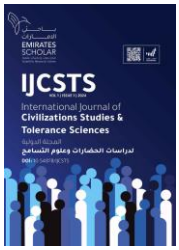

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M-learning and autonomous education: the impact of the Moroccan digital classroom project on science subject's learning

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ABSTRACT

The widespread adoption of pedagogical digitalization and its integration into teaching practices has been proposed in response to the global health crisis triggered by the COVID-19 coronavirus pandemic. This suggestion, aimed at ensuring inclusivity and equal opportunities among learners, has profoundly influenced education. In 2021, the Moroccan Minister of National Education for Preschool and Sport announced a significant step forward by launching the digital classroom project, combining distance and face-to-face learning models with digital tools to guarantee the continuity of educational systems in Moroccan institutions. The project specifically aims to strengthen the learning of science subjects (Mathematics, Life and Earth Sciences, and Physics) to secure ongoing education in the face of potential future disruptions. This digital pedagogical revolution has emerged as a highly suitable learning method for diverse social groups (such as people with disabilities and refugees) and various challenging circumstances (natural disasters, wars, pandemics…). The research outlined in this context seeks to assess the impact of combining the use of Artificial Intelligence (AI) and digital classrooms on the performance of science subjects in the Rabat Sale Kenitra region, providing insights into the evolving educational landscape.

Introduction

The global health crisis, exacerbated by the COVID-19 pandemic, has necessitated a transformation in education, prompting the adoption of distance learning models utilizing digital tools to ensure the uninterrupted flow of educational systems. In response to these challenges, the Minister of National Education for Preschool and Sport in Morocco has introduced a groundbreaking initiative the creation of digital classrooms in Moroccan educational institutions. This forward-thinking project seeks to establish a robust foundation for teaching science subjects, namely Mathematics, Physics, and Life and Earth Sciences.

The introduction of the digital classrooms project represents a paradigm shift in pedagogy, serving as a solution not only for maintaining educational continuity during crises like pandemics but also for catering to diverse social groups, such as people with disabilities and refugees, as well as addressing challenging circumstances like war and other disruptions. This digital pedagogical revolution has proven to be an effective and inclusive form of learning.

This research, incorporating IA, aims to assess the impact of digital classrooms on the performance of science teachers in the Rabat Sale Kenitra region. By evaluating the evolving situation, the objective is to provide insights into the efficacy of digitalization in pedagogy, leveraging AI for enhanced analysis. Additionally, the study proposes recommendations for the widespread adoption of digital pedagogy, integrating IA, and its incorporation into teaching practices across various subjects. The overarching goal remains to ensure inclusivity and equal opportunities among learners, fostering a dynamic learning environment that effectively adapts to the challenges of the modern world.

To achieve these goals, the research will employ AI technologies to analyze data, identify patterns, and draw meaningful conclusions. AI can assist in processing large datasets efficiently, allowing for a comprehensive examination of the impact of digital classrooms on teaching performance. Additionally, AI-powered tools can contribute to the development of personalized learning experiences, catering to individual needs and promoting an inclusive educational environment.

At the start of the 2021-2022 school year, the Ministry of National Education for Preschool and Sport announced that schools would adopt a pedagogical model that combines distance and face-to-face teaching. This model will be based on using smartphones as a digital tool and pedagogical platforms developed by the Department of National Education with the support of the Millennium Challenge Account-Morocco agency.

1. The Moroccan projects

After the health crisis, the combination of face-to-face and distance teaching adopted by educational institutions raises questions about the implications of this new learning model and the pedagogical approaches we should adopt.

The digital classroom project launched by the Minister of National Education for Preschool and Sport in Morocco represents a pivotal initiative in response to the transformative needs of education in the face of global challenges, especially the disruptions caused by the COVID-19 pandemic. This forward-thinking project aims to establish a robust and innovative educational infrastructure by introducing digital tools and technologies into the traditional classroom setting. The project focuses on enhancing the teaching of science subjects, including Mathematics, Physics, and Life and Earth Sciences, acknowledging the critical role these subjects play in fostering a well-rounded and scientifically literate society. By embracing digital pedagogy, the initiative not only ensures the continuity of education during crises but also opens new avenues for inclusive learning, benefiting diverse social groups such as people with disabilities and refugees. The digital classroom project is poised to revolutionize traditional teaching methods, offering a dynamic and adaptive approach that aligns with the evolving needs of students and educators in the 21st century [7] [9].

This new situation requires adapting the learning process by integrating information and communication technologies in teaching (ICT). This new pedagogical situation shows favorable professional disciplines.

This study focuses on the impact of digital classrooms on teachers on the one hand, on the teaching/learning process on the other hand, and the pedagogical techniques that can be adopted and associated with pedagogical platforms to achieve

high-quality digital teaching and learning for various social groups and in different circumstances (war, pandemic...).

Recently, there has been an increased desire to implement innovative pedagogical approaches, giving a prominent place to digital learning and optimal use of new technologies and digital tools to improve online learner autonomy by involving parents as fundamental actors [2].

The pedagogical methods that can be used to succeed in this digital teaching model must motivate learners and teachers to achieve favorable results and acquire new skills when there is no time or opportunity to travel.

Drawing on the experiences of other researchers and teachers around the world [3], this research relies on the added value of this learning model on the learning outcomes of learners and their parents to achieve the following objectives:

- Optimize self-education and online learning outcomes.
- Motivate students with pedagogical innovations by introducing digital tools (tablets, phones, computers...) into the educational process to individualize learning.
- Discover the joy of school in a new way.
- Support learner autonomy through distance learning orientation.
- Motivate all students in the class to develop the course collectively without exception.

According to Parent, G. & Paquin, A. [4], students' motivation loss affects learning performance. Students drop out of school because they lose their taste for studying, which shows a strong relationship between the loss of motivation and dropping out of school in the educational scene. This loss of motivation has reasons related to the school, and the courses taught (Marco Guilbault) [5]-[1].

Spending too much time on cell phones poses a real social problem. For adolescents, it has become a real addiction. Parents often need help to regulate its use, so teachers when faced with students whose minds are focused on social networks at the expense of the knowledge being taught [3]. Mobile learning applications can break down isolation for different social groups, such as people with disabilities, students facing mobility difficulties, and refugees [13] - [17] - [21].

2. Materials and Methods

Presentation of the study area

This study originates from research conducted in Morocco, centering on the impact of the digital classroom project on educators specializing in mathematics, life and earth sciences (SVT), and physics, within the secondary school cycle in the Rabat Sale Kenitra region.

	Mathematics	Physics	SVT
Discipline	16	16	16
Range	09 « 25-35 »	7 « 25-35 »	03 « 25-35 »
	05 « 35-45 »	5 « 35-45 »	08 « 35-45 »
	02 more than « 45 »	04 more than « 45 »	05 more than « 45 »
Gender	F/8	F/ 2	F/ 9
	M /8	M/ 14	M/7

Tableau 1 Range and gender of teachers' sample

The digitization of learning using educational platforms consists of dedicating more time to production, educational activities, and individualized student support [8], which affects the time allocated to course preparation and pedagogical scenarios.

Combining the flipped classroom approach with the digital classroom project has allowed for the unification of all students to develop the course without exception collectively.

2.1. The autonomous learning environment

When referring to the "Artificial Intelligence environment," we are typically discussing the ecosystem and context in which AI systems operate, evolve, and interact with deep learning, machine learning, and simulation.

The autonomous learning environment encompasses a variety of elements that influence the development, deployment, and impact of AI technology methods.

Teaching teenagers through robots and computer simulations represents a qualitative leap in the field of

education, offering exciting and innovative opportunities. Robots contribute to providing a dynamic and engaging learning environment that responds to the needs and learning styles of teenagers. They can deliver personalized and interactive lessons based on data analysis and a deep understanding of each student's requirements. Robots can also provide hands-on learning experiences, such as building robots or applying mathematical concepts through robot control.

Robotics technology and computer simulations enhance active student participation, providing them with additional motivation to explore educational topics. Robots can contribute to improving critical thinking skills and fostering creative solutions, while also promoting social interaction and teamwork through collaborative activities.

Leveraging robotics technology in teenage education can enhance the level of encouragement and deep understanding of subjects. Students can develop their technological and engineering skills through interaction with this advanced technology. Ultimately, the integration of robots in the learning process can contribute to providing sustainable and stimulating learning experiences for young individuals.

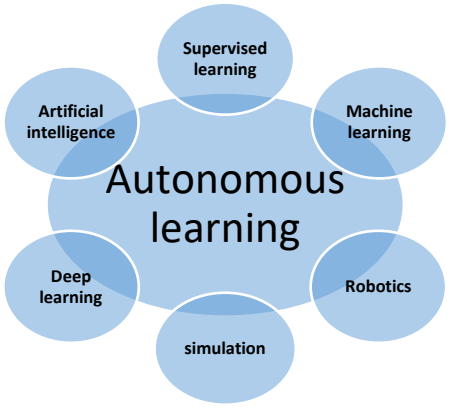

Figure 1: Autonomous Learning Environment

2.1.1. The digital classroom project

The Moroccan project of digital classrooms in schools aims to support teaching with digital tools to reinforce the learning of science subjects. The first step is to list the students and add them as users, from which they will get a username and password to access the site freely.

2.1.2. Appropriate the training system

The training system within the Digital Classroom Project plays a crucial role in ensuring the effective implementation and utilization of digital tools in the educational landscape.

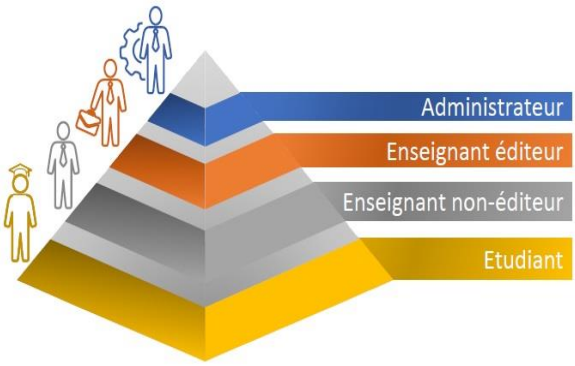

Figure 2: Teacher Training Programs (French version)

Teacher Training Programs use Moodle which allows to define and create roles with well-defined permissions (Digital Classroom Teacher)

One key aspect of digital classrooms is machine learning, where algorithms learn from data and improve their performance over time. This enables AI systems to adapt to new information and evolving situations, making them highly versatile. Deep learning, a subset of machine learning, involves neural networks with multiple layers, allowing AI systems to process and analyze complex data structures.

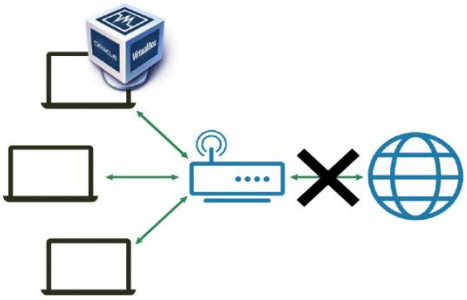

Figure 3: Overview of the Digital Classroom System Requirements

The success of this project heavily relies on equipping educators with the necessary skills and knowledge to harness the full potential of technology in teaching. Here are key aspects of the training system within the Digital Classroom Project:

- Teacher Training Programs: The project initiates comprehensive training programs designed to familiarize teachers with the digital tools and technologies integrated into the classroom. These programs cover a range of topics, including using educational software, managing digital content, and incorporating interactive elements into lessons.
- Technical Proficiency: Educators receive training to enhance their technical proficiency, enabling them to navigate digital platforms, troubleshoot common technical issues, and effectively utilize digital resources in teaching. This includes understanding the functionalities of digital devices and educational software.
- Pedagogical Integration: The training system emphasizes the integration of digital tools into existing pedagogical approaches. Teachers learn to align technology with educational objectives, creating a seamless connection between traditional teaching methods and innovative digital resources.
- Adapting to Digital Learning Environments: As the project incorporates both physical and digital classroom models, teachers are trained to adapt to diverse learning environments. This includes transitioning between in-person and virtual settings and making the most of the advantages offered by digital platforms.
- Inclusive Education: Training programs focus on fostering inclusive education by equipping teachers with strategies to cater to diverse learning needs. This involves using digital tools to create personalized learning experiences accommodating students with varying abilities and preferences.
- Continuous Professional Development: Recognizing the dynamic nature of technology, the training system ensures continuous professional development for educators. This includes updates on the latest advancements in educational technology, emerging trends, and best practices for incorporating new tools into teaching practices.
- Assessment and Feedback: Teachers receive guidance on using digital assessment tools and leveraging real-time feedback mechanisms to gauge student progress. This enhances their ability to tailor instruction to individual student needs and track overall class performance.
- Collaborative Learning Platforms: The training system encourages collaborative learning among educators, providing opportunities for them to share experiences, best practices, and innovative teaching strategies. This collaborative approach fosters a supportive community of practice.
- Student Engagement Techniques: Educators learn effective techniques for engaging students in a digital learning environment. This includes incorporating interactive elements, multimedia content, and collaborative activities to enhance student participation and motivation.
- Data Utilization: Teachers are trained to analyze data generated by digital tools to assess student performance and adjust instructional approaches accordingly. This data-driven decision-making process contributes to personalized learning experiences and continuous improvement.

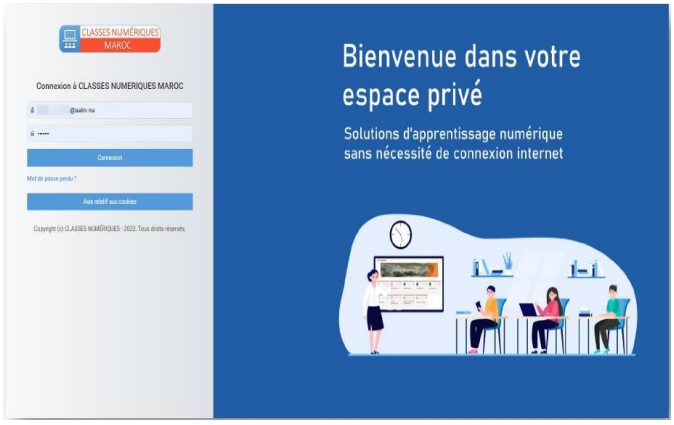

Figure 4: Digital Classroom environment (French version)

3. Result and discussion

Annual rainfall variability in the study area

Initially, the model of the combined digital classes project presents many advantages that can be considered a pedagogical innovation strategy aimed at strengthening the teaching of sciences. The results presented in the research show that the IA has advantages that can be considered compatible and remedial to the strategy of digital learning for a range of obstacles that hinder the reinforcement of scientific learning and the autonomy of the student in their manipulation of resources cited in a digital space.

The application of AI in the environmental sector holds great promise for addressing complex challenges and promoting sustainable practices. As technology continues to advance, the synergy between AI and environmental initiatives will likely play a

pivotal role in creating a more sustainable and resilient future.

The Correlation Between Smartphone Use and Academic Achievement

Questions about using digital tools and the combination of flipped classrooms and digital classes aim to list the activities that most marked them during the year, in a positive manner initially, and then in a negative manner:

Response	Number	Percentage
Strongly disagree	4	1.923%
Disagree	4	1.923%
Neutral	24	11.538%
Agree	80	38.461%
Strongly agree	96	46.153%
Total	**208**	**99.998%**

Tableau 2: Students who rely on using AI to prepare their homework

Table 2 indicates a substantial proportion of students, with 46.153% strongly agreeing and 38.461% simply agreeing, who rely on Artificial Intelligence (AI) as their primary method for completing homework. This statistic underscores that a significant majority of teenagers view smartphones as indispensable tools for searching and synthesizing information. They recognize the diverse and innovative methods facilitated by disciplined internet use and educational platforms...

The Pearson correlation is based on the following equation:

$$\mathbf{r} = \frac{\sum xy - nx - y}{\sqrt{\sum x^2 - nx^{-2}}\sqrt{\sum y^2 - ny^{-2}}}$$

X: The total degree of dependence on controlled AI use

Y: Degree Total school success

$$r = \left(\sum xy - nx - y\right) / \left(\sqrt{\left(\sum x\text{^}2 - \text{nx} - \text{^}2\right)}\sqrt{\left(\sum y\text{^}2 - \text{ny} - \text{^}2\right)}\right)$$

r= 0.89

Significance level	Sample volume	Person correlation coefficient	Indication level
The total degree of dependence on IA use	208	0.897	At indication threshold (0,05)
The total degree of school success			

Tableau 3 The correlation between using IA and academic success

Table 3 shows the relationship between using IA and Academic Performance, where the value of the Person's correlation coefficient was r=0.89. This means that there is a strong correlation between using IA and academic achievement. Controlled IA use can be a solution to higher academic achievement. Thus, the hypothesis asserting a statistically significant correlation between addiction to random digital resources and academic achievement within the study sample has been validated with a confidence level of 95%. This implies a 5% probability of making an error [19].

The following two questions were open-ended. The goal is to list the activities that most marked them during the year. In a positive manner initially, and then in a negative manner:

Do you find that using IA encourages students to learn?

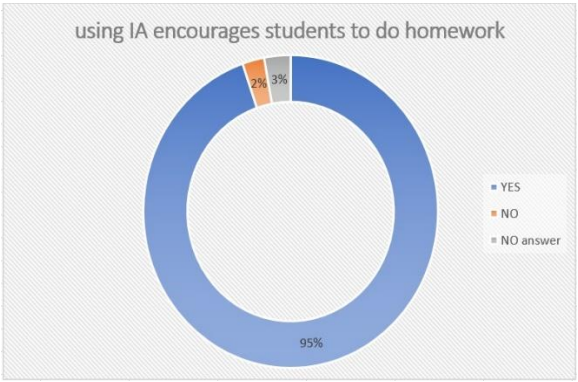

Figure 5: the percentage of students who found that using IA at home is motivating.

Using AI encourages students to prepare courses in advance and the capsules should make it easier to understand better. It helps students to remember the

course. We want to generalize this practice like watching a movie!

Do you find that the digital classroom system allows absentees to follow and copy the course ?

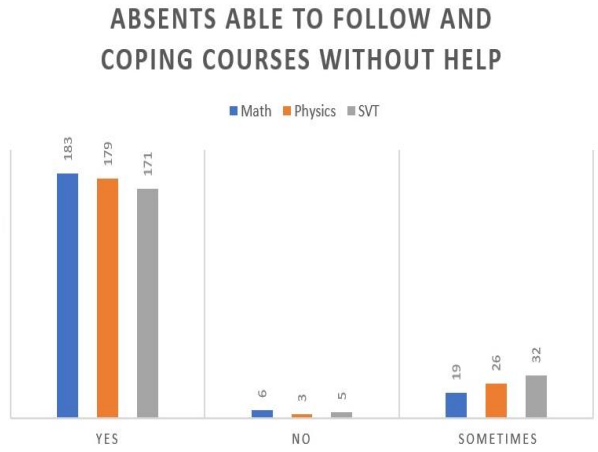

Figure 6: The percentage of absent students who can watch courses and do homework at home.

Practicing in class and seeing the course as a video capsule at home (flipped classroom) is more motivating than traditional methods. It allows us to see the course several times with the teacher's explanation and that means more exercises in class [13] - [21].

Do you find that combining IA with this digital learning model is useful?

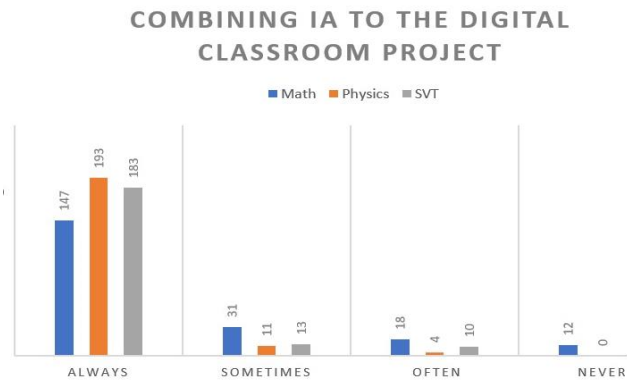

Figure 7: Combining AI according to the digital learning model?

Some teachers cannot work with students using this method because subjects require memorization, and the teacher must write the summary possible in math because the exercises require a huge face-to-face explanation and it would take time for students to work on all subjects. This method would facilitate learning in most scientific subjects and allow for more group work due to parental involvement

5. Difficulties anticipated during the session

To identify the difficulties and obstacles encountered, a range of questions were asked at the beginning of each session:

- Have you watched the lesson at home?
- If yes, how many times have you watched it?
- Did you understand the lesson?
- Did you encounter any problems?

Group work in the digital classroom also resulted in some trial and error related to the arrangement of tables, the size of the room, the allocation of students, and the composition of teams. Students only focus on technical difficulties, such as mastering applications, self-training pressure, and working under urgency.

Computer equipment presents obstacles that hinder the integration of digital classrooms. It is essential to have access to computers (or tablets with Wi-Fi access) to address the following difficulties:

- Work not completed.
- Access to digital resources in class.
- Ability to easily record audio/video to send productions to teachers.

Digital classrooms require the use of computer tools, which requires the presence of equipment in schools.

Students are motivated by the integration of digital means (tablets, smartphones, computer simulations...) and are involved in the educational process.

- Breaking the ice that hinders parental engagement in the learning process.
- Students who do not easily understand the lesson have the time to review it several times at their own pace in the form of video capsules.
- The level of students is improved through collaboration in class.
- Learners work with a certain freedom regarding the development of courses and are not prepared for the change of pace in classes.

To be sure of the impact of the digital classroom project on students' academic success in science subjects, we conducted 67 tests for each discipline (math, physics, and SVT) over 34 weeks:

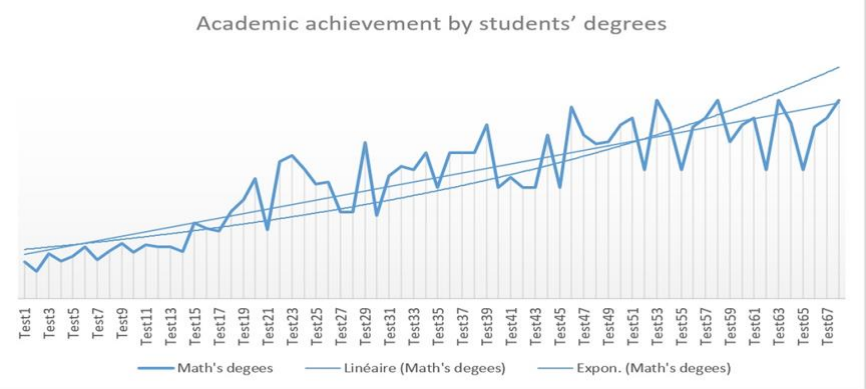

Figure 8: Academic achievement by math degrees

Figure 8 shows the academic achievement of students' degrees in math on 67 tests during 34 weeks, it's clear that learning by simulations and M-learning are a wonderful solution for the huge explanation in math.

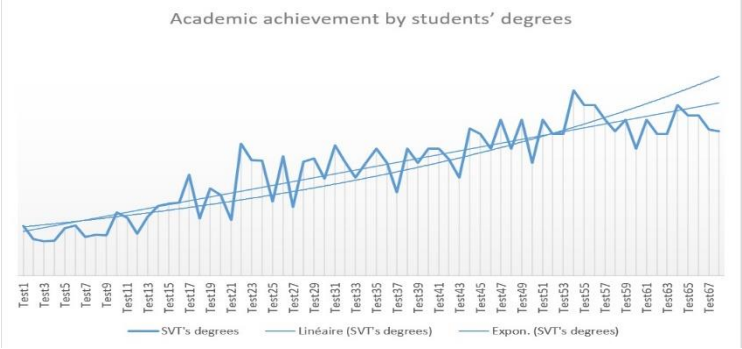

Figure 9: Academic achievement by physics degrees

Figures 8 and 9 shows the academic achievement of students' degrees in math and physics on 67 tests during 34 weeks, simulations conducted by digital classroom and M-learning can be a solution for the explanation of scientific concepts in physics

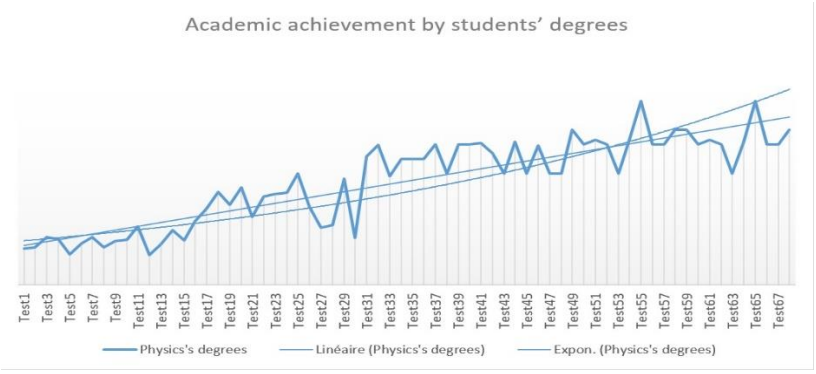

Figure 10: Academic achievement by SVT's degrees

Figure 10 shows the academic achievement of SVT students' degrees of 67 tests in 34 weeks, it requires a huge time and explanation it would take time for students to adapt to the new situation.

In conclusion, the integration of AI into the research process and educational M-learning practices will play a pivotal role in autonomous understanding and leveraging the benefits of digital classrooms. By harnessing the power of AI, Morocco can not only assess the current situation accurately but also pave the way for a future where education is resilient, inclusive, and adaptable to the ever-evolving challenges of the modern world.

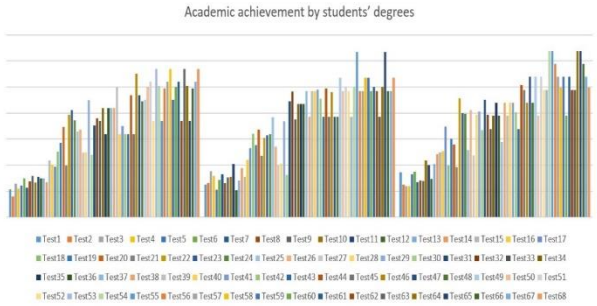

Figure 11 Academic achievement by students' degrees

6. Difficulties and obstacles

To cite the difficulties and obstacles encountered by students, I asked direct questions at the beginning of each session:

1. Did you watch the lesson?
2. If so, how many times did you watch it?
3. Did you use IA to understand the lesson?

In the scenario of integrating Artificial Intelligence (IA) with the Digital Classroom Project in Morocco, one can envision a significant advancement in the educational and technological landscape. Imagine the amalgamation of analytical capabilities and machine learning with digital classrooms to enhance student experiences and refine teaching methodologies. Here are some potential aspects of such integration:

1. Personalized Learning: AI can analyze student performance and understand their individual learning needs. Based on this information, tailored learning plans can be offered to create a more effective learning experience.
2. Automated Assessment: AI can assist teachers in assessing student performance more efficiently, saving time and contributing to identifying the strengths and weaknesses of each student.
3. Improved Interaction : AI integration in digital classrooms can enhance interaction between students and educational content, utilizing machine learning techniques and interactive interfaces.
4. Access to Rich Educational Resources: AI can be employed to provide diverse and enriching educational content, contributing to the effectiveness of learning processes.
5. Teacher Support : AI can provide tools to support teachers in lesson planning and understanding class needs, helping them positively impact student experiences.
6. Monitoring Student Progress : AI can analyze student performance data over time, allowing teachers to understand student progress and intervene when necessary.
7. Enhanced Student Engagement : Integrating virtual and augmented reality with AI can create inspiring and interactive learning experiences for students.

These benefits represent only a fraction of the possibilities of integrating IA and digital classrooms, capable of improving the quality of education and providing equal opportunities for all within the framework of modern technological advancements in Morocco [14].

7. CONCLUSION

The digital classroom project, led by the Moroccan Minister of National Education for Preschool and Sport, reflects an educational strategy based on M-learning and the integration of artificial intelligence. Launched as a response to the global health crisis triggered by the COVID-19 pandemic, it can be also a solution for various challenging circumstances like natural disasters, wars, and pandemics. This initiative aims to leverage AI technologies within the educational landscape. By combining distance and face-to-face learning models with digital tools, the project aims to strengthen the inclusiveness of students in the teaching-learning process and ensure the continuity of education systems in Moroccan schools, in particular, science subjects like mathematics, physics, and life and earth sciences (SVT) in the college cycle within the Rabat Sale Kenitra region. [11] - [12].

This study has shown that it is time to start using smartphones in the classroom as a pedagogical tool and to take advantage of their many benefits, with the

main one being the possibility of being autonomous in the digital learning process.

- Students are no longer forced to sit in silence for hours; they can "live" in the classroom and have rich exchanges with the teacher and other students.
- Students adapt quickly to the practice of digital classrooms.
- Using IA can eliminate several obstacles due to students' behavior.
- IA Unify the level of learning of learners
- Parents can integrate themselves into the learning process to become familiar with their students.

This amalgamation of AI and the digital classroom project holds significant promise for enhancing the learning experience. AI technologies can play a pivotal role in personalizing education, adapting to individual student needs, and providing valuable insights for educators. The marriage of AI and the digital classroom aligns with the broader goals of inclusivity, equal opportunities, and adaptability to diverse circumstances, reflecting a forward-thinking approach to education in Morocco. As the project unfolds, its impact on the performance of teachers and the overall educational landscape in the region will be closely examined, contributing valuable insights for the ongoing evolution of AI in education. [22] - [23].

Despite its drawbacks, digital education will continue to evolve due to several factors. However, the success of quality pedagogical digitalization with digital classrooms in an educational system requires developing and integrating digital, human, and financial resources. It depends on more than just the techniques used but on disciplinary requirements and mastery of didactic and pedagogical skills, which could also be exercised without recourse to digital tools [15] - [16] [20] - [24].

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