines that learning is always in motion, it is dynamic. It also consists in the fact that there are several participants for its development, there are stimuli that make its interest possible, but it is not simple, it is not clear, at first sight, and it becomes a complex scheme. Now, the issue of connectivism has its essence in the mobility of systems to achieve learning.

Ledesma (2015) on learning and connectivism, states that this theory promotes autonomous individuals who build knowledge, connection networks, languages and integral categories in various contexts of action (p. 34).

Connectivism proposes open, creative and inclusive learning oriented towards the "incorporation of the social value of knowledge that is constructed in a collaborative and connected way" (Ledesma, 2015, p. 19). This approach distinguishes a number of principles in which this theory can be put into practice. Utecht and Keller (2019) list a series of principles that stand out in this theory:

learning and knowledge, learning is a process of connecting specialised nodes, learning can reside in non-human devices, the ability to know more is more critical, connections need to be nurtured and maintained to facilitate learning, seeing connections between fields, ideas and concepts; accurate and up-to-date knowledge and decision-making (Utecht & Keller, 2019).

In this vein, Siemens (2005) explains how the inclusion of technology and the establishment of connections produce learning activities in a digital age. He considers that personal experience is a source of knowledge that inevitably requires expanding its boundaries, hence the connections that are established allow knowledge to be expanded. In that line of discussion, Stephenson (2004) states that not everything can be experienced in one circumstance, therefore, other people's experiences become a cognitive dissonance. They are axioms for gathering knowledge, not always verifiable, but testimonial (Stephenson in Siemens, 2004).

Therefore, connectivism includes within its foundations, principles given by chaos theory, network, complexity and self-organisation.

Chaos theory challenges order (Siemens, 2005). Chaos theory recognises the connectedness of disorder. Network and complexity are identified in the theory of connectivism. Knowledge is a conceptual network of knowledge that is achieved from neural connections that is fed by stimuli that generate learning for individuals, it is infinite (Siemens, 2005).

Finally, self-organisation according to Mateus (1988, cited in Siemens, 2005) is the formation of well-organised structures, patterns or behaviours from random initial conditions. Self-organisation is taken as a learning process that requires the individual to classify his or her interaction with a specific environment (p. 6).

Multimedia learning theory

Multimedia Learning Theory has several implications. First, there are two channels for processing information: a verbal and a visual one. Multimedia learning is one where the learner achieves the construction of mental representations using visual and verbal educational material to achieve epistemology. Mayer (2005) as cited in Bravo (2018) defines the term multimedia as "the presentation of verbal and pictorial material" (p. 2). Now, verbal material refers to words, such as printed text or that which is narrated. Pictorial material includes static images or graphic displays (e.g. diagrams, illustrations, maps and photographs) and dynamic material includes videos and animations.

Second, each channel has a limited processing capacity. The visual and verbal channels are known to be able to process only a small amount of information. Meaningful learning occurs when the learner constructs knowledge in an orderly and integrated way. If too many elements are presented in any of the channels, there may be some elements that are not remembered, or chaos or disorder may be generated.

Third, there are three types of storage memories. One is sensory memory, which receives external sensory stimuli and temporarily stores information. Another is working memory, which uses the information obtained from sensory memory. The last is the long-term memory, which has a higher retention capacity.

Consequently, the process is that the elements of learning are interpreted by the sensory memory, then used in the working memory and finally reach the long-term memory. This is where the knowledge is retained by the learner and can be used in other scenarios.

Fourth, five types of cognitive processes: word selection, picture selection, word organisation, picture organisation and integration. First, the learner pays attention to the important concepts of the multimedia message to create sounds in the working memory. Second, in the selection of images he does the same as with the words, but this time with the visual material. Third, in the organisation of the words he links the concepts to create the verbal model. Fourth, in the organisation of images he makes connections between them to create the pictorial model. Fifth, interaction is where the learner makes the connection between the elements of the verbal and pictorial model, and uses prior knowledge (Bravo, 2018).

Fifth, Five types of representation for words and pictures. This representation begins with the stimulus presented to the learner through the words and pictures in the multimedia material. These are then converted into sounds and images in the sensory memory, which are transferred to the working memory. In the working memory the learner builds up in his mind a verbal and a pictorial model. Finally, these models must reach the learner's long-term memory in order to reach full knowledge (Bravo, 2018).

Hyflex

The Hyflex model, although it may seem innovative, has already made considerable progress and has countless applications. Its antecedents date back to 2006 when Dr. Brian Beatty presented it at the Annual Technology Convention of the Association for Educational Communication (Beatty, 2006). This concept interprets two options for learning together: Hybrid and Flexible. This refers to the fact that students can learn face-to-face or virtually, in a flexible way. In other words, dynamism is guided by didactics in the presentation of content, face-to-face or online participation. This decision is based on the fact that the learner is at the centre of learning.

It is worth noting that Beatty (2006) states that the model has four pillars underpinning its use: alternatives, equivalence, reuse and accessibility.

The characteristics of the model are based on four axes: first, alternative the decision of student participation, online or face-to-face modality in relation to dates or contents; second equivalence generate participation activities so that in both modalities the instructional design must follow the same pedagogical strategy to obtain the same performance; reuse refers to the use of the same technological means in both modalities for learning; accessibility equipment and technological competences in an equitable manner for all students (Área-Moreira, et al., 2023).

On this point, various references such as Reigeluth (2011) consider that the paradigms of traditional behaviourist teaching must be broken towards one that redefines the role of the teacher as a controller of the teaching-learning process. The role that should be exercised is that of facilitator for the achievement of individual goals.

Although there are a large number of studies developed by various authors, some, such as Abdelmalak and Parra (2016), Lui and Rodriguez (2019), Detyna (2022), Area-Moreira et al. (2023), among others, agree that the characteristics of the Hyflex model tend to vary according to the scenarios. This refers to the fact that there are a number of implications to be considered when designing this type of course and that they are not for all audiences.

Authors such as Área-Morera et al. (2023), consider that these implications have to do with flexibility in the teaching-learning process (curricular, periods and modality), Learning Management Systems (physical or online), learning autonomy, the didactic method or approach, and learning itinerary (concept, organisation, vision, learning construction and expert map). In the critique of these authors, financial issues must also be considered from this perspective.

The issue of costs should be another variable to be included in the development of this modality, as the equipment used is not common. In other words, it is not only a matter of guaranteeing access to a well-designed classroom, but also of considering aspects such as the technological platform, Internet access, technological equipment such as computers, laptops, cameras, speakers, sound, digital blackboards, among others. According to Ruíz et al. (2022) in Blended pedagogy with high flex classrooms at GEM (2021), the management school in Grenoble France invested 30 million Mexican pesos to equip 32 Hyflex classrooms, which would mean that equipping each classroom would cost approximately 2.5 million

pesos. Therefore, a number of doubts arise about the implementation of this modality. However, it is essential to evaluate the learning efficiency of this model from another point of view.

2.4 Recent studies

In a study by Zelher, et al., (2021) entitled *Hyflex Simulation: A Case Study of a Creative Approach to Unprecedented Circumstances*, The medical students' perception of the effectiveness of the use of this model during the Covid-19 pandemic at a Midwestern university in the United States of America was presented. The sample consisted of 24 students from the nursing programme. The method used was quasi-experimental, where the following student perceptions were collected under the criteria of critical thinking, clinical judgement, clinical skills and communication. The data collection process took place in both modalities, one in an online session using the Zoom platform and the other face-to-face. The results show that students perceived that there was no difference in the use of one modality or the other. Nevertheless, it is proven that Hyflex can be an effective tool to trigger critical thinking.

Another study presented by Romero (2016), at the eleventh Technology and Information conference called *HyFlex, hybrid and flexible model for university education* In the case of the Universidad Técnica Particular de Loja (UTPL), the research design was designed to answer two central questions about the model and its application. The study also assessed strengths and weaknesses. The results were generally positive, however, the following obstacles were identified: The study to date claims that there is little research on the HyFlex model in Latin America. It was considered that the implementation of the model requires a 360° degree curriculum design as teachers require updates of web 2.0 tools (social bookmarking, blogs, wikis, among others), digital scenarios are a challenge for certain generations of teachers, and finally universities are unable to invest. In any case, the results of the study are focused on developing new competences within the teaching staff to use new technologies.

Finally, another study by González (2021) aimed to develop a comparative systematisation of experiences in two university environments to show successful practices. One at the Universidad Autónoma de Metropolitana (UAM-Mexico Campus) and the other at the Instituto Tecnológico de Monterrey (ITESM-Monterrey Campus).

The methodological design was based on participatory action-research. The comparative was structured along the following axes: origin of university funding, educational level, digital platforms, subject matter, evaluation, didactic strategies, and educational policy (Gonzalez, et al. 2021).

The results are varied, but in the axis of digital platforms, it is highlighted that educational innovation is granted through the use of Learning Management Systems (LMS). Therefore, it is confirmed that the use of LMS is a trigger for good practices in education. For ITESM, the Hyflex model was used, demonstrating its viability for the teaching and learning process. However, UAM used a platform called Programa Emergente de Enseñanza Remota (PEER).

The above studies raise a number of issues that should be framed in this research.

Research Questions

The above has allowed us to confirm the validity of the use of this model. Hyflex raises concerns that can contribute to further research, development and application. This model permeates different educational sectors, both public and private. However, in practical terms, it is necessary to identify or recognise concepts, characteristics, advantages and disadvantages that could arise in the university context, especially in a public university context. Consequently, the following questions arise to help guide this study.

1. Does the Faculty of Architecture and Design (FAD) have technological infrastructure for the use of the Hyflex model?
2. Does the university community perceive that teachers and students are competent in the use of the Hyflex model?
3. To what extent are the principles of the Hyflex model identified?
4. Do the learning strategies promote concepts, literature reviews, methodologies in face-to-face or online modality?
5. How socially connected do students feel in face-to-face or virtual modalities?

Methodological design

This section describes the methodology used to define the scope of the information found, its analysis, and to determine its usefulness; from the elements necessary to implement the opinion survey. In this sense, the procedure allows the answers to the research questions posed to be obtained. Therefore, this study used a qualitative approach to obtain perceptions on the use of the Hyflex model in a Mexican public university.

Method

The exploratory method is suitable for answering this study. Hernández et al. (2010) argue that research of this type is carried out when the aim is to find out what people think about a topic that has not been addressed much. Although the issue of the use of Hyflex has been considered in other contexts, there is little evidence on its effects in a Mexican public university context. For this reason it is sufficient to investigate the infrastructure, perception, identification, and socialisation of Hyflex.

Population-sample

The population for this study is made up of postgraduate students from the Faculty of Architecture and Design of the Autonomous University of the State of Mexico. In this case, a convenience sample of 30 students was selected for the academic year 2023, with no inclusion or exclusion criteria, only that they were postgraduate students.

Instruments

An instrument called an opinion survey was used, which was adapted to the needs of the research itself. However, it retained its essence in some questions. It used the google forms platform to collect the information. The instrument has a five-axis structure: infrastructure, Hyflex principles, teaching and student experience, learning strategies and social connection. A questionnaire with 5 questions with 23 items. Supported by a value scale: Strongly disagree 2) Disagree 3) Strongly agree 4) Agree and 5) Don't know. All with the intention of obtaining information in a simple, truthful and reliable way.

Procedure

To achieve the purpose and answer the research questions, the following activities were carried out in the order specified. The steps to obtain the information are as follows:

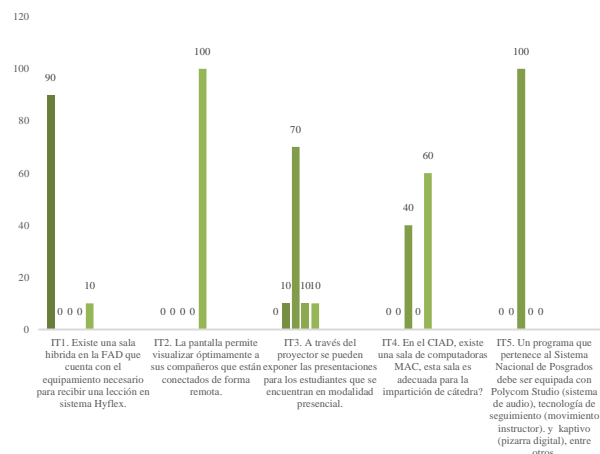
1. The opinion survey questionnaire was used.
2. It was located on the Google forms platform.
3. An email was sent to the subjects to invite teachers to participate in the filling out of the questionnaire.
4. A time frame of 30 days was given.
5. The platform was monitored to see the degree of response from the participants.
6. The platform was closed and the information was collected.
7. The results are presented in graphical displays.

Results

The purpose of the study focuses on the perceptions of the use of the Hyflex model in a Mexican public university. Therefore, the way in which the questions were answered is presented below. Consequently, some graphic visualisers were used to identify some qualitative data on this issue. In sum, a correlation was made between the research questions and the results of the study.

Results related to the research questions

First research question Does the Faculty of Architecture and Design (FAD) have technological infrastructure for the use of the Hyflex model?



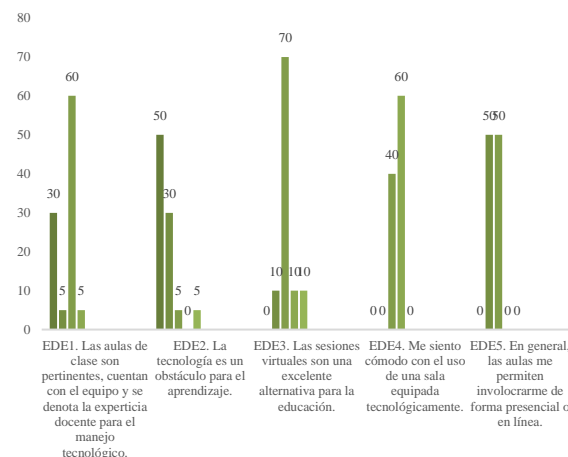
Note: 5 items, related to technological infrastructure, are raised

Graphic 1 Technological Infrastructure

The results in Graphic 1 show five questions that were posed in the instrument. The first question sought to identify the existence of a hybrid room where 90% of respondents confirmed that they disagreed that there is a hybrid room. However, in the second question, 100% of the respondents agreed that there is a screen where they occasionally work to view power point presentations. In the third question, 70% agree that projectors or projectors are used in face-to-face mode. The fourth question on the use of a computer room, where 40% of the participants indicated that they agreed that they did not know that there was a computer room. Finally, 100% of respondents consider that they agree that a programme belonging to the national postgraduate system should have a hybrid room for teaching.

Second research question:

Does the university community perceive that teachers and students are competent in the use of the Hyflex model?



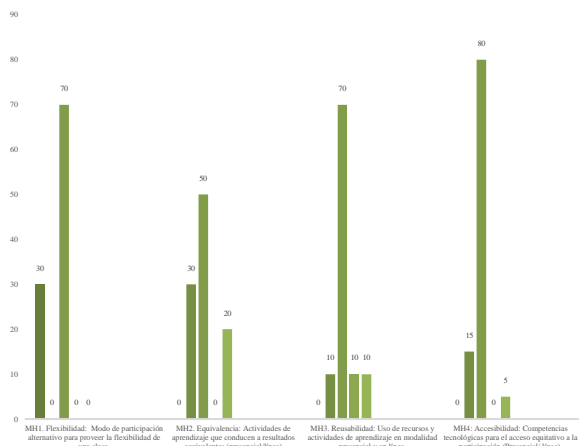
Note: The questioning of 5 items, related to teachers and students

Graphic 2 Teaching experience and students

The results in Graphic 2 indicate the application of five questions. The first question asked about the relevance of the equipment as well as the expertise of the teacher. The results indicate that 60% agree that the classrooms are relevant and that the teacher has the expertise to teach the class, however, 30% disagreed. The second question asked whether technology was an obstacle to learning, 80% of respondents disagreed. The third question on virtual sessions as an alternative for education indicated that 70% agreed. The fourth question considers that 60% agree with the convenience of using a room equipped with technology. Finally, 50% of respondents agreed and 50% disagreed with the question about the use of face-to-face or online teaching.

Third research question

With regard to the principles of the Hyflex Model, to what extent are they identified in your classes?:



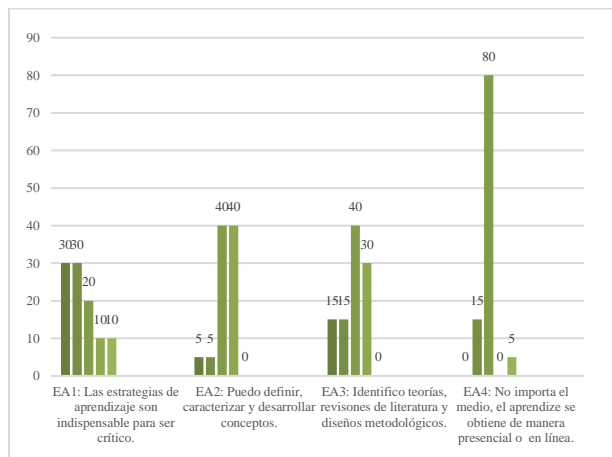
Note: Approach of 4 items, related to the Hyflex principles

Graphic 3 Axis 3. Hyflex model principles (HM)

The results in Graphic 3 set out the principles of the Hyflex model based on flexibility, equivalence, reusability and accessibility. The data indicate that 70% of the respondents agree that class participation should be flexible (MH1). However, on the principle of equivalence, 30% disagreed and 50% agreed with the statement that face-to-face and online learning activities lead to equivalent outcomes (MH2). On the principle of reusability, resources and activities, the results indicate that 70% of respondents agree for both modalities (MH3). Finally, 80% of participants consider that they agree that technological competences should be developed for participation in a face-to-face or online class (MH4).

Fourth research question.

Learning strategies promote concepts, literature reviews, methodologies in face-to-face or online mode. Learning strategies, according to Biggs (1999), are posited as useful techniques for teaching and learning.



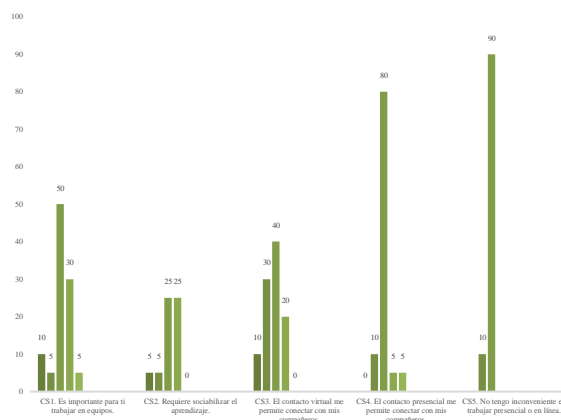
Note: 4 items, related to learning strategies.

Graphic 4 Axis 4. Learning Strategies (LSS)

The results of Graphic 4 are oriented towards learning. Four statements from the instrument are shown here. In the first, the data shows that 60% of respondents disagree that a learning strategy is required to be critical, on the contrary, 40% of respondents agree (EA1). In the second question, 90% of respondents agree that they can define, characterise and develop terms (EA2). In the third question, 70% agree in identifying theories, literature reviews and methodological designs, while the other 30% disagree (EA3). The fourth question, 80% of respondents consider that they agree that learning is obtained in face-to-face or online mode (RQ4).

Fifth research question:

How socially connected do students feel to this model?



Note: 5-item approach, related to social connectedness

Graphic 5 Social connection (CS)

The results in Graphic 5 show five statements oriented to the social connectedness of the respondents. The first statement confirms that 80% of respondents agree on the importance of teamwork (CS1). In addition, the second statement identifies a middle ground between those who require socialising for learning, with 25% saying no and over 75% agreeing (CS2). The statement that virtual contact allows me to connect with my classmates, in the third statement, shows different data, with 40% agreeing that through the virtual modality there is contact (CS3). Likewise, in the previous statement, but in the face-to-face modality, 80% consider it relevant that contact is important to connect with colleagues (CS4). In statement five, 90% of respondents consider that they agree that they can work in face-to-face or online mode (CS5).

From the results, it is confirmed that there is no classroom for hybrid classes in this context. Respondents stated that it is important to build competences in teachers and students for technological innovation in education. The Hyflex model is an alternative for the teaching-learning process, therefore, there are various strategies that should be used to detonate this tool efficiently and obtain excellent results. In this way, socialisation shows that there are different student profiles; on the one hand, socialisation through the face-to-face modality is indispensable, but on the other hand, the online modality does not prevent socialisation. In sum, the results show in this context that the use of a Hyflex model has various implications that will be contrasted in the following discussion section.

Discussion

In this section, both theoretical and practical aspects were discussed. That is, the contrast between what the authors proposed versus the results obtained. In this sense, the discussion starts from the research questions:

Research question 1

The answer to the question "Does FAD have the technological infrastructure to implement the Hyflex model in the public university system?", the survey focused on statements based on the type of infrastructure available to the academic body (OA), Computers, Audio, Screens, Projectors, and Classrooms. The findings on this axis, in contrast to what Beatty (2006) states, the Hybrid and Flexible model has the virtue of generating learning in both modalities: face-to-face or online. In the survey results, students considered that learning can be obtained in a flexible mode. In the case of the FAD, in relation to infrastructure, it was evident that there is no classroom with the characteristics required for a Hyflex model. There is no multimedia, sound equipment, software, among others. However, there are screens and projectors as resources. In addition, it is worth mentioning that there is a new space called the virtual reality and digital editing laboratory. This space may have the necessary infrastructure for the development of classes using the Hyflex model. In other words, there is no need to make a new investment, but rather to adapt this area to apply this model, especially in the postgraduate courses of the FAD, with multiple benefits for students and teachers.

With regard to an investment for the adaptation of this model, there are some studies such as Blended pedagogy with high flex classrooms at GEM (2021), which focus on recognising that investment in this technology is an alternative to counteract some complex dynamics that arise in adverse scenarios such as pandemics or the physical infrastructure itself. If this is the case, investment should focus on classroom equipment. This strategy is viable because of the benefits, not only for the students or the academic programme, but also to avoid congestion in urban agglomerations.

Finally, the respondents commented that the infrastructure in the academic space (screens, projectors, computers, and classroom) requires periodic renewal and licences for the use of software. Incidentally, these are basic tools for classes, but it is stated that a programme that belongs to the national postgraduate system (SNP) requires state-of-the-art technology to be competitive. This statement is confirmed by González (2021) in his comparative study UAM versus ITESM. Therefore, academic infrastructure is a determinant of the educational success of an academic programme.

Research question 2

The second research question, the university community perceives that teachers and students have competences for the use of the Hyflex model under the face-to-face or online modality. The data collection instrument established statements about competences, technology and face-to-face or online mode. From the data collection, the sample considered that a percentage of teachers and students require training for the development of competences. In this sense it can be highlighted that digital skills need to be developed. Technology is a challenge for all generations as confirmed by Romero (2016). It is for this reason that teachers and students have to add to their skills the use of technological tools, not only for teaching or receiving classes, but also for working with the range of Web 5.0. Learning uses a connectivist educational model (Simmens, 2013).

Respondents also felt that technology is not an impediment to learning. On the contrary, it is a support for educational scaffolding. In the postgraduate course at FAD, the data showed that virtual sessions help learning. It turns out that regardless of the modality, face-to-face or online, there is a comfort in achieving academic goals.

However, the survey highlights that there is a percentage of similarity between those who feel "comfortable" under virtual or face-to-face modalities. There is a group according to the figures in table 2 that affirms the importance of both modalities. They do not minimise each other but both maximise their benefits.

The above allows for an axis of discussion centred on the students' appreciation or perception of the assimilation of knowledge. According to the survey percentages, learning is generated when technology, competences (teachers and students) and the environment are strategically appropriate. Theoretical, technical, practical and structural involvement are part of a complete system in education, leadership for success in an organisation would be added. In this way all involved are able to participate in the teaching-learning process in the way that suits the individual learner.

Research question 3

The third research question according to the principles of the Hyflex Model for classroom implementation is based on flexibility, equivalence, reusability and accessibility. It was found that in flexibility the system requires adaptations to the curriculum. The instructional design must obey both modalities. The course structure requires academic planning considering the main axes in the design according to the method that suits the OA. However, in the modality section it should be clarified that the course design will be for face-to-face and online delivery.

Equivalence in the Hyflex model, this quality is framed by the learning outcomes achieved by both modalities. The postgraduate students surveyed argue, given their inclination between the use of one model or the other, that the importance of the learning outcome is given by the modality that each of them is inclined or feels more comfortable with. Given this data, it can be interpreted that the result reflects a subjective interpretative perception based on the confidentiality of the assimilation of one's own knowledge.

The reusability in the use of resources, mainly technological, shows valuable information that orients the type of need of each of the postgraduate students. The dynamics of today's research programmes require the implementation of innovation. The results of the survey indicate that 70% of master's or doctoral students agree that reusability is necessary for the development of their competences.

It should be noted that research for the solution of social problems should be at the core of the programmes. This is why using databases, software, digital repositories, statistics, geophraphic information systems, virtual reality laboratories, among others, is essential for studying issues from other global, national, state and local contexts. The issues require a research process that is based on the scientific method.

Accessibility aims to demonstrate that learning can be obtained face-to-face or online. The survey yielded information showing that all students can obtain knowledge through Hyflex. Strengths: technology, Internet, network, applications, software among others, for the generation and application of knowledge. Opportunities: digital skills, research, investment, face-to-face or online, educational coverage. Weaknesses: economic resources and infrastructure. Threats: projection, participation, time.

Research question 4

The fourth question, *learning strategies promote concepts, literature reviews, methodologies in face-to-face or online mode*. The data showed that learning strategies are indispensable for developing critical thinking. However, respondents felt that it is not only critical thinking in which critical thinking can be achieved, but that experience is also a determining factor in gaining knowledge.

They also considered that it is through academic work that learning is achieved, especially when strategies provoke the study of theories, literature reviews or studies on various methodological designs according to the discipline. Likewise, meaningful learning can be achieved through case studies in a variety of contexts. This is why the Hyflex strategy is ideal for face-to-face and online learning as was ensured in the data collection.

Research question 5

Fifth research question how socially connected students feel to this model. The findings show one of the most controversial issues about social connectedness. In that sense, teamwork, socialisation, virtuality and face-to-face showed diverse data.

On the one hand, it is recognised that teamwork is indispensable for any kind of work. Likewise, socialising knowledge makes it possible to achieve significant learning. For some of the respondents, sharing, exploring and exposing knowledge to others is a virtue for generating discussions.

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On the other hand, teamwork can be through the use of platforms, in the organisation of teamwork but virtual, as the discussion takes place in synchronous environments and through the analysis of written descriptions of topics. It is probably an activity that occurs in all environments, not only in academic environments, but also in political, business, scientific and other spaces.

In any case, the social connection is open to all students. In the case of FAD, the evidence supports that it has several factors to analyse, infrastructure, competences, and even emotional aspects. For in this last aspect, education understands that students have different characteristics, as well as different methods of learning. Therefore, it is not possible to pigeonhole students into one type of learning environment, as it is likely that in a sample of students all classifications could be present. From the results it can be said that social connection is not a determinant for learning, but on the contrary, it adds to a series of criteria that occur in a face-to-face or online classroom to make the environment suitable for learning.

Conclusions

In sum, this study focused on eliciting perceptions of the use of the Hyflex model in a public university context. Beatty (2006) considered that the principles of flexibility, equivalence, reusability and accessibility should be incorporated. However, in this context it is concluded that the application of the model raises a number of concerns regarding infrastructure investment.

The case study showed that equipment exists in the FAD that could be used as a virtual laboratory for this type of model. However, the equipment that is regularly used, such as screens, projectors and blackboards, needs to be upgraded. In the case of teachers and students, it is recognised that professionalisation in digital competences must be permanent. The Hyflex model considers principles that are adaptable to any curriculum at higher and postgraduate level. Learning requires strategies to be efficient and effective, involving technology as a mechanism for innovation in the teaching and learning process. And finally, social connectedness is not a constraint to learning, on the contrary, it requires articulating communication, information, technology and leadership schemes.

Limitations of the Study

Creswell (2013) points out that limitations in a study are visualised in the possible weaknesses that the researcher identifies, as well as being related to possible shortcomings in the measurement of variables, limited number of studies, sample sizes, data collection or data analysis. In this study, the search and sample selection work was a constraint to objectivity. This also led to an extension of the content of the information sources consulted.

Recommendations

It is recommended that in the future more studies be generated to explore the relevance of Hyflex in other programmes of the Faculty of Architecture and Design, UAEMEX.

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