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Information and Communication Technologies in Benefit of Educational Innovations

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Abstract

The rapid digital transformation of educational systems, notably accelerated by the COVID- 19 pandemic, has necessitated innovative teaching methods to accommodate the surge in online education. This paper explores the integration of Information and Communication Technologies (ICT) in education, focusing on their application in creating flexible, multimodal learning environments that enhance student engagement and participation. Specifically, we examine the effectiveness of various pedagogical innovations such as e-learning, m-learning, blended learning, flipped classrooms, BYOD policies, and MOOCs. Our analysis is based on a survey conducted with 200 students from the National Higher School of Telecommunications and ICT in Oran, Algeria, assessing their experiences and satisfaction with these modalities. The study highlights the critical role of ICT in facilitating accessible, inclusive, 9 and effective learning solutions and discusses the challenges and opportunities that lie ahead in the context of educational innovations. This work not only underscores the evolving landscape of educational methodologies but also provides insights into future directions for leveraging technology to improve learning outcomes.

Keywords

E-learning;
Blended learning ;
Flipped learning;
BYOD ;
MOOC.

تكنولوجيا المعلومات والاتصالات في خدمة الابتكارات التعليمية

ملخص

إن التحول الرقمي السريع للأنظمة التعليمية، والذي تسارع بشكل ملحوظ بسبب جائحة كوفيد-19، قد استلزم أساليب تدريس مبتكرة لاستيعاب الزيادة الكبيرة في التعليم عبر الإنترنت. يستكشف هذا البحث دمج تكنولوجيا المعلومات والاتصالات في التعليم، مع التركيز على تطبيقها في إنشاء بيئات تعليمية مرنة ومتعددة الوسائط تعزز مشاركة الطلاب. على وجه التحديد، ندرس فعالية العديد من الابتكارات التربوية مثل التعلم الإلكتروني، والتعلم عبر الهاتف المحمول، والتعلم المدمج، والفصول الدراسية المقلوبة، وسياسات إحضار الأجهزة الشخصية، والدورات الجماعية المفتوحة على الإنترنت. ويستند تحليلنا إلى استطلاع أجري مع 200 طالب من معهد تكنولوجيا المعلومات والاتصالات، لتقييم تجاربهم ورضاهم عن هذه الوسائل. تسلط الدراسة الضوء على الدور الحاسم لتكنولوجيا المعلومات والاتصالات في تسهيل حلول التعلم المتاحة والشاملة والفعالة وتناقش التحديات والفرص التي تنتظرنا في سياق الابتكارات التعليمية. لا يسلط هذا العمل الضوء على المشهد المتطور للمنهجيات التعليمية فحسب، بل يوفر أيضًا رؤى حول الاتجاهات المستقبلية للاستفادة من التكنولوجيا لتحسين نتائج التعلم.

الكلمات المفتاحية

التعلم الإلكتروني؛
التعلم المدمج؛
التعلم المعكوس؛
إحضار أجهزتك الخاصة؛
MOOC.

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I- Introduction :

Digital transformation of educational systems has significantly accelerated in recent years, especially following the COVID-19 pandemic in 2020, introducing new challenges and necessitating adaptation to novel teaching methods that leverage the benefits of online 18 education [1]. In this paper, we engage in the critical discourse surrounding distance learning—a mode that has become essential globally. Prior to the pandemic, the annual increase in student numbers, the rapid assimilation of Information and Communication Technologies (ICT) in education, and evolving attitudes necessitated innovative pedagogical approaches.

The pandemic casts us as pivotal actors in elucidating and implementing distance learning under pressing circumstances. This role includes guiding teachers and students, accustomed to traditional classroom settings, on how to adapt their practices for remote education. Initially, this shift might seem straightforward; however, it risks oversimplifying the complexities inherent in direct classroom interactions and may inadvertently promote subpar practices that could undermine the credibility of e-learning [2].

Modern learners prefer to study "on the move"—they are nomadic, studying at universities, in cafes, libraries, and even before sleep, using social networks to dynamically exchange information, solve problems, and discuss lessons effortlessly. This shift necessitates a reevaluation of teaching strategies to accommodate fast, efficient learning with minimal logistical hurdles.

This paper presents various pedagogical innovations facilitated by the rapid evolution of learning modalities influenced by technological advancements. We explore emerging trends that foster multimodal education and enhance student engagement, including e- Learning, m-Learning, blended Learning, flipped Learning (flipped classroom), Bring Your Own Device (BYOD), and Massive Open Online Courses (MOOCs). Post-lockdown, we suggest that co-modal courses could serve as a valuable supplement to traditional learning models [3].

Our investigation centers on the application of e-learning methods via the Information and Communication Technology Institute (ICTI) e-learning platform in Oran, Algeria, specifically focusing on initial training for students from the 2nd to the 5th year. The survey underlying this study is scientifically robust, with a representative sample of 200 students across various disciplines, providing a comprehensive insight into the integration of these educational innovations.

II. Concepts and definitions

In the evolving landscape of educational methodologies, “Multimodal Training” stands out as a pivotal concept that caters to the diverse learning needs of students in a digital age. This approach integrates various pedagogical tools and environments to create a more dynamic and flexible learning experience. Before delving into the specifics of multimodal training, it is crucial to understand its foundational principles and how it contrasts with traditional educational models. This section aims to define and explore the essence of multimodal training, highlighting its practical applications and the benefits it brings to contemporary education systems.

II.1. Multimodal training

Multi-modality in education encompasses a diverse mix of pedagogical strategies and scenarios that facilitate optimal learning outcomes across various locations, times, digital media, and tools. Online learning has diversified, manifesting in forms such as educational software for schools, virtual campuses for universities, corporate training applications, and MOOCs for independent learning.

II.2. Learning forms

Individual learning preferences vary widely, and online education accommodates these through diverse modalities such as e-learning, m-learning [4], blended learning [5];[6], flipped learning [7], BYOD [8], and MOOC [9]. The global pandemic has led to the suspension of in-person academic activities at many universities, accelerating the shift to- wards online teaching. This transition, while widespread, introduces significant challenges, especially in developing countries, where resources and infrastructure may not support effective online learning. Next, we will explore the various digital tools used in online education and discuss their benefits. These tools are categorized into three primary modes:

Mode 1: Videoconferencing tools, such as Zoom, Google Meet, Skype, and Microsoft Teams, have become indispensable during this period, as noted in [10]. These platforms are favored for their comprehensive feature sets that enhance virtual collaboration. They enable remarkable mobility by allowing multiple participants to converge seamlessly in a virtual meeting space while ensuring superior audio and video quality. Furthermore, they equip users with a range of functionalities including screen sharing, file sharing, instant messaging, and meeting recording. An especially valuable feature is active voice detection, which automatically identifies and focuses on the speaker within a group, thereby optimizing the communication experience.

Mode 2: Sharing tools [11] play a crucial role in enhancing communication between students and teachers. Platforms such as WhatsApp and Facebook facilitate the interactive exchange of lessons and assignments, while also serving as repositories for the storage and sharing of large files, notably through their drive features. Traditionally supplementary to in-person teaching, the utilization of these tools has become essential for maintaining the continuity of distance learning under current conditions. Their importance is underscored 88 by the provision of free services, rapid sharing and submission capabilities for assignments, and robust features for data storage, security, and protection.

Mode 3: With the ubiquity of internet access today, online education has become increasingly feasible. Approximately 46% of the surveyed participants can engage in online learning using platforms such as YouTube, MOOC, and Moodle [12]. These tools provide several advantages over traditional in-person classes. Firstly, they offer the flexibility for students to learn at their own pace, as educational content is readily available online for access at any time. Secondly, these platforms facilitate the use of co-modal courses, adding a versatile dimension to learning. Recorded lessons, for instance, are conveniently up-loaded to the Moodle platform, enhancing the accessibility and convenience of educational resources.

In the foundational work by [13], a comprehensive framework is laid out, delineating the core principles vital to designing effective co-modal courses. This framework guides the structure of a typical student's experience within a co-modal course. The journey, characterized by the National Research Council (NRC), unfolds through various stages, each integral to the student's learning pathway (refer to Figure 1 for a detailed illustration):

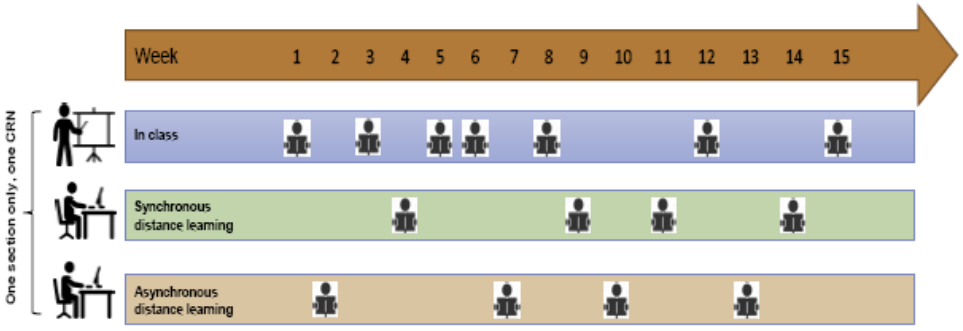

Figure 1. Typical student pathway in a co-modal course(1).

The Course Reference Number (CRN) is a four-digit code that links the campus and the course offering (course acronym). Each CRN is unique. This figure was sourced from https://sup-ubs.fr/wp-content/uploads/enseignement_comodal.pdf.

1. **Course Enrollment:** Students select a co-modal course offered by their educational institution, embracing this format to integrate both in-person and remote learning experiences.
2. **Pre-Course Preparation:** Before the start of the course, students receive detailed information about required materials, online resources, and assessment methods. They are also encouraged to acquaint themselves with the e-learning platform that will be used for the distance learning aspects of the course.
3. **In-Person Classes:** Students attend scheduled in-person sessions as outlined in the timetable. These sessions typically occur in traditional classroom settings where instructors deliver live lessons to students physically present.
4. **Distance Learning:** Complementing in-person classes, students have access to various distance learning components, such as pre-recorded videos, live online conferences, or interactive learning modules. Students can engage with these materials at their convenience, aligning with their personal schedules and preferences.
5. **Assignments and Assessments:** Throughout each course, students are required to complete assignments and undergo assessments in both in-person and distance learning formats. These tasks may include projects, examinations, or facilitated online discussions. The type and nature of these assessments may vary depending on the course specifics and the instructor's methodology.
6. **Interaction with Instructors and Peers:** Interaction between students and instructors, as well as among peers, occurs through both face-to-face and remote modalities. In-person interactions take place during lectures, tutorials, or discussion groups, while remote interactions are facilitated through online forums, video chats, and emails.
7. **Monitoring and Support:** Students receive continual monitoring and support from instructors and educational advisors throughout the course duration. These professionals are available to address questions, offer additional explanations, and guide students towards successful course completion.
8. **Final Assessment:** At the end of the course, students participate in a final assessment designed to evaluate their understanding and mastery of the content. This assessment might include final exams, major projects, or alternative evaluative methods.

9. **Credit Attainment:** Upon successfully completing the course, students earn credits pertinent to their degree program. The specific requirements for credit attainment may vary based on the educational institution, the particular course, and the pedagogical methods employed.

In essence, optimizing resources and ensuring tool accessibility across all modalities are essential practices, adhering to established accessibility standards and best practices in inclusive education. This strategic approach guarantees equitable, high-quality educational opportunities for all learners, tailored to their diverse abilities and needs [14].

Some advantages and constraints of co-modal education are outlined below [14]:

- Flexibility for students in terms of time and location.
- A variety of activities that cater to student preferences.
- Optimized use of educational resources and pedagogical materials.

Some constraints include:

- The need to adapt teaching methods, particularly for advanced courses with specific learning objectives.
- Ensuring a balance in learning activities that maintain equivalence across all modes.

II.3. E-Learning

E-learning, which refers to online training or learning, encompasses all educational methods that enable learning through electronic means. In 2001, the European Commission defined e-learning as “the use of new multimedia technologies and the Internet to enhance the quality of learning by facilitating access to resources and services, as well as remote exchanges and collaboration.” E-learning techniques are characterized by the degree of the instructor’s physical presence and the preferred communication methods. Communication can be synchronous (direct, such as via video conferencing) or asynchronous (indirect, such as through discussion forums).

Based on these two aspects, a typology of e-learning training emerges, as distinguished by [15]. Full e-learning courses refer to training programs delivered entirely online to learners. A platform is provided, offering guidance to achieve predetermined objectives. These courses can be described as fully online, often structured as individualized learning experiences. Full e-learning is typically offered either as a self-paced, independent program or as self-directed training with methodological support, and in some cases, remote tutoring.

E-learning 2.0 (social learning) is primarily based on the evolution of the web. In its early stages, e-learning involved a vertical transmission of knowledge from instructor to learner. Today, e-learning 2.0 represents a more social and collaborative form of online learning. This shift is driven by the transformation of digital tools and the development of blogs, wikis, social networks, and discussion forums. E-learning 2.0 undeniably rethinks learning through communication technologies, as evidenced by the use of social networks and/or MOOCs.

II.4. Blended learning

Also known as “mixed learning,” this is an innovative and effective personalized hybrid training approach. This form of training combines in-person instruction with customized e-learning modules. Blended learning allows for the personalization of training by integrating online components tailored to the learner’s needs, selected in collaboration with the instructor. It aligns with the pedagogical concept of the “flipped classroom,” where the traditional learning model is inverted, prioritizing "homework at home and classwork in the classroom." This flipped classroom method is gaining popularity, particularly in the United States, to the extent that some predict the potential disappearance of traditional teaching methods [16]. In France, according to the e-learning barometer cited by AFINEF[(2)], these blended approaches are being adopted by numerous organizations. Furthermore, a meta-analysis by the U.S. Department of Education, [17] shows that students who partially or fully engage in online learning tend to perform better, on average, than those in traditional in-person courses. The results are even more favorable when a blended learning approach, combining online and in-person learning, is employed.

II.5. Flipped classroom

This refers to a type of blended learning where students are introduced to new content at home and then apply and practice it at school. This approach contrasts with the traditional method of teaching new material in the classroom, followed by homework and independent projects assigned for students to complete at home.

II.6. Mobile Learning

Also known as m-Learning, mobile learning is an innovative approach to training that can take place on a smartphone or tablet. The goal of this medium is to provide quick and efficient access to educational content. Thanks to its flexibility, learners can access training whenever they wish. Mobile learning is revolutionizing the approach to training. According to the APECR (Annual Report of the Postal and Electronic Communications Regulatory Authority)[(3)], the number of mobile telephony subscribers (GSM, 3G, and 4G) increased by 1.88%, rising from 50.573 million

subscribers in the 3rd quarter of 2023 to 51.522 201 million in the 4^{th} quarter of 2023. Globally, according to the Statista website, the number of smartphone users worldwide reached 6.648 billion in July 2023, meaning that 83.72% of the world's population owns a smartphone. To emphasize the growing importance of 204 these devices, the Statista Research Department reports that global smartphone sales to end users reached 1.28 billion in 2022 alone(4) .

II.7. MOOC

The definition provided by the Cambridge Dictionary is "an abbreviation for massive open online course; a program of study made available on the Internet that can be followed by a large number of people(5)" . It refers to an open form of distance learning capable of accommodating a vast number of participants. The term "MOOC" has become part of everyday language in France and is now recognized by major dictionaries.

III. Advantages and limits of e-learning

E-learning has transformed the delivery of education by offering flexible, accessible, and cost-effective opportunities to learners worldwide. However, like any educational approach, it comes with its own set of advantages, as well as limits and constraints. In the following sections, we will explore the key benefits and challenges of e-learning, providing a comprehensive understanding of its impact on modern education.

III.1. Avantages

Thanks to e-learning, geographical distance is no longer an obstacle to education. Learners can access training wherever they are and whenever they wish. Furthermore, most e-learning platforms offer native mobile applications, enabling access from any digital device (PC, tablet, smartphone). Some providers even offer mobile applications that work offline, allowing learners on the move or in areas without internet access to continue their training. An example is Poodle, a portable implementation of Moodle, an online learning management system, which runs from a USB stick and is built on the Portable Apps platform.

The future of e-learning will increasingly be mobile and ubiquitous. Learners no longer wish to sit at a desktop for hours "learning," despite the wide variety of tools offered by Learning Management Systems (LMS). Instead, they prefer to learn at their own pace and in a flexible manner. Today's learners are "on the move"—they study at university, at home, in restaurants, kitchens, before going to bed, over a coffee, and more. Learning has also become a community activity, where learners effortlessly exchange information, share solutions, and explain concepts to each other with remarkable ease, often complementing what the teacher has conveyed.

III.2. Limits and constraints

First, limits can be identified based on the specific features of the tools:

- **Class size constraints:** Most videoconferencing tools impose a maximum number of participants in their free versions (100 for Zoom and 50 for Skype), which can create difficulties for large classes.
- **Time constraints:** Virtual meetings are generally limited in length (40 minutes for Zoom, for example), requiring teachers to start a new meeting once the time is up, and wait for all the students to rejoin, leading to a loss of time
- **Issues with free access:** Some applications are not free, meaning not all students can fully utilize their features. For instance, Google Meet requires a G-Suite subscription to create videoconferences. While participants can join meetings without cost, certain features, such as meeting recording, screen sharing, and HD video, require a paid subscription.
- **Assessment constraints:** Teachers have been asked whether they have solutions for administering upcoming remote examinations. One teacher summarized the responses: "I have considered using an MCQ or a summary exercise with open documents during a videoconference session, with the duration specified and verified by the time taken to submit answers on the platform." Despite the diversity of methods and innovative tools developed, distance assessment remains a significant challenge, highlighting the inability of ICT to fully replace in-person assessments. "However, these solutions are not entirely effective, as internet stability varies, students have unequal access to bandwidth and ICT devices, and fraud is more frequent and difficult to control" [18].

IV. Results and discussions

The research methodology employs a combined and sequential use of qualitative and quantitative methods to enhance the validation of results. A standard questionnaire was first developed and distributed to a targeted sample of 200 students (3^{rd}, 4^{th}, and 5^{th} year) to assess various aspects. The questionnaire consists of 17 questions, the majority of which are closed multiple-choice questions. These questions are divided into three sections: participation in the survey,

personal information, pedagogical and organizational aspects, communication and exchange, web design and ease of use, as well as general evaluation and comments.

The first section gathers personal information (gender and age) of the respondents. The survey results indicate that, among the 200 students, 70% are male and 30% are female, suggesting that female students may have a preference for non-technical studies compared to male students. A detailed analysis of the questionnaire responses was conducted, allowing for the identification of key figures and preliminary results regarding digital practices following the COVID-19 crisis. These insights then formed the basis for the subsequent quantitative study.

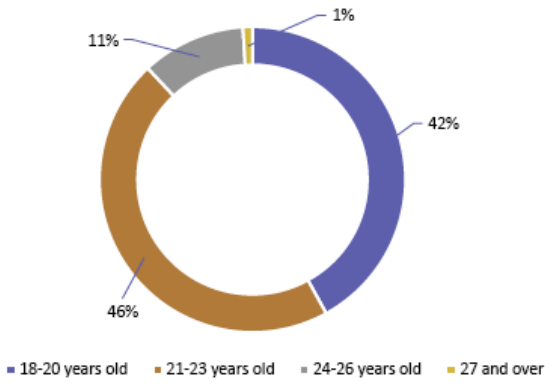

Figure 2. Age Distribution of Participants: Grouped by Age Range.

This study allowed for an in-depth analysis of the various pedagogical forms of ICT and the key factors influencing their use. Particular attention was given to the challenges that hinder the effective use of these technologies. To illustrate the findings, the results have been presented in graphical form. The study reveals that nearly all the students are aged between 18 and 23, and belong to the ”digital native” generation, having grown up in a digitally immersive environment (Figure 2) (19).

The use of the Moodle platform is widespread across all levels, with 100% of students utilizing ICT for educational purposes. The study underscored the significant impact of various teaching methods, as illustrated in Figure 3.

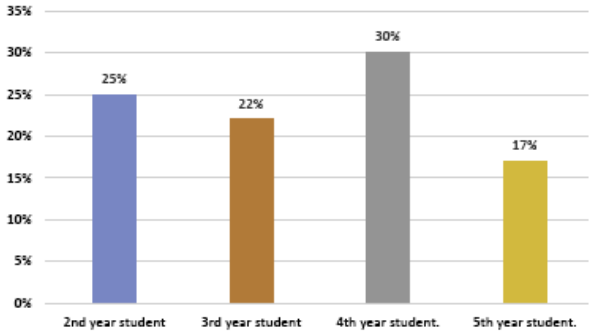

Figure 3. Enrollment Trends by Year: Student Distribution Across Academic Years

A total of 78% of students expressed a strong preference for face-to-face learning. Additionally, 72% of respondents favored blended learning as part of the institute’s annual programs, while 48% opted for MOOCs, and 38% preferred e-learning. Only 10% of students supported m-learning, suggesting that its current application for teaching may be perceived as limited (Figure 4).

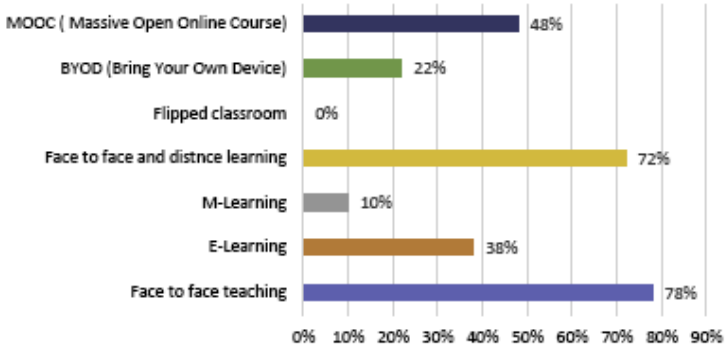

Figure 4. Distribution of Teaching Methods: A Comparative Overview

While it is possible to imagine reading course material on devices as small as mobile phones, it quickly becomes apparent how challenging this can be. Not all course content is easily displayed on such devices. Despite the increasing capabilities of these tools, the screen size remains too small for comfortable reading.

We found that during the COVID-19 pandemic, distance learning became the only viable option to maintain course continuity, resulting in an 86% increase in the use of the Moodle platform (see Figure 5). After public authorities decided to halt in-person classes, more than half of the students initially did not engage with ICT. However, a shift in student attitudes has since been observed, as reflected in the following results: 60% of students now use YouTube for learning, and 56% utilize the Google Classroom platform.

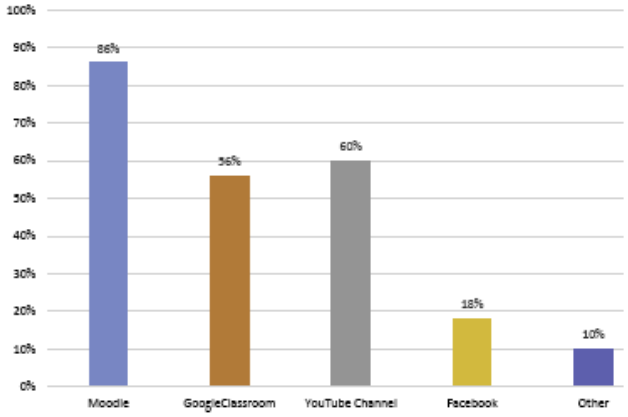

Figure 5. Usage Rates of Various Educational Platforms.

Figure 6 illustrates that the quality of the internet network is the primary obstacle hindering the success of ICTE, with nearly 78% of surveyed students reporting connection issues that disrupted their training, particularly when using tools involving video-recorded lessons or videoconferencing. The Speedtest Global Index website corroborates the students responses in this survey[6].

According to the same source, the average download speed in Algeria was measured at 5.78 megabytes per second (Mbps), while the average upload speed was 1.55 Mbps, compared to the global average latency of 2 ms. Worldwide, the average internet connection speed was 98.67 Mbps, which is 17 times faster than Algeria. Singapore leads with an average fixed internet speed of 234.40 Mbps. Inaccessibility to hardware is the second biggest issue faced by respondents using ICT for learning. Thirty percent of students reported that they either did not have a computer or lacked the means to access learning platforms. They noted that, since the suspension of in-person classes, they had to work with new tools for the first time, which were often complicated and required significant effort to use. This highlights the issue of insufficient training in digital technologies. Consequently, integrating ICT courses and training into the curriculum is considered essential. As shown in Figure 6, 24% of students reported receiving no guidance from their teachers, which diminished their motivation due to the difficulty of organizing themselves. Additionally, 16% of respondents expressed dissatisfaction with using new technologies, citing the complexity of the tools as a major deterrent.

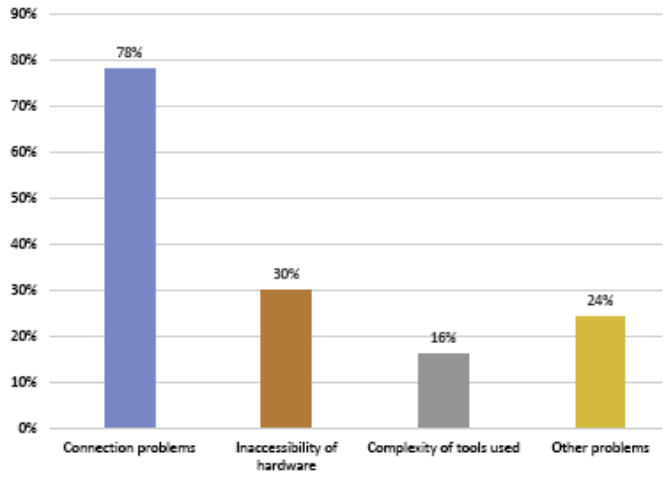

Figure 6. Challenges Faced by Students in Online Learning Environments.

Figure 7 shows that 60% of students are satisfied with the use of ICTE to follow their courses. Only 10% of students expressed dissatisfaction, primarily due to their preference for face-to-face learning. The COVID-19 pandemic forced public authorities to adopt distance learning measures, and it is encouraging to see that 86% of students now use the school's Moodle platform. In addition to Moodle, teachers have also opted to enhance their courses by utilizing other platforms, such as YouTube and Google Classroom, to offer a broader range of learning methods and resources.

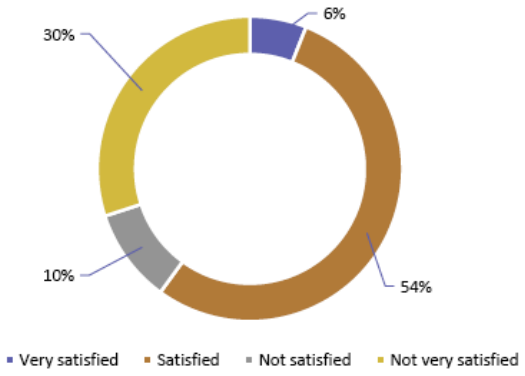

Figure 7. Student Satisfaction Levels with Online Learning Platforms.

V. Conclusion

Although it is still too early to fully assess the long-term positive impacts of the COVID-19 crisis on the development of the distance learning system in Algeria, several significant advances in the pedagogical integration of ICTs have already emerged. The crisis underscored the critical role of digital technology and its many advantages for the education system as a whole, particularly in fostering the spread of a distance learning culture, which has proven to be a viable alternative for ensuring the continuity of education.

The number of students who now utilize ICT for teaching purposes, or at least recognize its value, has grown significantly, and some barriers related to segregation in access have been noticeably reduced. The results of our study demonstrate strong evidence of the relevance of ICTE in the educational process. The statistical significance of the findings emphasizes the role of these technologies in enhancing both the quality and efficiency of teaching, while reducing costs and saving time.

The majority of students surveyed displayed genuine enthusiasm and determination to overcome the challenges they faced. Their responses indicate substantial progress in their academic programs, largely due to the use of various platforms that have ensured continuity in their learning experience. Our study also highlighted key pedagogical innovations, particularly the rapid evolution of learning methods driven by technological advancements.

The emergence of new trends, such as multimodal training, has enabled learners to become more engaged by incorporating diverse forms of learning. In light of the COVID-19 crisis, recommendations have been made to further integrate co-modal courses as a complementary training tool.

References

[1]. Y.Bentata,"Covid2019pandemic:atruedigitalrevolutionand birth of a new educational era, or an ephemeral phenomenon?" *Medical education online*, vol. 25, no. 1, p. 1781378, 2020.

[2]. H. E. Vidergor, "The effect of teachers' self-innovativeness on accountability, distance learning self-efficacy, and teaching practices," *Computers & Education*, vol. 199, p. 104777, 2023.

[3]. F. Acquatella, "Le mooc comme levier d'un processus d'apprentissage organisationnel," *Question (s) de management*, no. 2, pp. 21–34, 2017.

[4]. S. Kumar Basak, M. Wotto, and P. Be´langer, "E-learning, m- learning and d-learning: Conceptual definition and comparative analysis," *E-learning and Digital Media*, vol. 15, no. 4, pp. 191–216, 2018.

[5]. G. Soulimane, B. Kouninef, M. Senouci, and M. Djelti, "Qr codes and mobile technology used in the blended learning approach," in *Online Course Management: Concepts, Methodologies, Tools, and Applications*. IGI Global, 2018, pp. 1035–1048.

[6]. A. Nouby and T. Alkhazali, "The effect of designing a blended learning environment on achievement and deep learning of graduate students at the arabian gulf university," *Open Journal of Social Sciences*, vol. 5, no. 10, pp. 248–260, 2017.

[7]. M. Guilbault and A. Viau-Guay, "La classe inverse´e comme approche pe´dagogique en enseignement supe´rieur: e´tat des connaissances scientifiques et recommandations," *Revue internationale de pe´dagogie de l'enseignement supe´rieur*, vol. 33, no. 33 (1), 2017.

[8]. G. Rae, N. Dabner, and J. Mackey, "Bring your own device (byod) and teacher pedagogy in a new zealand primary school." 2017.

[9]. T. Karsenti, "Is the mooc a revolution or just a fad?" *International Journal of Technologies in Higher Education*, vol. 10, no. 2, pp. 6–22, 2013.

[10]. I. Fuady, M. A. S. Sutarjo, and E. Ernawati, "Analysis of students' perceptions of online learning media during the covid-19 pandemic (study of e-learning media: Zoom, google meet, google classroom, and lms)," *Randwick International of Social Science Journal*, vol. 2, no. 1, pp. 51–56, 2021.

[11]. M. Ahmed Ould Mohamed, "Detecting and tracking ego- community evolution in dynamic social networks," *Cheikh Anta Diop University*, 2019.

[12]. S. H. Gamage, J. R. Ayres, and M. B. Behrend, "A systematic review on trends in using moodle for teaching and learning," *International journal of STEM education*, vol. 9, no. 1, p. 9, 2022.

[13]. B. Beatty, "Hybrid courses with flexible participation: The hyflex course design," in *Practical applications and experiences in K-20 blended learning environments*. IGI global, 2014, pp. 153–177.

[14]. M. Duquesnoy, "La formation "comodale"," PortailEduc, Jun. 2020, retrieved from. [Online]. Available: https: //portaileduc.net/website/la-formation-comodale/

[15]. Y. Alami and I. El Idrissi, "Students' adoption of e-learning: evidence from a moroccan business school in the covid-19 era," *Arab Gulf Journal of Scientific Research*, vol. 40, no. 1, pp. 54– 78, 2022.

[16]. K. Arai, "Free open source software: Foss based e-learning, mobile learning systems together with blended learning system," *International Journal of Advanced Research in Artificial Intelligence*, vol. 2, no. 11, pp. 9–16, 2013.

[17]. C. Depover and F. Orivel, "Developing countries in the e- learning era," 2013.

[18]. P. Detroz and J.-G. Blais, "Les e´tudiants sont-ils compe´tents pour e´valuer la qualite´ des enseignements?" *Mesure et e´valuation en e´ducation*, vol. 35, no. 3, pp. 5–30, 2012.

[19]. B. Kouninef, G. Merad, and M. Djelti, "The use of qr codes and mobile technology in the blended learning approach," in *2015 Fifth International Conference on E-Learning (Econf)*. IEEE, 2015, pp. 135–143.

Note:

[1]. We have been authorized to retouch this figure by University Service of Pedagogy - http://sup-ubs.fr 56017 VANNES Cedex University of Southern Brittany

[2]. French Association of Digital Manufacturers in Education and Training) Created in 2012, AFINEF is the first association to bring together digital companies for education and training. https://afinef.net/

[3]. https://www.arpce.dz/fr/file/f8g4p7

[4]. https://fr.statista.com/statistiques/565012/ventes-mondiales-de-smartphones-aux-utilisateurs-finaux/

[5]. https://dictionary.cambridge.org/fr/dictionnaire/anglais/mooc

[6]. https://www.speedtest.net/global-index/algeria#fixed