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Distance Mathematics Teaching and Academic Performance in Morocco

Salwa El Abbadi and Moulay Ismail Hafidi Alaoui
Faculty of Educational Sciences, Mohammed V University, Rabat, Morocco

Abstract

In this article, we discuss the academic performance and impact of distance teaching of mathematics in the Moroccan education system. This educational science research, based on exploratory thinking, aimed to show the impact and challenges of distance teaching of mathematics within the Moroccan education system through examining this fundamental question: How could school programs, pedagogical organization, and the performance of pupils and teachers in Morocco best address the challenges of distance teaching of mathematics? The answer is based on a qualitative analysis of the content of the documentation that frames the teaching-learning process and the evaluation of mathematics in Morocco and, on the other hand, on the projection of research hypotheses in the field through various strategies inspired by our research objectives.

Keywords: curriculum, education system, e-learning, evaluation, technology, Morocco

Introduction

This work of educational science research aimed to examine distance learning in relation to mathematics taught in the Moroccan education system. In this research, we addressed two fundamental aspects. The first aspect concerned the content of the various mathematical programs, describing and briefly analysing the teaching-learning process of mathematics in Morocco. The second aspect dealt with teachers' in-depth concept of teaching mathematics at a distance to better appreciate and understand the specificities and characteristics related to this practice.

In this context, we were interested in two school levels: secondary college and qualifying secondary education (defined in detail in the section titled The Context of Education in Morocco). In view of this, it seemed useful to ask how best to deal with distance teaching of mathematics through the delivery of the Moroccan curriculum, including school programs, pedagogical organization, and the performance of students and teachers.

Problem

The Context of Education in Morocco

In order to better understand the way in which technical education is integrated into this system, we present first an overview of the Moroccan education system.

The Moroccan education and training system falls under the supervision of the Ministry of National Education, Preschool and Sports. This system is based on educational subsystems relating to:

- preschool, elementary, secondary college, and qualifying education
- higher education
- vocational training
- literacy and non-formal education

As we considered only the first subsystem in our research, we present now a brief description of this subsystem.

Preschool education is for children aged 4 to 6. It aims, on the one hand, to facilitate the physical, cognitive, and emotional development of the child and, on the other hand, to develop a child's autonomy and socialization.

Elementary education is the initial level of education in Morocco and lasts 6 years (students aged between 6 and 12 years; grades 1 to 6). It consists of a 2-year core cycle and a 4-year intermediate cycle. Students must successfully complete a primary school certificate in order to be admitted to the college cycle of secondary education.

The mission of *secondary college education* is to sharpen the formal intelligence of young people and introduce them to basic concepts and laws in mathematics, science, and the environment. It lasts 3

years (grades 1 to 3) and welcomes pupils from primary school and holders of the primary school certificate. The end of college education is sanctioned by a college teaching certificate which allows students to continue studies in qualifying secondary education, according to their orientation and aptitudes.

Qualifying education is divided into three categories: general, technical, and vocational. It lasts for 3 years (grades 1 to 3), and it welcomes, on the one hand, students from college school and holders of a college teaching certificate and, on the other hand, people who do not hold the certificate, subject to an assessment of their skills and the prior or parallel follow-up of the necessary upgrading learning as a prerequisite. In addition, it focuses on different training courses that improve the knowledge and skills acquired from college education and diversifies the areas of learning.

The Framework of Distance Learning

Nowadays, technology occupies a central place in human activity. Some governments, decision-makers, and educational institutions treat distance learning as one of the fundamental opportunities relating to the future of societies. Indeed, various information and communication technology (ICT) tools are part of work and communication environments. Depover, Karsenti, and Komis (2006) stated that “ICT provides an opportunity to rethink and relocate, in space and time, exchanges between teachers and students, and thus promote[s] new avenues for learning or training activities” (p. 179).

During the COVID-19 pandemic, education systems in the majority of countries agreed on the importance of distance learning. However, this importance was not translated in the same way when it came to the teaching of mathematics. Moreover, any curriculum requires the development of a set of criteria and choices that justify the design and organization of the use of educational technology. The digital tool occupies a crucial place in the educational world as in other areas of human activity.

The professional adaptation of digital tools is mandatory in any training and educational practice. Technological tools play a fundamental role in the development of distance learning. The importance of this role is underlined by Sofi et al. (2017): “Mobile learning is one of the facets of the application of ICT in education. But because it relies on technology that is more affordable and easier to acquire and use yourself than the desktop computer, it requires a reconceptualization of the modalities of implementation” (p. 2).

Consequently, distance learning is defined through the use of mediated pedagogical communication that contains a combination of all traditional media including video cassettes, radio, and television, as well as digital media such as virtual classrooms, virtual campuses, and videoconferencing.

From these various considerations, our interest in distance learning grew, and we decided to explore the place occupied by distance teaching of mathematics in the first Moroccan educational subsystem and, in particular, the secondary college cycle and the qualifying cycle.

Research Questions

Interest in distance learning in Morocco has grown since the COVID-19 pandemic. In this context, the transition from face-to-face to distance learning was characterized by the absence of pedagogical guides and official documents to direct this mode of teaching. Since 2012, Morocco has emphasized the

usefulness of integrating ICT into its education system. However, ensuring good pedagogical continuity and supporting new living and working modalities during the COVID-19 pandemic required the Moroccan education system to go a step further and examine ICTs as fundamental elements.

In view of the importance accorded to distance education in Morocco, it seemed useful to ask the following research question: How could school programs, pedagogical organization, and the performance of pupils and teachers in Morocco best address the challenges of distance teaching of mathematics?

We broke down this research question into five sub-questions, allowing consideration of several aspects of our research problem:

- What is the potential of technology in distance mathematics education in Morocco?
- Do the technological practices adopted for distance learning in Morocco pose specific integration problems?
- Does distance learning in Morocco improve students' level of acquisition in mathematics?
- What are the limitations and obstacles that the teacher and student may encounter in distance teaching of mathematics in Morocco?
- What are the necessary conditions to establish a relevant relationship between distance learning devices and the process of teaching-learning mathematics in Morocco?

Theoretical Framework

Distance learning is an expression that is part of the vocabulary of expertise, so it is often complicated to study. Indeed, this expression is associated with a specific field of practice that involves the implementation of specific knowledge and concepts.

The development of learning models for each educational system is based on the implementation of different contexts of this system at political, institutional, technological, and linguistic levels. Peraya and McCluskey (1995) said that the same terms and their meanings therefore differ from one country to another and from one language to another. According to some authors, distance learning scholarship refers to *Fernunterricht* in Germany, *open learning* in England, and *multimedia teaching* in France.

To deal with our fundamental research question and the five sub-questions, we established two analytical strategies: conceptual and didactic.

Conceptual Analysis

This type of analysis addresses the specific framework of distance education compared to face-to-face teaching (traditional teaching), through an analysis of the conceptual organization and, thus, the role played by the media and new technologies for this mode of education.

The treatment of the conceptual analysis was to focus on the following objectives:

- know the definition of distance education or distance learning;

- improve general knowledge of the term distance education;
- provide an overall historical overview of distance education; learn the characteristics of distance learning;
- think about the use of different technology tools in distance education; and
- provide a general representation of distance learning practices between past and present.

In order to identify the objectives mentioned above in relation to what is achieved at the research level, we mention a few research articles in this regard. Note that these works are both international and national. Each of these works addresses the problem of distance education from a particular angle and for a specific type of education (school education or higher education):

- Deeb: "Place and Role of the Teacher Involved in Distance Learning at the University: The case of the FORSE Digital Campus at the Université Lumière-Lyon" (2016).
- Zahra Riad: "Education in Morocco: Educational Requirements and Ideological Intrusions" (2020).
- Mohamed Oudrhiri: "The Pedagogical Use of Digital Technology in Mathematics Education in Morocco" (2016).
- Kaoutar Aarab and A. Belmoudene: "Distance Education: Student Perceptions and Use of Digital Technology During the Covid-19 Lockdown" (2021).
- Driss Louiz: "Distance Education in Morocco at the Time of Covid-19" (2020).

In our analysis of these research works, we identified fundamental aspects that characterize distance learning, as well as the elements associated with them:

- definition of distance learning:
- linguistic definition
- elements of the literature for a definition of distance learning
- types of distance
- the lexical field associated with distance learning
- learning modes in the context of distance learning and support modalities
- types of distance e-learning/e-learning
- the historical context of distance learning
- the development of the distance learning system
- the comparative study of distance learning and face-to-face teaching

Through this analysis, we determined the basic elements of distance learning, as well as the different choices made in this mode of teaching.

Didactic Analysis

This analysis aimed to show how distance learning is organised in an education system. Specifically, we were interested in two elements.

- Mathematical and didactic organisations supporting distance learning, in particular, distance mathematics education. For this analysis, we borrowed tools from different frameworks based on need. We thus sometimes mobilized elements of Chevallard's (1985) anthropological theory of didactics.
- The status of distance learning in the Moroccan education system: Through this work, we sought to detect the mechanisms that manage the proper functioning of an education system. We attempted to delineate and characterize the elements that support the use of different technologies to successfully teach mathematics from a distance.

Methodology

This research had two fundamental approaches:

- the reflexive approach, consisting of delineating documents and texts which framed the research objectives, and
- the testing approach, in which we adopted a strategy based on the implementation of tools that enable critical analysis.

Consequently, our data collection strategies were grouped into two fundamental categories: the study of documentation and the study of the experimental field.

Study of Documentation

Analysis of Mathematical Content at the Learning and Assessment Level

The fundamental objective of this study of documentation was to understand teachers' discourse in an institutional setting. We performed a content analysis of official documents and referents in Morocco to classify procedures and objective descriptions in order to arrive at a set of qualitative data. Indeed, these documents and referents represented the status accorded to mathematics in Morocco. The analysis of official documents supporting both the teaching-learning and the evaluation of mathematics made it possible to:

- determine the status of the mathematics discipline in relation to other school subjects and
- establish what needs to be learned in order for the learner to be competent and able to exploit the different aspects of mathematics in different situations arising from a working life.

Official documents are produced by the Directorate of Curricula, the Ministry of National Education, the Higher Council for Education and Training, as well as the National Centre for Assessment, Examinations, and Guidance. The following documents support teaching practices in Morocco:

- CNEEO (2007), Ministerial Note No. 142-08: "Organization of the Continuous Assessment of Mathematics in the Qualifying Secondary Cycle," Ministry of National Education, Higher Education and Scientific Research;
- CNEEO (2010), Ministerial Note No. 28: "Reference Framework for the Evaluation of Standardized Examination Subjects for Obtaining the Certificate of Secondary College Studies," Ministry of National Education, Higher Education and Scientific Research;
- CNEEO (2010), Ministerial Note No. 192: "Organization of the Continuing Evaluation of Mathematics at the College Secondary Cycle";
- CNEEO (2010), Ministerial Note No. 46: "Reference Frameworks for the Subjects of the Regional Examination for Obtaining the Certificate of Secondary Education," Ministry of National Education, Higher Education and Scientific Research;
- CNEEO (2010), Ministerial Note No. 39: "Frameworks of Reference for the Standardized National Examination for Obtaining the Baccalaureate," Ministry of National Education, Higher Education and Scientific Research;
- Direction des curricula (2009): "Orientations Pédagogiques et Programmes de Mathématiques de L'Enseignement Secondaire Collégial," Ministère de l'Éducation Nationale de l'Enseignement supérieur, et de la Recherche Scientifique;
- Direction des curricula (2007): "Orientations Pédagogiques et Programmes de Mathématiques de L'Enseignement Secondaire Qualifiant," Ministère de l'Éducation Nationale de l'Enseignement supérieur, et de la Recherche Scientifique.

Study of the Experimental Field

We also undertook a study of the experimental field, based on the discourse of different actors in the Moroccan education system (teachers, learners, and discipline-specific inspectors) through an interactive approach. This strategy consisted of projecting the hypotheses and questions of the research onto various Moroccan schools.

In addition, we addressed a set of constraints and problems encountered in distance mathematics teaching in the Moroccan education system.

This part of the research used two strategies: two focus groups and an analysis of professional practices. The strategies are described in more detail in the sections that follow.

Focus Groups

The participants in the focus groups were mainly teachers. These teachers were selected according to teaching cycles (in this case, secondary college and qualifying education). We decided to contact

teachers from rural and urban areas, teachers from public and private institutions, and teachers from disadvantaged and favoured regions. We aimed to have both female and male participants.

Our sample was composed of 15 teachers.

During the focus group sessions, we let the conversation unfold informally, after asking the following question: What do you think about teaching mathematics remotely in Morocco, based on your experience during the COVID-19 pandemic?

The first focus group was dedicated to qualifying education teachers. It was held in September 2022. The second focus group was dedicated to secondary college education teachers and was also held in September 2022. Each meeting lasted between 60 and 90 minutes. The teachers were seated in a circle to stimulate further discussion.

Prior to the focus group, participants' demographic characteristics such as number of years of work, teaching cycle, sector, and environment were collected. See Table 1.

Table 1

Sociodemographic Characteristics of Participants

Characteristic	Teaching cycle		Total
	Secondary college	Qualifying education	
Gender			
Female	5	3	8
Male	3	4	7
Years of work			
1–10	4	5	9
11–20	1	1	2
Over 21	3	1	4
Sector			
Public	7	4	11
Private	1	3	4
Environment			
Rural	3	1	4
Urban	5	6	11

*Note: $N = 15$.

Following each focus group, we conducted a final interview with participants to question them about the conduct of distance mathematics teaching sessions for their respective teaching cycles, as well as their general achievements in distance education compared with face-to-face teaching. These interviews focused on their experiences during the COVID-19 pandemic and explored three issues:

- difficulties encountered during distance learning,
- achievement of learning objectives, and
- how the distance education sessions were organized.

While teacher participants were randomly selected, inspector participants had to be selected more purposefully in order to ensure the research represented both education cycles (secondary college and qualifying), and a variety of regions. We were interested in diverse opinions on the research subject.

Analysis of Professional Practices

In this part of the study, we focused on the practices of teaching mathematics remotely at both cycles (secondary college and qualifying education) during the COVID-19 pandemic. The main aim was to describe teachers' relationship to distance mathematics teaching. This was an informal way to evaluate distance education in mathematics and evaluate the consequences and achievements of the teaching method used by the teacher on the knowledge acquired by the learners.

This analysis aimed to better understand the personal behaviours of mathematics teachers in relation to the integration of technological tools in their pedagogical practices. It was a matter of gaining a better understanding of the situation based on a conception of the educational professional in order to share different educational reflections and critical thoughts.

The analysis of professional practices complements the results obtained in the focus groups. Indeed, the same group of teachers was involved.

The analysis of professional practices was based primarily on analysis of the communicative dimension of distance mathematics teaching during the COVID-19 pandemic. Exploring this dimension made it possible to identify the interaction between actors (teacher, learner) in the teaching-learning process, as well as the type of activities planned.

Data collection was approached according to the results obtained in the focus groups.

Thus, the data dealt with:

- conditions and constraints that affect teachers' practices during face-to-face mathematics teaching and distance learning,
- teachers' personal relationships with distance learning, and
- students' personal relationships with distance learning.

Data from the two types of analysis have made it possible to discuss the difficulties faced by teachers in teaching mathematics at a distance.

Results and Discussion

In this section, results obtained by each of the data collection strategies are shown and explained.

Study of Documentation

We began the analytical study of the official documents supporting the process of teaching-learning mathematics and the evaluative framework of this discipline with a general didactic anthropological analysis of the curricula and pedagogical orientations and, then, the ministerial notes that organize both the continuous assessments and, at times, the regional and national standardized examinations. These studies were conducted at both the secondary college and qualifying cycles.

When analyzing the official documents, we focused on a set of ministerial directions that we consider important to help in our analysis:

- Programs first focus on developments associated with mathematical knowledge taught through the implementation of the skills to be achieved, and only then do they address formalization of this knowledge;
- Ministerial notes and terms of reference set out content based on assessment situations that emphasize the relationships between types of mathematical knowledge and reasoning, in order to respond to situations.
- The adoption of the competency-based approach is often present in curricula and pedagogical orientations; however, for ministerial notes, implementation of this approach is ignored. In fact, there is an explicit absence of aspects associated with the competency-based approach in ministerial notes.

The teaching content described in official curricula and pedagogical orientations is difficult to teach using available technologies. Indeed, there is a gap between the content presented in these official programmes and orientations and the content actually projected, on a screen, to learners.

- The Moroccan education system represents evaluation as a decision-making process in which the skills and knowledge acquired by the learner are weighed against learning objectives. In this context, a teacher must plan the evaluation process to account for the type of learning targeted and the manner in which the evaluation is to be conducted.

We note that the ministerial notes reviewed for this study were adapted with the content of the curricula and pedagogical orientations; there was not a question of emphasizing mathematical organization based on didactic conditions of curriculum execution in the classroom.

The discipline of mathematics in the Moroccan education system is shaped by a progression associated with the achievements of students. This progression is based on the understanding and construction of mathematical knowledge, as well as the development of different mathematical skills.

In conclusion, the analysis carried out in this part showed the organizational and functional consequences of the teaching and evaluation of mathematics. Further development in the education system, in the teaching of mathematics in particular, will remain a difficult objective to achieve.

Study of the Experimental Field

Focus Group

We now present the opinions of some teacher participants on distance education of mathematics as expressed in the focus groups.

An early-career, female teacher working in the secondary college cycle in the public system in Marrakech said:

In my opinion, the experience that Moroccan teachers experienced about the COVID-19 pandemic in 2020 and this of teaching remotely, showed several difficulties. From the pedagogical point of view, teachers had no training or experience of teaching by this distance method, as they had no didactic, pedagogical, or electronic logistics support to succeed in this teaching method. Most Moroccan teachers have chosen to use social media to communicate with their students. The latter had more difficulty understanding the courses in their social networks, some of them were not serious about this method of teaching; however, the majority of students in rural areas did not have the material means to be able to follow the courses remotely. Most of these students come from poor families. In short, distance education in Morocco during this period was a great disappointment.

However, another early-career, female teacher also working in the secondary college cycle but in a private school in Marrakech said:

The COVID-19 pandemic has impacted the world negatively. However, private education was lucky to develop quality with its pupils and also teachers; courses were held online and all pupils were on their computers connected and ready to execute every teacher request via the internet. But, the latter was forced to change the classic preparation of his lessons and make them read dynamiqueen using videos and animations.

In parallel with the courses, private schools have organized online activities to not reduce the cultural level of students. Many competitions were held at many schools, which allowed students to continue their school year.

Finally, I supported the success of the period of private education in distancing, but, thanks to the conditions of technology that private schools provide, unlike public schools that had absolutely no means to proceed.

A more senior, male teacher, working in the qualifying education cycle in an urban private school, had this to say:

From my personal experience of teaching mathematics remotely, it can be said that the period of confinement that forced us to follow this mode of teaching and to do so, we used several methods: applications such as Zoom that allows to communicate with students, as well as, to explain classes either through screen sharing or through video calls.

Another means used is social networks like Facebook or WhatsApp, but, they only allow to share a few lessons and sets of exercises without having interactions between the teacher and the students.

Indeed, when we used these methods we did not see much difference between teaching mathematics at a distance and in face-to-face. The only difference is that in the distance education mode, students could not take their courses permanently because of the lack of computer resources or the lack of internet connection. In my personal opinion, if we combine the teaching of mathematics at a distance and the teaching of mathematics in face-to-face, we can have better results than that obtained by each of these modes of teaching.

Finally, a very senior, male teacher working in the secondary college cycle in a public, urban setting, expressed these views:

Today, distance learning has become a ubiquitous mode of teaching that is developing rapidly. To be successful in this mode of instruction, emphasis must be placed on:

- Generalize the Internet to all educational environments (urban and rural);
- The integration of new information and communication technologies in all educational settings;
- Improve learner self-learning.

The Moroccan kingdom experienced during the COVID-19 pandemic exceptional circumstances within the public and private education systems because of the mandatory cessation of face-to-face classes. To carry on the teaching-learning process and not deprive students of their right to education, those responsible set out to build a distance learning framework that would guarantee the transmission of fundamental knowledge for all learners through the use of accessible ICT tools such as television, computer, telephone, Internet, as well as the various computer systems. As a result, these tools have helped implement the strategy of the Ministry of Education in the field of distance learning.

In the context of the problem posed in this research, the teaching of mathematics at a distance during this period was, as stated by the first teacher quoted in this article, a great disappointment.

On the other hand, distance learning was presented as a useful tool for self-training in the computer field, for the use of communication tools, and with mathematics-specific software (such as dynamic geometry software, numerical calculation software, statistical software, spreadsheets, etc.) and computer systems devoted to mathematics. This aspect makes it possible for teachers to improve their professional skills, manage learning time, and transmit knowledge in a non-traditional way.

Private school teachers offered richer distance learning compared to public school teachers. This may have been due to the technology that private schools are able to provide, unlike public schools that are lacking the means to be able to offer more technology.

The combination of face-to-face and distance mathematics teaching improves the quality of teaching. Indeed, distance learning is considered as a complement to face-to-face teaching through the realization of exercises by the learner and problems from the various technological tools available, which allow learners to manage their fundamental knowledge in an individual way. Glikman (2003) stated that the term distance education applies to “any type of organised training, whatever its purpose, in which the bulk of knowledge transfer and learning activities are outside the direct, face-to-face ... relationship between teacher and student”¹ (p. 126).

To conclude, more than half the teacher participants stated that the effect of distance education in mathematics in rural areas had a greater negative effect on the general level of learners when compared to urban areas.

The integration of ICT in distance mathematics teaching has created a new dynamic for the learner. This is the time for a radical change in curricula and didactic and scientific tools used in the Moroccan education system, to build a relevant distance education system, as well as to solve other problems, such as the load of school programs and class size (40 students or more).

Analysis of Teachers' Professional Practices

Distance learning was a ubiquitous choice in the Moroccan education system, just as it was in all other education systems during the pandemic. In this context, it was necessary to take into account pedagogical and technological factor and the ability of teachers to prepare learning content.

The analysis of teachers' professional practices is a complex process. Indeed, this analysis represents a research method based on description and explanation. These last two elements help to explain the consequences of distance mathematics teaching, as well as to establish teachers' behaviours and attitudes. From the selection of important elements that highlight the object of this research, this analysis makes it possible to understand the actions of teachers and the way in which these actions were executed.

Distance learning has difficulties and problems that can be grouped into three categories:

- **didactic:** Content taught remotely is less well managed than that taught face-to-face.
- **pedagogical:** The distance learning mode does not grant students the necessary attitudes that allow them to learn and assimilate their learning in an explicit way such as they do in the face-to-face teaching mode.
- **technical:** The distance learning mode does not make it possible to explicitly organize a pedagogical discourse well adapted to the teaching contents.

According to the teachers interviewed, there is a set of conflicts typically encountered during distance learning. These include:

- Teaching mathematics in distance learning courses does not correspond to the objectives associated with these courses. Indeed, these objectives are based on aspects that require the presence of both learners and teachers at the same time.
- The various resources allocated to the face-to-face teaching mode must be modified so that they can be accessed in the distance learning mode. Indeed, it is a question of digitizing these resources to be available to students remotely. This aspect is a bit difficult to manage because it requires deep knowledge of computers and software.

The teachers offered suggestions to improve the quality of distance learning in Morocco, including:

- Manage and organize a common time, planning for all students. Adapt learning schedules

according to the availability of these students. Indeed, it is a question of specifying fixed times and phases for learning at a distance and taking into account the pace of work and availability of students.

- Improve teachers' skills, teaching methods, as well as their resources in relation to distance learning and the use of information and communication technologies. The aim is to train teachers to acquire new skills adapted to new developments and changes in their career paths.
- Inform teachers and learners about the importance of distance learning and the acquisition of technological skills. This aspect makes it possible to change and renew learning methods, pedagogical practices, as well as the assimilation of new technological elements.

The COVID-19 pandemic was an opportunity to measure the relevance and value of distance learning under real-life conditions. While distance learning does not replace face-to-face teaching, it can complement face-to-face teaching.

Conclusion

The main objective of this research was to carry out an in-depth study on distance mathematics education in Morocco. This study evaluated, on the one hand, the mathematical content taught within the Moroccan education system and, on the other hand, professional practices. This makes it possible to implicitly evaluate the Moroccan education system.

The methodological framework for mathematics education within the Moroccan education system is based on a set of choices ranging from the general to the specific, from the main objectives of teaching to assessment to the desired specifications and characteristics of the learner at the end of each year of teaching. Thus, it is based on modern principles and pedagogies.

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