International Journal of Chemical and Biochemical Sciences
(ISSN 2226-9614)

Journal Home page:www.iscientific.org/Journal.html

The Application of Information and Communication Technology (ICT) in Biology Teaching to Improve Students' Learning

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Abstract

Information and communication technology (ICT) has revolutionized teacher education in Albanian classrooms and created new opportunities for improving students' educational experiences. This study investigates the incorporation of ICT in biology instructing to improve student's learning experiences and the efficient use of ICT facilities in certain schools. The study employed a descriptive survey research style and used questionnaires and interviews to acquire data. A sample of 79 participants in Albania, including biology teachers, head teachers, and district leaders was selected from a total of 118 people. The acquired data was submitted to both qualitative and quantitative assessment, providing notable results. The findings revealed that the use of ICT in Biology instructing was not achieving its utmost potential. The main cause of this insufficiency was the minimal accessibility of training opportunities for teachers and a lack of necessary ICT-related facilities. Hence, this study highlights the need for increased support in the development of ICT-related facilities and comprehensive training initiatives for teachers. These measures are necessary for implementing ICT into Biology instructing and, eventually for improving students' learning experiences.

Keywords: ICT, improve student learning, biology instructing.

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1. Introduction

The fast development of Information and Communication Technology (ICT) has coincided with the beginning of a revolutionary age in education, which has had an effect on the manner in which biology is both taught and learnt. Because of its potential to improve students' educational experiences, the movement toward incorporating technology into the teaching of biology has received a significant amount of attention in recent years. Teachers want to make biology more interesting, dynamic, and ultimately more effective by using technology [1]. Biology is a dynamic, multifaceted science that is characterized by difficult ideas, a wide variety of organisms, and complex mechanisms. Traditional teaching strategies fell short of expressing this underlying complexity and piquing students' attention ICT, on the other hand, offers a range of instruments and materials are close this gap and give students a thorough and immersive educational experience. Incorporating ICT into biology education has many benefits, chief among them being the establishment of an engaging learning environment that accommodates diverse learning preferences.

The use of digital platforms, simulations, interactive modules, and multimedia material gives educators the ability to design classrooms to accommodate students with a wide range of learning styles and aptitudes [2]. Albania's capital, Tirana, is the location of many secondary educational institutions. There are three stages to the Albanian educational system: elementary school, middle school, and university. Gymnasiums are a part of the general secondary school type, which are the two kinds of secondary schools [3].

Students can engage in active and individualized learning experiences, interact with digital simulations of biological processes, conduct virtual experiments, and explore 3D cell and organism models. These hands-on activities not only deepen their understanding of biology but also foster critical thinking and problem-solving skills, which are essential in the modern world [4]. Moreover, ICT facilitates self-paced learning, allowing students to revisit complex topics as needed to gain a profound understanding [5]. Students are given the ability to take charge of their own education as a result of the adaptability of the learning process, which develops a sense of ownership and responsibility for the students' growth.

Geographic constraints do not limit the incorporation of ICT into biology lessons. It has the ability to build global connections among students and teachers all around the world, thereby encouraging collaborative learning. Online discussion boards, virtual labs, and forums can let people share their knowledge and learn from their peers. This collaborative approach not only helps students enhance their social and communication skills, but it also allows them to become acquainted with a broader range of points of view and ideas. It prepares children for a future based on global interactions and various viewpoints [6]. Furthermore, ICT supports asynchronous learning, enabling students to access course materials at their convenience. This flexibility is beneficial in the diverse landscape of educational settings, catering to both traditional classroom environments and online or blended learning scenarios. It ensures that students with varying learning speeds and unique needs can receive personalized assistance, breaking down the barriers that may have hindered their progress in traditional educational models. While the advantages of incorporating ICT into biology education are evident, it is essential to acknowledge and address certain challenges and potential hazards [7].

The digital divide, which represents the disparity in student access to technology, is a pressing issue. This divide the potential to increase educational inequities, as students without proper access, it may fall behind in the fast expanding world of technology-enhanced education [8]. The use of ICT into biology instruction marks a substantial pedagogical shift. It has the possibility of making biology teaching more engaging, participatory, and successful by capitalizing on the discipline's dynamic and multidimensional nature. While there can be hurdles, the potential for enhanced learning experiences, tailored education, and global collaboration are enormous. As we continue to harness technology's power, we must guarantee that it serves all kids, bridging the digital gap and increasing educational fairness. In this paper, we organize our discussion into the following sections: Part 2 presents an overview of related works. Part 3 delves into the methodology. Part 4 presents the result and discussion. Subsequently, Part 5 is dedicated to conclusions, summarizing the key insights derived from our study.

1.1. Related works

Study [9] investigated the factors that influence students' opinions about the utilization of ICT in increasing educational sustainability, as well as their level of contentment with the implementation of this technology. They concentrated their efforts on determining students' levels of contentment with ICT as well as their intents to make use of it. Paper [10] focused on enhancing the digital understanding of the students enrolled in the Education programs. Their aim was to provide individuals with the necessary skills to transition from using ICT to utilizing "Learning and Knowledge Technologies (LKTs)." Through a combination of research methods, they sought to identify the trainee teachers' understanding and perceptions of fundamental technological concepts and tools. The article [11] investigated the levels of "computer self-efficacy, computer anxiety, perceived satisfaction, and acceptance of digital learning" at universities for sustainability.

As a result, Albanian students' satisfaction with their real use of ICT for digital learning in relation to sustainability was assessed. The results demonstrated a link between computer anxiety, computer self-efficacy, and reported pleasure, which had a major influence on perceived usefulness and ease of use.

Research [12] demonstrated how advanced technology, specifically ICT, was helpful to students with exceptional abilities. According to the findings of their research, it was shown that gifted students could derive a great deal of benefit from the implementation of ICT in the educational setting and obtain significant advantages through this. The purpose of article [13] was to investigate the barriers preventing the usage of ICT in Turkish educational institutions. During the course of their investigation, they utilized the qualitative research methodology. The resolutions that were proposed by the participants covered a variety of different subjects. Research [14] examined the connections between "tertiary teachers' perceived acceptance of technological innovation" instructing utilizing ICT. The results suggested that there was a strong and positive correlation between the organizational innovation environment and the use of innovative instructing methods with ICT. Additionally, the acceptance of technological innovation was associated with novel instructing using ICT, and their relationship was managed by the organization's innovation climate.

The use of ICT in the instructing of other languages was investigated in study [15], which demonstrated the benefits of using electronic and Internet resources in the process of acquiring communicative proficiency. They discussed the components of ICT, in addition to the principles and stages involved in the methodical use of such components. The students' personal qualities were better revealed, preserved, and developed as a result of their use in ICTs. Research [16] examined the correlation between "ICT, population education, and economic growth." Their findings showed that "the Government of the Republic of Serbia" considered ICT and education as critical to the country's economic and social progress. Article [17] focused on bringing pre-tertiary institutions under the jurisdiction of the Sagnerigu Municipality. Inadequate computer resources, inadequate network connectivity, and the absence of ICT procedures at the school level were the barriers that their research revealed to be a barrier to the successful integration of information and communications technology (ICT).

Paper [18] emphasized the essential connections among three distinct activity systems that resulted in the successful integration of ICT in a collaborative environment in a school community. The results suggested that it was crucial for all students involved in the school community to collaborate in order to address problems caused by inherent inconsistencies in various systems of operation, which influenced the overall culture around ICT used in schools. Research [19] examined the impact of ICT on the inspiration of university students. They evaluated the motivational aspects of ICT as considered by students. The study's findings demonstrated that ICT had a significant impact on student's inspiration and enhanced their knowledge by promoting knowledge preservation and deep perceptive. ICT has the potential to address students' problems and enhance their motivation. In a study [20], the researchers looked at the possibility of developing a classification system for the different philosophies held by educators on the role that ICT plays crucial in the educational process. In order to answer

the topic, latent class analyses were carried out on a sample of the data acquired from teachers across three distinct nations.

Due to the importance of ICT in the teaching and learning process, this study was done to investigate how it has been put to use for the benefit of students in certain schools. This study aimed to investigate the prevalent areas in which ICT was utilized in instructing and improving the student learning process, training and available technology have a role on how much students use ICT to study biology. Two research questions were established to accomplish the provided objectives. The following inquiries are included:

- How frequently is ICT used in instructing Biology by the teachers?
- What impact do ICT pieces of training and access to sufficient ICT facilities have on the efficient application of ICT and improving student learning?

2. Methodology

The study included a total of 118 participants, consisting of 65 Biology teachers from secondary schools, 35 head teachers, and two district-level Education staff members. A sample size of 79 participants was drawn from the population to partake in the study. The participants comprised of 49 Biology instructors from public and government high schools (Gymnasiums "*Ismail Qemali*", "*Çajupi*", and "*Samiu*" in Tirana, the country of Albania). Participants were selected at random. Additionally, 28 head teachers were purposefully selected from schools corresponding to the selected Biology teachers based on their availability. 2 staff members from the Education unit at the district level were also purposefully selected, as their positions are related to secondary schools' education.

The research involved the participation of school head teachers and staff from the education unit at the District. Its purpose was to gather information regarding the support given to all teachers, with a specific focus on Biology teachers, in integrating ICT into Biology instructing to improve student learning. Additionally, the research aimed to identify future plans for the effective implementation of this modern policy.

2.1. Data collection tools

The data collection tools comprised five points (Table 1). This research included Likert scale surveys and rating scale questionnaires to gather data from Biology teachers, while semi-structured interviews were conducted with head teachers and District administration.

Table 1: Likert scale

Reaction	Strongly Contrary	Disagree	Neutral	Agree	Completely Agree
Numerical Value	1	2	3	4	5

The research questions were developed in detail with regard to the specific goal of the study. To ensure the accuracy and consistency of the data, the data-collecting methods were tested in 3 schools. Subsequently, the "Pearson coefficient correlation (r) and Cronbach alpha (α)" were calculated using SPSS software (version 14.0). The questions demonstrating that r<0.5 were removed, while the remaining questions were modified.

After considering all responses from experts regarding the accuracy and consistency of the data-collecting instruments, the consistency coefficient α was calculated and determined to be 75%, suggesting that the questionnaire is appropriate for gathering the necessary data.

2.2. Data analysis

Following the input and coding of quantitative data in SPSS, descriptive statistics were employed to calculate the average, percentages, and standard deviation (SD). The results were displayed in various tables and graphs. The goal of this research is to evaluate how well training and ICT infrastructure contribute to the successful incorporation of ICT into biology education and the improvement of student learning, a Chi-square (X^2) test and correlation analysis were employed, respectively. In addition, the data collected from interviews endured qualitative analysis and were presented as sentences to complement the quantitative outcomes.

3. Result and Discussion

The outcomes collected from the research survey administered to Biology teachers were displayed using graphical representations and tabular formats. The results were improved by the information gathered from the interviews conducted with "Head teachers and District education unit representatives."

3.1. Information on demographics

The data presented in Figure 1 indicates that out of the 49 Biology teachers in Albania, who participated in this research, 35 were male and 14 were female. Of the participants, 28 had a bachelor's degree, 19 had advanced diplomas (AD), and 2 held a diploma (D), as shown in Figure 2. Regarding the instructing experience of Biology teachers in this research, 5 had less than 5 years, 25 had between 1 and 5 years, 12 had 6 to 10 years of experience, and 7 had 11 to 15 years of experience (Figure3). According to the data shown in Figure 4, most of the respondents (32) had experience in using ICT for instructing purposes, while 17 had not experienced it.

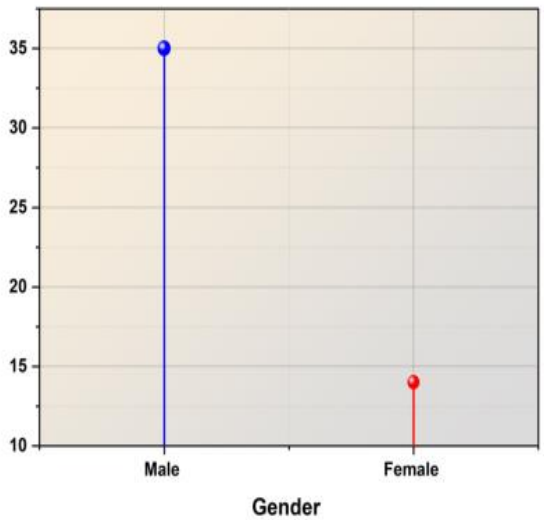

Figure 1: Gender

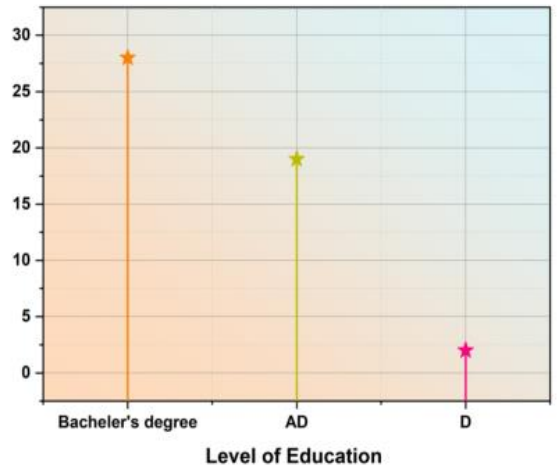

Figure 2: Education level

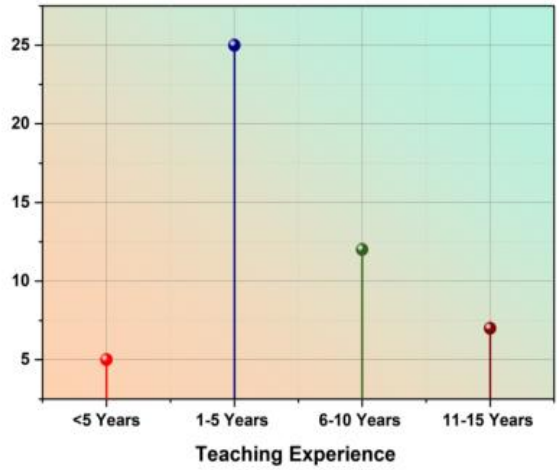

Figure 3: Experience

Figure 4: Training

The limited number (17) of experienced Biology teachers using ICT for instructing may hinder the successful implementation of ICT in instructing. Professional development, in the form of training that may be utilized to provide teachers with the necessary skills to incorporate ICT into instructing. Professional development improves student's skills and boosts their confidence. The provision of teachers' training on the use of ICT in instructing was shown to be a significant factor in determining its impact.

3.2. The use of ICT for instructing and learning Biology

ICT can be applied in a variety of ways to enhance learning when instructing biology. This usage can vary from the general utilization of ICT, such as storing and presenting Biology content, particular and complex application of virtual laboratories for conducting various investigations related to complicated biological processes. However, the quantity to which ICT is utilized in the instructing and learning processes might differ according to the proficiency of the teachers in Albania. Table 2 provides a summary of the data about the average utilization of ICT in several elements of instructing Biology and improving learning.

Table 2: ICT levels of use in various aspects

Use of ICT	Total	Average	SD	Remarks
Instructing preparation	49	2.2	1.60	Often
Biological explain	49	1.9	1.25	Never
Scheme preparation	49	3.2	1.54	Frequently
analysis and recording	49	2.1	1.15	Sometimes
virtual experiments	49	1.6	1.43	Never

In Table 2, the research participants utilized a three-point rating scale "(N = Never, S = Sometimes, and F = frequently)" to select their responses for 5 statements about the utilization of ICT in various Biology instructing activities and improving student learning. The assessments provided by Biology teachers in Albania, who participated in this investigation were documented, and the average rating was determined for each question. Within these rating averages, a value below 2 indicates in the absence of ICT usage (N), a value between 2 and 3 denotes a moderate level of ICT usage (S), and a value between 3 and 3.5 implies an outstanding level of ICT usage (F).

3.3. The impact of training on the use of ICT in instructing and learning

The extent to which ICT is utilized in the instructing process is connected to the skills and abilities of teachers. One of the fundamental means of learning these skills is training sessions. In this context, the impact of training programmers on the utilization of ICT in the field of instructing. The field of biology was explored, and Table 3 shows the outcomes.

Table 3: ICT training improves learning

Use of ICT	X^2
To facilitate biology lesson preparation	9.67
Students' marks records and analysis	5.99
In designing a scheme of work for Biology	1.71
Explanation of different biological experiments	10.69
In biological experiments to improve learning experiences	9.69

From Table 3, those activities demonstrate the application of ICT in the field of biology instructing and learning. The tasks include improving the efficiency of biology classes, organizing and analyzing student records, clarifying biological experiments, and boosting the overall learning process. Each activity is assigned a rating, indicating its perceived significance. For example, the explanation of experiments using ICT obtained a good score. However, the

planning of a program of work with ICT received a lower grade. These scores may indicate the preferences of teachers in employing technology for the purpose of instructing and learning in the field of biology.

3.4. Facilities effect on the use of ICT for learning Biology

The efficient integration of ICT in instructing and learning depends on the presence of sufficient ICT facilities for both teachers and students. Table 4 provides a brief overview of the agreements made by Biology teachers regarding the availability of ICT-related facilities for instructing and learning.

Table 4: ICT Facilities in School

Item	Total	Average	SD	Remarks
Computers and Laptops	49	2.49	1.342	N/A
Projectors and Screens	49	2.39	1.400	N/A
Internet Connectivity	49	1.99	1.392	N/A
Computer Labs	49	1.79	1.311	N/A
Cloud Storage and Collaboration Tools	49	1.19	1.109	N/A
Online Learning Management Systems	49	1.39	1.089	N/A

From Table 4, the data highlights biology teachers' agreements regarding the availability of ICT-related facilities for instructing and improving learning. The data show a consistent pattern of absence across several types of ICT resources.The majority of teachers (49 in total) asserted that computers and laptops, projectors and screens, internet access, and computer labs were insufficient for effective instructing and improved learning, as evidenced by average scores of less than 2.5. These evaluations are accompanied by large standard deviations, indicating a lack of agreement among the teachers polled, with some finding the resources more acceptable than others. Furthermore, cloud storage and collaboration tools, in online Learning Management System (LMS), were evaluated as "Not available," with low average scores. This shows that crucial digital tools for instructors are severely lacking. Finally, the data shows that there is an urgent need for increased ICT facilities and resources in biology education to improve the quality of instructing and learning experiences.

Table 5: Relationship between ICT facilities in Biology instructing to improve Students' learning

Variable	*r*	Sign (2-tailed)	*n*
Availability of ICT facilities level of using ICT in instructing and learning Biology	0.721**	.000	49

The findings on the r, which assesses the connection among the ease of employ of ICT conveniences and the employ of ICT in Biology instructing and improved knowledge of students, are reported in Table 5. The data shown in Table 5 reveals that there is a significant correlation between the availability of ICT facilities and the integration of ICT into Biology instruction to enhance student learning. This is demonstrated by the fact that Pearson's correlation coefficient, which was calculated to be 0.721, is greater than the significance level of 0.000.

4. Conclusion

In this study, we highlight the revolutionary potential of ICT in the field of education, especially in biology instructing and improving student learning in Albania. This investigation demonstrated several important findings through a descriptive survey research approach comprising interviews and questionnaires with a sample of 79 participants, including biology teachers, head teachers, and district representatives. The research concluded that the use of ICT in biology instructing has not reached its potential. The key reasons for this limitation were a lack of teacher training opportunities and a lack of essential ICT-related facilities in schools. These results show that there is a strong need for development in these areas to leverage the benefits of ICT in biology education. The technical skills needed to utilize ICT in the classroom may not be present in both instructors and pupils. Training is required to ensure that teachers can make the best use of these technologies.

As technology advances, courses for teachers need to develop as well. Professional development programs that equip educators with the technical abilities needed to integrate ICT into their instruction are in high demand. Future teacher training initiatives could be more personalized, online, and modular, allowing educators to advance at their own pace.

Grant Support

There was no funding provided for this research.

Conflict of Interest

The authors declare that there is no conflict of interest.

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