International Journal on
"Technical and Physical Problems of Engineering"
(IJTPE)
Published by International Organization of IOTPE

ISSN 2077-3528
IJTPE Journal
www.iotpe.com
ijtpe@iotpe.com

June 2024 | Issue 59 | Volume 16 | Number 2 | Pages 368-375

DEVELOPMENT OF QUALITATIVE SKILLS: A REVIEW OF INTERACTION BETWEEN ICT INTEGRATION AND ITS CREATIVE USE

S. Etterach M.Y. Hadi F.Z. Guerss

Laboratory Research in Computer Science, Faculty of Science, Ibn Tofail University, Kenitra, Morocco
said.etterach@uit.ac.ma, hadi@uit.ac.ma, fatimazahra.guerss@uit.ac.ma

Abstract- The objective of this study was to evaluate the impact of the creative use of the Geogebra software in the cooperative learning on the performance of students of first year of high school. The research sample consists of 36 students divided in two groups. The first group is an experimental group which followed this study with the software of dynamic Geometry and the cooperative pedagogy while the second group is a witness group or the students of the second group followed a focused learning on the collective visualization of animated productions via PowerPoint. Before the experimentation starts, a diagnostic test was administered to evaluate students' prerequisites and distribute them evenly among the groups. The qualitative analysis which was done with the aid of NVIVO has shown that the utilization of Geogebra can improve other competences of students, such as autonomy, self-esteem and active earning. These results show that the use of Geogebra in a traditional teaching environment based on the transmission of knowledge still has limits in terms of development of students' competences and knowledge. On the other hand, when Geogebra is used creatively, combining cooperative learning and active teaching methods, the benefits are considerable.

Keywords: Geogebra, Creative Use of ICT, Homothety, Focus Group, NVIVO.

1. INTRODUCTION

Recently, we cannot deny the importance of the integration of information and communication technologies (ICT) in education in improving students' learning, because this integration has a positive impact on their qualitative competences like autonomy, group work and critical thinking, etc.

In this sense, this article completes our article [1]. entitled (The impact of ICT and cooperative pedagogy on the success of the 1st year students of high school in mathematics) which aims to see the impact of the combination of technology and cooperative pedagogy in the quantitative aspect and to see the impact of the methodology used in this article but this time in the qualitative aspect. In this context, our article deals with the impact of this integration on the qualitative skills of learners by using the dynamic geometry software Geogebra in the discovery of the properties of homothety, one of the usual transformations studied in the chapter on usual transformations in the plan for students in the first year of high school.

As a result, the following hypotheses have been established:

• The pedagogical integration of ICT improves the qualitative skills of learners.

The aim of this study is to identify the qualitative skills developed in learners when technology is combined with pedagogy. In this sense, our problem is stated in the following questions:

• What are learners' perceptions when technology is combined with cooperative pedagogy?

• What qualitative skills do learners develop in this case?

The results of our study show that the creative use of technology develops a number of skills in learners: autonomy, anti-stress, self-esteem, active learning, and so on.

All these results can help us to solve other problems in educational systems, such as school drop-out, school failure and violence in schools. In other words, the effective use of ICT and its coupling with innovative pedagogies has indirect benefits for the success of any educational reform.

2. LITERATURE REVIEW

"The introduction of digital technologies in the field of education appears like an opportunity to develop new pedagogical approaches which aim to improve the quality of the teacher's teaching in the field and the students' learning" [2]. This is why the school must benefit from the multiple advantages of ICT and consequently it has introduced the acronym (ICTE) Information and Communication Technology for Education, as pedagogical supports at the service of teaching and learning.

The use of new technologies will help students transfer their acquired knowledge to all appropriate situations. In this way, they learn to use what they learn to structure their own thinking, open up new horizons and become autonomous learners. In today's society, it is essential to develop learners' autonomy.

Registered: 231220 | Article Info: 1823 | Accepted: 240527
Reserved: 240425 | Available: 240630

In other sense, thanks to ICT, students become masters of their own learning and capable of educating themselves. Laberge confirms this idea, asserting that "Teaching methods are suggested by teachers and supported by ICT, but learners educate themselves. This is fertile ground for awakening, practicing and developing skills" [3].

Certainly, the integration of ICT can improve the quality of teaching and diversify the modes of learning and consequently change the type of the pedagogic relationship between learner and teacher. This integration is defined by: "Technical tools are inserted into one or more courses in the entire teaching sequence, the goals of which have been clearly determined". Each stage specifies implementation methods and evaluation in terms of requirements, goals, task progress, etc., making the whole into a coherent teaching means [4].

Current means have transformed the education and learning systems, which gave birth to "e-learning" [5]. The e-learning system has facilitated exchanges and access to information, allowing learners to adapt to the learning process [6]. Furthermore, it has promoted interactivity, collaboration, individualization of the learning path, and learner self-assessment [7].

Many authors have identified other advantages of the use of ICT at school. Oullet, et al. [8] consider that ICT promote autonomous learning, facilitate exchanges, increase the range of resources available in the classroom, offer the possibility for teachers to present the content and improve the productivity of students. Laferriere, et al. [9] identified other benefits of using ICT in schools: "acquisition of computer and networking skills", "use of exciting, user-friendly and stimulating technologies", "access to a wider range of subjects and courses" and "a wider range of learning activities". Deaudelin and Nault in [10] cite some of the possibilities offered by the use of ICT: "Consultation, research and processing of information on the Web or on CD-ROM, electronic publishing, creation of Web sites, school correspondence, the list of technology-based activities is long and varied".

On the other hand, the use of ICT in a personal capacity does not achieve the educational objectives or develop the skills of learners , because when learners are "placed in a learning environment that only allows him to view digital resources or interact with some elements of the environment without any productive achievement, they will be in the position of consumers" [11], that is, "in the consumption uses, digital is mainly aimed at searching, consulting and sharing resources and sharing existing digital resources" [12]. Therefore, it is necessary to mix between a relevant use of ICT and appropriate teaching modes. In other words, "the use of technology would promote more active, even socio-constructivist, pedagogical approaches, that it would encourage teachers to evolve their practices in this direction. [13] enables students to be more active, productive and creative... similarly, certain skills related to cooperation, communication, methodology and reflexivity would be strengthened through these practices".

In the same vein, UNESCO insists on the collaborative use of technologies: "Recent developments related to the development of collaborative learning tools, the Internet and mobile technologies are emerging opportunities and effects of a very different nature: the possibility of supporting collaborative forms of mathematical learning for students through technology, online and free access to a wide range of resources, new remote learning organizations, support for co-production and sharing of resources, support for the emergence of communities of teachers and researchers, support for networking events and remote communication between students and teachers" [14].

Like other types of teaching methods, active teaching methods have a number of advantages, but there are also a number of disadvantages to integrating them into teaching and learning. The advantages and disadvantages of active teaching can be summarized in Table 1.

Table 1. The advantages and disadvantages of active teaching

The advantages	The disadvantages
□ Develop learners' autonomy and curiosity. □ Improve the capacity for innovation and collaboration. □ Improve communication, argumentation and critical thinking skills. □ Guarantee understanding. □ Increase enjoyment of learning and studying. □ Enable sustainable learning.	□ Waste of teacher time. □ Lack of teacher skills. □ Lack of flexibility in classrooms. □ Lack of necessary equipment. □ Very large numbers of learners. □ The burden of teaching programmes.

There are several types of active pedagogy, including: Project pedagogy, discovery pedagogy, problem-solving pedagogy, cooperative pedagogy, case-based pedagogy and experiential pedagogy.

The cooperative teaching approach aims to achieve two objectives: learning to cooperate and cooperating to learn. On the one hand, this approach aims to promote education in cooperative values; on the other, it provides principles, tools and strategies to better structure teamwork in order to increase its effectiveness and encourage constructive learning interactions. Numerous studies (e.g. [15], [16]) have demonstrated a positive relationship between the use of cooperation and learning outcomes.

The term cooperative learning refers to a range of methods aimed at organizing classes into small, often heterogeneous, groups in which pupils work together to complete academic tasks. Various approaches fall under this umbrella, including the teamwork methods developed by [15]; the Jigsaw method [17]; Learning Together [18]; Group Investigation [19]; Structural Approach [20]; Complex Instruction [21].

3. RESEARCH METHODOLOGY

As already noted, this study aims to complete the research of our article in [1], and see the impact of the methodology used in the qualitative side, recalling that the study aims to identify the qualitative skills developed by learners when technology is combined with pedagogy, with the example of discovering the properties of

homothety, one of the common transformations studied in the chapter on common transformations in the plane by students in the scientific 1st year of high school.

The study was carried out with 36 students from a scientific 1st year of high school and took place in the engineering room at Al-Quds High School in Tan-Tan during the 2021-2022 academic year.

Our sample for this study is formed of thirty-six learners, divided into two groups. Geogebra software and cooperative pedagogy were assigned to be adopted by the experimental group. whereas, the second groups were taught to focus on the collective visualization of animated productions via PowerPoint. We have conducted a pre-experimentation diagnostic test which served to the repartition of learners and to verify their uptake, and a focus group after the experience session.

As this was the first experiment for the majority of the students, we held an explanatory session for them to explain the importance of their participation in this experiment in our article and to give them a detailed description of the entire procedure of this experiment. Before starting the experiment, we requested authorization from the headmaster of the Al-Quds high school to use the high school's multimedia room, called the Engineering room, during the experiment. Following his agreement, we installed the dynamic geometry software Geogebra on 12 office computers.

The students in the G1 (experimental group) work collaboratively with the Geogebra software were divided into small sub-groups of 3 people each. During the experimental session, a teaching scenario based on Geogebra was prepared and a student sheet describing the stages of the practical work was distributed. The students in this group are responsible for their own productions and digital animations, so the teacher's role becomes that of a coach.

For each of the properties studied, we prepared practical activities intended for the G1, group to collaboratively create their own digital productions with the Geogebra software. We also prepared animations in advance with Geogebra and projected them using PowerPoint for G2.

It should be mentioned that the cognitive content that's been taught to both groups is totally the same , which is exactly common transformations in space, specifically the common transformation of homothety. This choice is based on the fact that the other common transformations (translation , central symmetry and axial symmetry) have all been previously taught to students in middle school. Yet, homothety is the new common transformation. This lesson covers and includes the properties of homothety regarding lengths, angle measures, parallelism, orthogonality, areas, constructing an image of a given figure, and discovering the concept of enlargement and reduction of a figure.

In a focus group on integrating GeoGebra with cooperative pedagogy, the role of the teacher is crucial in facilitating the process, encouraging collaboration between participants and ensuring that the pedagogical objectives are achieved. Here are some key roles that the teacher could play in this context.

Table 2. The roles of the teacher in a focus group on integrating GeoGebra with cooperative pedagogy

Group facilitator:	The teacher can act as a focus group facilitator, guiding discussions and ensuring that all participants have the opportunity to express themselves. They can encourage active participation and maintain an open environment for the exchange of ideas.
GeoGebra expert:	If the teacher has expertise in using GeoGebra, they can share their knowledge and demonstrate how the tool can be effectively integrated into collaborative educational activities. This can include practical demonstrations and advice on how to make the best use of the tool.
Defining educational objectives:	The teacher can play a key role in defining the pedagogical objectives of integrating GeoGebra into cooperative teaching. They can help identify the specific skills that students need to acquire and ensure that the use of GeoGebra contributes to achieving these objectives.
Time management and structure:	The teacher can be responsible for time management during the focus group, ensuring that each aspect of the discussion is addressed in a balanced way. They can also structure the session to maximise efficiency and ensure that participants focus on the relevant topics.
Collecting qualitative data:	The teacher can collect qualitative data about participants' experiences with GeoGebra and cooperative pedagogy. This can include feedback, concerns, suggestions and innovative ideas.
Promoting collaboration:	As an advocate of cooperative pedagogy, the teacher can encourage collaboration between participants. They can create opportunities for idea sharing, collaborative problem solving and co-creation of learning resources.
Evaluation and feedback:	The teacher can gather information on the effectiveness of the integration of GeoGebra and collaborative pedagogy through formative assessments, observations and feedback from participants. This can help to adjust and improve teaching approaches.

In short, the teacher plays a central role in the successful integration of GeoGebra with cooperative pedagogy by guiding, facilitating and ensuring that the results are aligned with the educational objectives.

4. RESULTS

In a previous study [1] on the impact of this methodology in improving mathematical skills, very significant results were found on the quantitative side. The table below summarizes the results found in that study.

Table 3. Comparison multiple of diagnostic tests' results, assessment test and evaluation test for two groups in [1]

Test	Contrast	Difference	Standardized Difference	Critical Value	Pr > Diff	significant
Diagnostic	G1 vs G2	0.667	1.063	2.032	0.295	No
Assessment	G1 vs G2	1.986	3.491	2.032	<0.001	Yes
Evaluation	G1 vs G2	3.417	12.955	2.032	<0.0001	Yes

Now, in order to discover the impact of our experiment on the qualitative side, we relied on a focus group of 18 students on the G1 (experimental group) who were chosen at random. The choice of this method is due to flexibility of the group, and this advantage will help us to question many students at once. Plus, this makes students feel at ease and feel free to express their opinions and ideas because they like group discussions and they feel their belonging to the community. The discussion with the focus group lasted for 8 minutes and it was all about getting students opinions and points of view concerning the new experience. The discussion has been recorded in an audio form, after reviewing it later, we moved to its transcription and at the end we utilized NVIVO as a qualitative data analysis software.

The result that we got with NVIVO's help revealed that the use of Geogebra with the cooperative method does not only improve students' mathematical abilities but also fosters other qualities and competences such as:

1. *Anti-Stress*:

The use of Geogebra software created an anti-stress atmosphere for the students, in the same sense the study in [22] consider that ICT has the potential to improve certain skills, notably motivation, enjoyment of learning and self-esteem.

a) Reducing stress: The use of Geogebra software has created an anti-stress atmosphere for the pupils, as the use of the software as an intermediary in the learning process reduces the pupils' stress. As RD states, "this method has enabled me to reduce the stress level in the classroom, where I work with paper and pencil". DF also announced that "this method is effective in reducing the stress of learning mathematics in class".

b) Increased self-esteem: The increase in self-esteem is a direct consequence of the reduction in stress, as the pupils also gain self-confidence during the learning process compared with the traditional classroom, as YS confirms: "teaching mathematics with the computer is more relevant and easier than teaching with the traditional method".

2. *Positive Relationships*:

The use of software in the classroom has changed the classroom climate and diminished the traditional authority of the teacher, as the study in [23] point out, "In collaborative learning, the integration of ICT mainly concerns: communication between students and teachers thanks to asynchronous tools (such as email, forums, mailing lists, ...) or synchronous tools (such as chat, interactive whiteboards, electronic voting systems, software to build flowcharts, graphs, ...)".

a) With the teacher: The student-teacher relationship has changed thanks to the horizontal relationship between the teacher and the students, as KT states: "this experience has allowed me to see that the teacher is not mean and that learning maths with this method has allowed the students to build a good relationship with the math's teacher", and BD also stated that "I thank the teacher very much for this initiative and that this experience has strengthened the relationship with the math's teacher".

b) With Students: The relationship between the pupils becomes more constructive and cooperative by aiming together at peer learning, as MH stated: "this method has enabled me to see mathematics in a different way and that working in groups with the computer makes it possible to diversify the methods of teaching mathematics".

3. *Autonomy*:

The use of software makes students autonomous and able to learn either individually or in groups, in the same sense the study in [9] state that "today, technologies allow students to work even more than before in an autonomous way, alone or in small groups".

a) Vis-à-vis the teacher: Student can learn on their own using software, as KT states: "this experience has enabled me to conclude that the teacher is not the only one who has the knowledge"; in the same vein, AM stated that "learning mathematics using this method is better than the traditional method because this method encourages autonomy".

b) Vis-à-vis the students: Student can learn on their own or with others, independently of the teacher, as YS stated: "I propose this method so that pupils can work on mathematics on their own".

4. *Active Learning*:

The student is at the centre of the learning process with an active method that encourages them to explore their abilities without being pressured by the teacher, as noted by the study in [9] "students have become users of media and technology and no longer mere spectators of teacher-orchestrated presentations".

a) Active students: Each student expresses his participation in his learning, which shows that he is active and that he is the centre of the learning process and not the subject in itself as he notes AM "this experience is very relevant and I propose to dedicate a weekly session to work with this software for each class because it makes the pupil active", also RD declared that "learning mathematics with this method helps pupils to become active in their learning". MH, for his part, noted that "learning with this method changes traditional learning towards active learning", and AN announced that

"learning in this case is better than the traditional method because it makes the pupil active".

b) Different methods: The use of Geogebra software proves that there are several methods and techniques to make learning maths more active and more attractive, as BD states: "it's a new experience that gives us a new type of teaching and a different way of looking at maths". MH also stated that "it's an experience that shows me that there are other ways of learning math's than the traditional method of using paper and pencil", while HS stated that "this experience makes learning math's more practical".

c) Sources of knowledge: Using software to learn shows pupils the possibility of diversifying sources of knowledge and that the teacher is not the only source, as KT states: "this experience has enabled me to conclude that the teacher is not the only one who has knowledge".

d) Cooperation: The students see cooperation as the key to active learning using the software, as YS confirms: "this method is relevant compared to the traditional method".

5. DISCUSSION

In our study in [1] our results indicate that the passive use of Geogebra without the participation of learners in the production of content fails to achieve the pedagogical objectives. An approach combining the creative use of Geogebra with a collaborative pedagogical approach created by the students is always preferable, and this was the case for G1 in our experiment, which obtained the best average values compared with the other groups in the experiment. The aim of this study was to investigate the impact of the integration of Geogebra software on the qualitative skills of pupils, using as an example the discovery of the usual transformation homothety, and to determine the influence of cooperative teaching on such integration, i.e. to find the right formula for a relevant combination of technology and teaching methods to make learners more active, productive and responsible in their learning. To do this, an experiment was carried out with 36 students in 1St of high school, divided into two groups (experimental group and control group).

According to this research, we can conclude that the contributions of the effective integration of ICT in teaching-learning is not reduced to the quantitative side, but also in the qualitative side because such integration improves other skills in learners; autonomy, self-esteem, cooperation, reduction of stress in class... All these skills can be used to solve other problems related to education such as school dropout, school failure and violence against teachers and between students as confirmed by Karsenti in [24] "In my opinion, the integration of ICT is equally important, especially in the field of education, in order to promote access to information and the educational success of university students and to improve the professionalism of teaching staff." Administrator leads collaboration between university and community Cooperate and even promote South-South and North-South cooperation.

The ICTs are powerful tools with cognitive potential to provide multiple solutions to various current educational problems in Africa. Africa must also train high-level university specialists in the field of ICT and education, and consequently the school becomes a space for building a good citizen who helps the development of society, in the same sense, "Information and communication technologies are not a panacea, etc. but they can contribute to improve the life of all the inhabitants of the planet" [25].

Our results also show that the use of Geogebra software allowed students to progress significantly in terms of learning the homothetic transformation. These results reinforce the conclusions of numerous studies on the impact of the use of Geogebra ([26], [27]). But this use still remains limited because according to Romero "even if the technological uses related to passive or interactive consumption could have an initial motivating effect, their added value is very limited". Therefore, it is necessary to combine this use with innovative pedagogy to achieve the educational goals.

The benefits of effective coupling of ICT with active pedagogy must lead policy makers and education decision makers to update the educational system and include co-creative teaching with ICT in the curriculum because the problem today is not about the physical integration of ICT but the pedagogical integration and their effective use to achieve educational objectives, thus and according to several authors ([28],[29],[30]) the physical integration is unavoidable, but it is essentially the pedagogical integration that must be implemented through ICT .

This table gives an overview of the advantages and disadvantages of the creative use of ICT in the development of qualitative skills.

Table 4. The advantages and disadvantages of creative use of ICT in the development of qualitative skills

The advantages	The disadvantages
Enables personalized learning, adapted to the pace and learning style of each individual. Encourages collaboration, enabling learners to work together on projects even if they are not physically present. Improve communication, argumentation and critical thinking skills. Offers multimedia creation tools that enable learners to express their creativity and develop their visual and aural communication skills. Encourages independent learning and taking charge of one's own educational path. Enable sustainable learning.	Risk of over-dependence on technology, which can lead to reduced commitment to non-digital activities. The possibility of online distractions, which can reduce concentration and learning efficiency. Can amplify inequalities in access to digital resources, favouring those with pre-existing technological skills and resources. Requires reliable access to the Internet and digital devices, which may exclude some learners who do not have the necessary means or access. Risks to the security and confidentiality of learners' personal data, particularly online.

While there is obviously no clear and definitive answer as to the effectiveness of integrating ICT into teaching in the absence of a set of didactic and pedagogical conditions, the results obtained confirm the importance of using ICT in general and Geogebra software in particular in the learning context mobilized with the G1 experimental group (co-creative use of Geogebra). In fact, the aspect that can enrich the students' learning experiences is linked, on the one hand, to their involvement in the creation of content and, on the other, to the dynamic nature of the Geogebra software, which enables them to observe how manipulations of one object (or group of objects) lead to changes in other objects, allowing the students to manipulate these solids in different directions, to vary their dimensions and to study the various possible cases. In particular, the three-dimensional representations of concepts in a dynamic environment and the dynamic transitions of these representations allow students to build their knowledge and explore mathematical concepts.

On the basis of these results, we can say that Geogebra software alone cannot promote effective learning, but its use in a cooperative teaching context where learners are engaged in a process of creative use of dynamic digital resources, linked to the learning object, enables them to construct their knowledge thanks to its construction protocol, its visualization and concretization functions.

According to the results of this study, teaching with ICT requires an innovative pedagogy based on collaboration between learners and learners themselves creating content in digital media. Consequently, these results reinforce the conclusions of the large number of studies synthesized in the literature review on the impact of ICT on European schools, which emphasize that the use of information and communication technologies must be based on a pedagogical approach, taking into account differentiation and accompanying a project approach to improve learning.

In fact, in a digital environment, learners have more opportunity to interact with each other and with teachers, which helps to make students more active in the learning process compared with students working in traditional systems. Consequently, using mathematics software to learn mathematical concepts makes student behaviour observable in terms of attention, engagement and social interaction between pairs and with teachers more meaningful.

From this research we can conclude that the contributions of the effective integration of ICT in teaching-learning are not limited to the quantitative side but also in the qualitative side because such integration improves other skills in learners, autonomy, self-esteem, cooperation, reduction of stress in class ... all these skills can be used to solve other problems related to education such as school dropout, school failure and violence against teachers and among students.

the benefits of effective coupling of ICT with active pedagogy should lead policy makers and education decision makers to update the education system and include co-creative teaching with ICT in school curricula because today's problem is not the physical integration of ICT but its pedagogical integration and its effective use to achieve educational goals, physical integration is unavoidable, but it is essentially pedagogical integration that must be implemented through ICT.

6. CONCLUSIONS

ICTs, as a matter of fact, has a significant role in terms of acquiring the qualitative skills. Nowadays, students are in need to search the net and use technology in their studies. Therefore, students can have access to a huge number of recourses and tools that triggers their curiosity to know , search and delve more into the topics of their interest. so, they can search for what they need , get the information and analyze the data as well as do an overall evaluation to the sources that they used .By doing this with the help of the online tools , students will develop their critical research skills which will undoubtedly help them in the future in their higher education.

In addition, it is clear that ICTs's groundbreaking and amazing opportunities which it offers to students help them a lot in terms of creativity in expressing their thoughts. Among the opportunities provided we can find graphic design , video editing , music edition and so on. Thus, students' ideas can no longer be boring to present. In contrast, they can be creatively expressed visually, auditorily and interactively in a very well organized manner. Therefore, this widens students imagination and enhances their ability to solve problems creatively.

Collaboration and team work is considered to be one of the most important needed skills in the world, and students need to have this skill and work collaboratively in order to switch from the traditional method of learning and teaching which no longer shows any good results. ICTs facilitate and offer this the ability to acquire the skill of collaborative work and being an active member in the team for students by offering good opportunities to work with other students, even online. Collaborative work platforms, online forums and documents sharing tools allow students to meet, collaborate, share ideas and try to solve problems as one team. Plus, this also has a positive impact on students' communication skills, teamwork and conflict management.

Finally, students can be autonomous and self-reliant in their learning through the use of ICTs as they can have access to online lessons in different form (videos, pictures …), interactive exercises and teaching and learning materials which are adapted to suit their needs. Besides, students can self-monitor and self-assess their learning and they are responsible for their learning.

To conclude, ICTs integration in education, without any shadow of doubt, helps to improve the qualitative skills among students. By developing students' communication skills, critical thinking, collaboration, ICTs offer more and new learning opportunities for the purpose of preparing students to the outside world where their can exploit these skills which are needed specially to get a job.

ACKNOWLEDGEMENTS

➢ Provincial Directorate of National Education Tantan, Morocco.

➢The high school director qualifying al Quods, Tantan, Morocco.

➢students of 1st year of high school scientific in qualifying al Quods, Tantan, Morocco.

REFERENCES

[1] S. Etterach, M.Y. Hadi, F.Z. Guerss, "Impact of ICT and Cooperative Pedagogy on the Success of the 1st year Students of High School in Mathematics", International Journal on Technical and Physical Problems of Engineering (IJTPE), Issue 58, Volume 16, Number 1, March 2024.

[2] A.M. Nouhou, "Impact of the Use of GeoGebra on Student Learning: Case of Understanding the Concept of Numerical Functions in High School", Doctoral Dissertation, Cergy-Pontoise, pp. 35-55, 2019.

[3] M.F. Laberge, "Our Students are Entering the Digital Age", Pedagogical Life, Supplement, Vol. 3, No. 12, pp. 41-49, 2003.

[4] C. Bourguignon, "How to Integrate the Computer into the Language Classroom", Micro-Knowledge Documents, Vol. 5, No. 2, pp. 12-21, 1994.

[5] T. Karsenti, L. Savoie-Zajc, F. Larose, "Future Teachers Confronted with ICT: Changes in Attitude, Motivation and Teaching Practices", Education and Francophonie, Vol. 29, No. 1, pp. 86-124, 2001.

[6] M. Bouhaji, N.A. Mouddene, D. Benloubir, Z. Serhier, M.B Othmani, "Perception of Distance Training (E-Learning) by Internal Doctors at Ibn Rochd University Hospital in Casablanca, Morocco", Jour. of Epidemiology and Public Health, Vol. 62, pp. 223-224, 2014.

[7] E. Houze, R. Meissonier, "E-Learning Performance: Initial Feedback on Learner Results", The 9th Conference of AIM, pp. 54-64, 2004.

[8] J. Ouellet, D. Delisle, J. Couture, G. Gauthier, "ICT and Educational Success at College", Chicoutimi College, pp. 23-44, 2000.

[9] T. Laferriere, A. Breuleux, R. Bracewell, "Benefits of Information and Communications Technologies (ICT) for Teaching and Learning in Classrooms from Kindergarten to the End of Secondary School", Tele Learning Network Inc, Vol. 22, No. 4, pp. 63-75, 2001.

[10] C, Deaudelin, T. Nault, "Collaborate to Learn and Make People Learn: The Place of Technological Tools", University of Quebec, Vol. 8, No. 4, pp. 22-29, 2003.

[11] M. Romero, B. Lille, A. Patino, "Creative Uses of Digital Technology for Learning in the 21st Century", Presses of University of Quebec, pp. 83-92, 2017.

[12] M. Romero, D. Belhassein, "Interdisciplinarity and Co-Creative Uses of Digital Technology in Education", Interdisciplinarity at School, Success, Resistance, Diversity, Vol. 6, No .4, pp. 257-277, 2019.

[13] C. Bullat-Koelliker, S.T.A.F. Gina, "The Contributions of ICT to Learning. What Teachers who Use Computer Workshops with Their Students Think", Specialized Higher Education Diploma Thesis, Faculty of Psychology and Educational Sciences, University of Geneva, pp. 55-63, 2003.

[14] UNESCO, "The Challenges of Teaching Mathematics in Basic Education", Paris, France: UNESCO, pp. 103-121, 2011.

[15] R.E, Salvin, "Cooperative learning: Theory, Research, and Practice", New York, United-States, pp. 65-72, 1990.

[16] D.W. Johnson, R.T, Johnson, "Cooperation and Competition: Theory and Research", Interaction Book Company, pp. 83-91, 1989.

[17] E. Aronson, N. Blaney, C. Stephin, J. Sikes, M. Snapp, "The Jigsaw Classroom", Beberly Hills, pp. 43-51, 1978.

[18] D.W. Johnson, "Cooperative Learning in the Classroom", Association for Supervision and Curriculum Development, 1250 N. Pitt St., Alexandria, VA 22314, pp. 73-81, 1994.

[19] S.E. Sharan, "Handbook of Cooperative Learning Methods. Greenwood Press/Greenwood Publishing Group, pp. 31-39, 1994.

[20] S. Kagan, "Cooperative Learning. California: Resources for Teachers Inc", pp.44-54, 1994.

[21] E.G. Cohen, "Group Work: Teaching Strategies for the Heterogeneous Class", Cheneliere, pp. 53-61, 1994.

[22] W.J. Pelgrum, N. Law, "ICT and Education in the World: Trends, Issues and Perspectives", UNESCO, International Institute for Educational Planning, pp. 33-42, 2004.

[23] J. Dintinger, R. Oppliger, "Collaborative Learning and Electronic Voting Systems", Doctoral Dissertation, University of Education of the Canton of Vaud, pp. 75-92, 2017.

[24] T. Karsenti, "How to Promote the Success of African Students in Open and Distance Learning: Educational Principles", ICT and Development, Vol. 2, No. 9, pp. 9-23, 2006.

[25] D. Traore, "Integration of ICT in Education in Mali: Inventory, Issues and Evaluation", Distances and Knowledge, Vol. 5, No.1, pp. 67-82, 2017.

[26] C. Williams, G. Charles-Ogan, R.Y. Adesope, "The Geogebra Interactive Software and Senior Secondary School Three (SSS3) Students' Interest and Achievement in Mathematics", International Journal of Mathematics and Statistics Studies, Vol. 5, No. 1, pp. 1-8, 2017.

[27] N. Arbain, N.A. Shukor, "The Effects of GeoGebra on Students Achievement", Procedia-Social and Behavioral Sciences, Vol. 172, pp. 208-214, 2015.

[28] L.B. Dias, "Integrating Technology", Learning and Leading with Technology, Vol. 27, pp. 10-13, 1999.

[29] C. Raby, "Analysis of the Path that Led Primary School Teachers to Develop Exemplary Use of Information and Communication Technologies in the Classroom", Doctoral Dissertation, University of Montreal, pp. 54-62, 2004.

[30] M. Serghini, N. Mjahed, K. Raouf, L. Kamal, A. Khyati, "Pre-Analysis of Teaching Practices: An Approach that Promotes Development of Reflexivity Case of Physics Chemistry Teachers", International Journal on Technical and Physical Problems of Engineering (IJTPE), Issue 54, Vol. 15, No. 1, pp. 140-147, March 2023.

BIOGRAPHIES

Name: **Said**
Surname: **Etterach**
Birthday: 25.04.1990
Birthplace: Tantan, Morocco
Bachelor: Mathematical Sciences and Applications, Department of Mathematics, Faculty of Sciences, Ibn Zohr University, Agadir, Morocco, 2015
Master: Teaching and Training in Mathematics, Faculty of Sciences, Ibn Tofail University, Kenitra, Morocco, 2019
Doctorate: Student, Laboratory Research in Computer Science, Faculty of Sciences, Ibn Tofail University, Kenitra, Morocco, Since 2019
The Last Scientific Position: Teacher, Mathematics, Secondary Educations, Morocco, Since 2016.
Research Interests: Didactics of Mathematics, ICTs in Education
Scientific Publications: 1 Paper, 5 Communications

Name: **Moulay Youssef**
Surname: **Hadi**
Birthday: 28.05.1978
Birthplace: Errachidia, Morocco
Bachelor: Computer Science, Software Engineering, Faculty of Sciences, Moulay Ismail University, Meknes, Morocco, 2001
Master: Software Engineering and Advanced Information Technologies, Mohammedia School of Engineers, Mohammed V University, Rabat, Morocco, 2003
Doctorate: Computer Science and Telecommunications, Faculty of Sciences, Mohammed V University, Rabat, Morocco, 2008
The Last Scientific Position: Prof., Computer Science, Ibn Tofail University,Kenitra, Morocco, Since 2009 - Deputy Director in Charge of Educational AFFAIRS, Superior School of Technology, Ibn Tofail University, Kenitra, Morocco
Research Interests: Model Driven Engineering, Virtualisation and Cloud Computing
Scientific Publications: 53 Papers

Name: **Fatima Zahra**
Surname: **Guerss**
Birthday: 01.01.1984
Birthplace: Casablanca, Morocco
Bachelor: Computer Sciences, Mathematics and Informatics, Computer Department, Faculty of Sciences, Hassan II University, Casablanca, Morocco, 2007
Master: Mathematics and Computer Science, Hassan II University, Casablanca, Morocco, 2009
Doctorate: Computer Science, Faculty of Sciences and Technology in Mohammedia, Hassan II University, Casablanca, Morocco, 2018
The Last Scientific Position: Prof., Computer Science, Ibn Tofail University, Kenitra, Morocco, Since 2019
Research Interests: Sports, Education, Information and Communication Technologies, E-Orientation, E-Guidance, Artificial Intelligence
Scientific Publications: 15 Papers, 1 Books, 3 Projects, 1 Thesis