Pedagogical innovation in the context of higher education 4.0: A systematic literature review

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Abstract: Higher education is experiencing a revolution in teaching practices. At the same time, the problem of improving learning has become a debate for many researchers, especially in the context of the industrial revolution. This period of revolution requires a new form of education—education 4.0—based on innovative new approaches. Research on innovation in the academic world has also undergone some evolution since the 2000s. Previously, pedagogical innovations in higher education were not well received. This article proposes a systematic analysis of the literature published between 2013 and 2023 using PRISMA guidelines to ensure the reliability of our results. Content analysis of the 30 selected articles. The results of our study indicate that the adoption of innovations in the academic field remains a crucial issue. Education 4.0 has facilitated innovation, and this observation presents promising prospects for enhancing the quality of education by focusing on the implementation of these innovations, adaptation and resilience to change, the development of skills necessary for Industry 4.0, creative thinking, and digital literacy for future students.

Keywords: transformation, technology, university, learning, prisma

1. Introduction

Recently, the context in which we operate has been marked by various threats, such as crisis, uncertainty, complexity and turbulence. In other words, globalization, evolving work processes and methods, and rapid technological changes are shaping our current environment.

In this context, the fourth industrial revolution, known as Industry 4.0, has significantly influenced the educational, social, political and economic spheres. Indeed, the introduction of new information and communication technologies, artificial intelligence, robotics, immersive reality, big data and the Internet of Things has generated considerable transformations in these spheres (Zahra Fakir & Majdouline, 2022). As a result, the education sector has implemented many reforms to adapt to this new reality, requiring creativity and innovation.

The issue of teaching quality has become one of the major challenges facing universities (Kravchuk et al., 2022). The accelerating pace of change, driven by the fourth industrial revolution, demands new skills and assets for both current and future populations (Marzal et al., 2019). The higher education sector therefore needs to develop to respond effectively to the demands of the future (Jugembayeva & Murzagaliyeva, 2022).

The process of digital transformation of higher education institutions has led to the creation of tasks essential to the deployment of an innovative university, often referred to as University 4.0. As (Donnelly, 2019) points out, the term "innovation" is used in the higher education sector to refer to new pedagogical practices and creative learning. From this perspective, the use of digital technologies in university learning is closely linked to the adoption of innovative pedagogical methods (Pinto & Leite, 2020).

With this in mind, the concept of Education 4.0 or University 4.0 is relatively recent and has been little explored in the literature. According to (Jugembayeva & Murzagaliyeva, 2022), University 4.0 represents a new model that challenges the learning methods of various university actors. For this reason, it is essential for the success of an innovative system to understand how it is perceived by the actors who will use it (Biemar et al., 2022).

For this reason, University 4.0 represents a collaborative initiative to combine smart technologies, IT systems, intelligent pedagogy and innovative learning methods while promoting pedagogical innovation. We have structured this document as follows. After introducing the theme of our research, we outlined the objectives of the methodology and research protocol adopted to address our research questions. Subsequently, we conducted a content analysis to summarize the main contributions of the selected studies. Finally, we highlighted potential avenues for future research.

2. Aim of the study
Today, innovation is an integral part of a university’s vision and approach. From this perspective, innovative pedagogy now plays a key role as a catalyst for transformation within universities against a backdrop of revolution. With this in mind, our review aims to complement previous research in the field of innovation in higher education while assessing the contribution of these studies to bridging the scientific gap. To achieve our objective, three research questions were selected:

Q1: What research on pedagogical innovations in academia has been published to date, and how has the literature on the subject progressed?
Q2: What are the contributions of these studies?
Q3: What are the gaps and future research prospects?

3. Methodology

Originally, this systematic literature review has its roots in the medical field and has just been adopted in management research. They help researchers carry out a targeted, in-depth and critical study of the main lines of research on a particular topic, with the aim of identifying new avenues of research and advancing knowledge.

Following (Kitchenham, 2004) guidelines, a systematic review of the literature was performed, detailing the essential stages of planning the review, carrying out the review and, finally, writing the review report. In this section, we detail the first two stages by presenting the data collection process.

3.1. Information sources and search strategy

Aligning our protocol with our research objectives, we adopted the flow diagram methodology to carry out our review. The first step is to identify the relevant literature on the subject. For this reason, we used 3 databases, SCOPUS, WEB OF SCIENCE and CAIRN INFO, because of their comprehensiveness, their accessibility in the Moroccan university environment via IMIST, and the ease with which they can be used to collect keyword data.

Table 1 illustrates the search protocol involved determining the keywords to be used to review relevant publications and articles. The SCOPUS search was carried out on the basis of title, abstract and keywords, while the Web of Science search was carried out on the basis of subject (TOPIC) for the period 2013-2023. The aim is to understand the progression of articles on the subject and to highlight the main future prospects. As mentioned in Table 1, the identification process resulted in 75 articles on Scopus and 114 on Web of Science after unifying our search to years with the option ‘article’ or ‘review’, as well as for the languages ‘French or English’ and 14 on Cairn.

<table>
<thead>
<tr>
<th>Search query</th>
<th>Database</th>
<th>Numbers of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE-ABS-KEY (= Education* AND “Pedagogical” AND “Innovation” AND “Digital” AND “higher education”)</td>
<td>Scopus</td>
<td>75</td>
</tr>
<tr>
<td>education* AND pedagogical* AND innovation* AND digital* AND higher education* (Topic)</td>
<td>Web of Science</td>
<td>114</td>
</tr>
</tbody>
</table>

3.2. Data collection process

The PRISMA flowchart in Figure 1 shows the different results by step. After identifying our preliminary database, the next step was to import the references from Zotero into the "SCOPUS" & "Web of Science" & "CAIRN INFO" collections and then into Excel in a worksheet named "BD". Once the data have been found, this step involves eliminating duplicates to avoid the risk of seeing the same reference repeated several times in the databases. This procedure was developed with EXCEL software, and the steps for deleting duplicates were as follows: after grouping the two databases in an Excel sheet, "Tot ref with duplicates" of 209 duplicates were automatically detected using the "delete duplicates" command.

Our first selection is based on these results. The aim of this phase was to select articles on the basis of the inclusion and exclusion criteria. Our criteria are linked to our research questions. Articles were selected on the basis of "Tot unduplicated articles". Of the remaining 159 articles, we read the title and keywords of each article; only 96 articles were retained for the second selection. Once the first selection had been made, we moved on to the second. Based on the abstracts, we selected 49 articles.

This first selection was performed in Excel using the "filter" function in the "data" tab. Once the 49 articles had been selected, they were reviewed in full text. As shown in Table 2, articles that contained a mention of pedagogical innovation as well as those that examined pedagogical innovation in relation to technology with a focus on higher education were included. A total of 30 articles were selected to help us answer our research questions and inclusion criteria.

3.3. Review selection (DIAGRAM)
The selection was made by examining the research results in accordance with the following inclusion and exclusion criteria:

**Table 2** Screening criteria.

<table>
<thead>
<tr>
<th>Criteria for inclusion</th>
<th>Criteria for exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple mention of pedagogical innovation</td>
<td>Duplicate items</td>
</tr>
<tr>
<td>Article examining pedagogical innovation in relation to technology</td>
<td>Articles published before 2013</td>
</tr>
<tr>
<td>Sector: higher Education</td>
<td>Articles published in languages other than English/French</td>
</tr>
<tr>
<td></td>
<td>Documents other than articles in journals and reviews</td>
</tr>
</tbody>
</table>

### 4. Results

This section focuses on presenting the main findings of the remaining 30 articles. To this end, this section will be divided into three parts. The first will be devoted to the progression of the articles over time. Next, we provide an overview of the theories mobilized in the various studies and, finally, the research methodologies used.

To present these various results, we used the output of Excel software.

#### 4.1. Publication history

The 30 selected articles were published between 2018 and 2023, as indicated in Table 3. Figure 2 shows the progression of the 30 papers over time. The majority of articles were published between 2019 and the present, which can be explained or linked to the importance given to the subject of pedagogical innovation. The number of published articles increased...
significantly from 2022 onward after the spread of COVID-19, allowing us to conclude that the COVID-19 pandemic stimulated research into pedagogical innovation in the university world. As the linear regression confirms, there may be future research trends in this area.

<table>
<thead>
<tr>
<th>Year</th>
<th>Numbers of papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>2</td>
</tr>
<tr>
<td>2019</td>
<td>6</td>
</tr>
<tr>
<td>2020</td>
<td>3</td>
</tr>
<tr>
<td>2021</td>
<td>3</td>
</tr>
<tr>
<td>2022</td>
<td>10</td>
</tr>
<tr>
<td>2023</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
</tr>
</tbody>
</table>

4.2. Theory employed

The literature review of the 30 articles also enabled us to identify the theories used to understand pedagogical innovations in academia. Figure 3 illustrates the different models and theories used.

Social learning theory is the most frequently cited, with 8 mentions and a percentage of 19.51%. This theory, developed by psychologist Albert Bandura in the 1970s, emphasizes cognitive and social factors as essential sources of behavior. In other words, this theory proposes guidelines for the implementation of innovative pedagogical approaches, emphasizing collaboration, observation, building confidence and self-efficacy, and the use of educational technologies to create new learning methods (AL-Nuaimi et al., 2022; Bizami et al., 2023; Cherusheva et al., 2023).

(Rogers & Williams, 1983), “theory of diffusion and adoption of innovations”, is one of the models considered as a theoretical basis. This model provides a conceptual framework for the concept of acceptability since its aim is to explain the change in a technological innovation from the invention stage to that of general use. In other words, we need to focus on how this innovation can be disseminated to users. Roger’s model therefore describes an evolutionary type of change in which an individual passes through a series of stages: knowledge, persuasion, decision, implementation, and confirmation (AL-Nuaimi et al., 2022; Cristol & Cavignaux-Bros, 2019).

Bloom’s taxonomy is at the third level and was developed by the American psychologist Benjamin Bloom, a specialist in pedagogy (Benjamin, 1956). It aims to align pedagogical objectives with competencies to improve the quality of learning (Guru et al., 2022; Zahra Fakir & Majdouline, 2022).
The applications of some of the theories discussed in the articles are limited. This is the case for the unified theory of technology acceptance, which focuses on behavioral intention and actual technology use. Figure 3 shows other theories that have received less attention, such as motivation theory and resilience. We will then examine the methodologies used in the selected articles.

5. Research Methodology

The research methods used were as follows. Generally, 4 approaches were mentioned, as shown in Figure 4: review, qualitative, quantitative, and mixed.

The largest share is attributed to the literature review method, with a percentage of 37%, considering its importance in the presentation and evaluation of research on a specific theme using existing information. In other words, 11 articles, as shown in Table 4 opted for review analysis, demonstrating the importance attached to the subject by researchers, as well as the importance, topicality and relevance of the theme of pedagogical innovation in higher education. However, 33% of the articles were qualitative, based mainly on interviews. On the other hand, there are few studies utilizing the quantitative method, accounting for only 17% (5 articles), as confirmed by (Shenckoya & Kim, 2023). The remaining 13% are based on a mixed approach as illustrated in Figure 4.

<table>
<thead>
<tr>
<th>Method</th>
<th>Number of papers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed</td>
<td>4</td>
</tr>
<tr>
<td>Qualitative</td>
<td>10</td>
</tr>
<tr>
<td>Quantitative</td>
<td>5</td>
</tr>
<tr>
<td>Review</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

Figure 3 Mobilized theory.
Source: SCOPUS and Web of Science databases.

Figure 4 Methodology percentages.
Source: SCOPUS and Web of Science databases.
6. Discussion of Results

In general, this section is dedicated to analyzing the main findings of the literature synthesis based on content analysis (Stemler, 2001). In other words, it will provide useful answers to research questions, namely, the progress and publication of articles to date on pedagogical innovation, the methods employed, and the main contributions and implications of these studies.

The following Table 5 shows the summaries of the selected studies included in the review.

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Methods</th>
<th>Contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>(AL-Nuaimi et al., 2022)</td>
<td>Extending the unified theory of acceptance and use of technology to investigate determinants of acceptance and adoption of learning management systems in the post pandemic era: a structural equation modeling approach</td>
<td>Quantitative</td>
<td>This article deals with a harmonized theoretical framework, so that these different theories have highlighted several variables, namely, social influence, technological innovation, flexibility, relative advantage and ease conditions.</td>
</tr>
<tr>
<td>(Cramarenco et al., 2023)</td>
<td>Student Perceptions of Online Education and Digital Technologies during the COVID-19 Pandemic: A Systematic Review</td>
<td>Review</td>
<td>The results of these studies show positive perceptions due to the use of innovative technologies such as mobile augmented reality, the Internet of Things, machine learning and artificial intelligence assistants, as well as new educational platforms.</td>
</tr>
<tr>
<td>(Cunha et al., 2020)</td>
<td>Threats, challenges, and opportunities for open universities and massive online open courses in the digital revolution</td>
<td>Review</td>
<td>This article presents useful perspectives on the threats, challenges and opportunities for universities in an industrial revolution. The article is based on a virtual pedagogical model that contains 4 pillars, namely, student-centered learning, flexibility, interaction and digital inclusion. The main conclusions are that it is now necessary to rethink innovation: public universities should be institutions of integrated innovation, or constant and continuous innovation.</td>
</tr>
<tr>
<td>(Jugembayeva &amp; Murzagaliyeva, 2022)</td>
<td>Physics Students’ Innovation Readiness for Digital Learning within the University 4.0 Model: Essential Scientific and Pedagogical Elements That Cause the Educational Format to Evolve in the Context of Advanced Technology Trends</td>
<td>Quantitative</td>
<td>The methodology used is a survey that was conducted to investigate the extent to which students were ready to adopt digital learning approaches in terms of innovation across 4 variables, namely: personal creativity, attitude toward innovative educational activities, motivation toward digital activities, technological capability and digital literacy. The article has enabled us to discover new student-centered learning solutions with a focus on the concept of Education 4.0. The results show the essential elements for successful implementation of Education 4.0: skills, learning methods, infrastructure and technologies. The use of innovative technologies for teaching practices enhances both teaching and student performance, so it takes time to adapt.</td>
</tr>
<tr>
<td>(Zahra Fakir &amp; Majdouline, 2022)</td>
<td>L’apprentissage mixte à l’ère de l’innovation pédagogique dans les universités marocaines : aperçu sur l’université internationale d’Agadir (Universiapolis)</td>
<td>Qualitative</td>
<td></td>
</tr>
</tbody>
</table>
| (Costan et al., 2021) | Education 4.0 in developing economies: A systematic literature review of implementation barriers and future research agenda | Review | This systematic literature review explores the barriers to implementing Education 4.0. The authors identify several barriers to its implementation, including: limited and
As Figure 2 confirms, research into pedagogical innovation is still underdeveloped and requires further investigation. The literature on pedagogical innovation in universities has demonstrated that pedagogical processes have been slow to develop and change, particularly in the context of digitalization.

The article deals with innovations in the educational process and the difficulties of implementing them. Innovative educational technologies based on information, technology, organization and culture promote interaction with students in the educational process. These innovations offer students the chance to develop their skills through active, interactive methods based on competency-based learning, via innovative technologies such as e-learning platforms.

The first research question concerns the publication of articles. Figure 2 depicts the increase in the number of articles published over time proves that the subject is of growing interest to the literature and to researchers. Since 2021, the COVID-19 pandemic has been characterized by a new context. The health and education crisis triggered by the outbreak and spread of the coronavirus has called into question the challenges facing higher education (Pinto-Santos et al., 2022).

Before COVID-19, higher education was not based on an innovative approach. COVID-19 has revolutionized the way we live and conceive pedagogy (Rodríguez-Abitia et al., 2020). This is why all higher education institutions today strive to provide quality education that meets the changing needs of society. The COVID-19 pandemic has stimulated and accelerated the implementation of an innovative strategy by creating new resilience projects for the adaptation of higher education institutions to change within the framework of quality learning (Chans et al., 2023). As Figure 2 confirms, research into pedagogical innovations in higher education has grown in importance since 2021.

Today, all countries are currently undergoing rapid development and change. Universities are at the heart of this development project (Jugembayeva & Murzagaliyeva, 2022). The literature on pedagogical innovation in universities has recently shifted to the era of the fourth industrial revolution, focusing on new learning methods to foster the use of digital technologies (Kovalchuk et al., 2022). This means that the higher education system is obliged to transform itself, pushing universities to move from a logic of teaching to a logic of quality learning (Ramírez-Montoya et al., 2022).

From this point of view, Figure 4 summarises the classification of articles according to the method used indicates that the majority of them are attributed to the literature reviews, which can be explained by the importance given to the subject of pedagogical innovation and the introduction of this new concept in universities. According to the content analysis, the research topic is still not sufficiently developed and in depth.

The concept of innovation was introduced by the economist Schumpeter in 1934 as the adoption of a new product or method in the practices of an institution. Today, innovation is considered an interesting and valued practice in modern society. In this sense, the notion of pedagogical innovation refers to elements, material or immaterial, designed to improve teaching and learning processes (Pignier Hondareyte, 2021).

A content analysis of a selection of articles on pedagogical innovation identified contributions to the improvement of higher education, as shown in Table 5. Studies have shown the need to reconsider the university as a more adaptable learning environment. As (Cunha et al., 2020) show, the university must undergo profound transformations to integrate pedagogical innovation. The majority of the studies selected focused on pedagogical innovation while also introducing a new concept: University 4.0 or Education 4.0.

Today, the development of the fourth industrial revolution and the rapid evolution of knowledge, technology and science are having major impacts on our lives. This Industrial Revolution 4.0 can be defined as a range of technologies that breaks down the barriers between the physical, digital and biological worlds and has a profound effect on all industries, stimulating the production of products and services that give human society the ability to lead a more rewarding and prosperous life (Jugembayeva & Murzagaliyeva, 2022).

In this regard, universities must adapt to the new industrial revolution, which is why the concepts of university 4.0 have emerged (Costan et al., 2021). This situation has been confirmed by (Zahra Fakir & Majdouline, 2022), who explained that the Industry 4.0 model has led to many changes and new requirements. Therefore, adopting the university toward a 4.0 model requires innovation in learning practices and new innovative and sustainable methods.

The research shows the importance of pedagogical innovation in higher education, particularly in the context of digital-based change. As (Paquelin & Chantal, 2019) explains, digital technology is an effective tool for stimulating a process of transformation. When innovative pedagogy uses digital technologies in the educational environment, it aims to strengthen the pedagogical process while enabling the democratization of educational quality (Cramarenco et al., 2023).
This is why the digital transition process for higher education institutions has created essential tasks for the effective deployment of innovative digital universities. Digital technologies are a lever for stimulating pedagogical innovation. Furthermore, most studies have focused on students. In other words, an innovation is defined as educational when it is learner-centered. Students must be innovative enough to adapt to a fast-changing environment.

By exploring the impact of integrating these innovative new practices in the digital age, research has highlighted a number of challenges and obstacles for teachers and students: poor educational infrastructure, skill and knowledge gaps, and inadequate coaching (Romero et al., 2019). However, the teaching methods adopted are disconnected from the real situation, preventing the deployment of learning adapted to the 21st century (Ávalos et al., 2019). Ultimately, the challenge lies in effectively adapting to change and embracing emerging innovative practices. Consequently, when pedagogical innovations are implemented judiciously and are aligned with the educational needs of students, they have the potential to enhance the learning experience and equip students with a digitally oriented world.

In summary, University 4.0 provides the essential technological capacity for pedagogical innovation, while pedagogical innovation enables the leveraging of these technologies to develop more innovative and effective teaching approaches.

Furthermore, to better understand the impact of pedagogical innovation on various university stakeholders, future research should also focus on several factors that can help overcome challenges related to the diffusion of these innovations. These factors include encouraging and improving teaching practices by promoting innovation, advancing research and development in education, and focusing on the challenges of the 21st century (Chans et al., 2023; Silva et al., 2020; Villalba et al., 2018). It is also recommended to focus on the development of creative thinking, digital literacy, attitudes, and the cultivation of student engagement and motivation to prepare students for the job market (Cherusheva et al., 2023; Cook & Palmer, 2018; Tsuniak et al., 2022).

7. Final Considerations

The main objective of this study was to perform a systematic literature review to gain an overview of the existing content on innovations in higher education for the period 2013-2023. To refine our results, our search was extended to reviews and articles based on the inclusion and exclusion criteria. Overall, 209 articles were selected, 30 of which were chosen to answer our research questions. To examine these articles, we performed a content analysis of each study.

According to our findings, innovation in higher education has become a necessity in an evolving educational landscape. Therefore, most studies emphasize the concept of University 4.0. Higher education must confront these challenges, fostering a genuine dynamic of innovation and creativity. Innovation in teaching practices is a complex and pedagogical process, as it places the learner at the center of all considerations. Given that few studies have focused on pedagogical practices and their performance impact on learners and teachers, this underlines the need for further research in this area.

However, our study also has limitations. The first limitation concerns databases, since we have relied exclusively on SCOPUS, WOS and CAIRN INFO. In addition, other databases are available for future research, such as the Education Resources Information Center (ERIC), IEEE Xplore, and ProQuest Education Journals. Regarding the selection of document types, we have limited our choice to articles and reviews. This selection could be extended to include other types, such as conference papers, conference reviews and book chapters. Similarly, the integration of additional keywords such as e-learning, artificial intelligence, and smart teaching could improve the relevance of the results. In summary, the interaction between knowledge and the learning process has undergone an evolution. Currently, the discourse focuses on the future of the university, emphasizing the strengthening of skills essential to successful innovation, including critical thinking, problem solving, collaboration, communication and creativity.

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Ethical considerations

Not applicable.

Conflict of Interest

The authors declare no conflicts of interest.

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References


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