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Teaching Using Modern Technological Tools (The Computer as a Model) and Its Role in Acquiring Scientific Concepts Among University Students: A Field Study at the University of Constantine 2

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Abstract:

This study aimed to explore the relationship between teaching using computers and the acquisition of scientific concepts among university students. It also sought to examine the differences in students' scientific concept acquisition based on gender and academic specialization. The study adopted a **descriptive correlational methodology**, with a randomly selected sample of **185 male and female students**. Two research instruments were used: a questionnaire on teaching using computers and another on the acquisition of scientific concepts.

For data analysis, the study utilized **means, the independent samples T-test**, and the **Pearson correlation coefficient** to investigate the relationship between computer-assisted instruction and the acquisition of scientific concepts.

The results indicated a **statistically significant positive correlation** between teaching using computers and the acquisition of scientific concepts. Additionally, no significant differences

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were found based on **gender**, while statistically significant differences were found based on **academic specialization** in favor of certain disciplines.

Keywords:

Teaching, Modern Technological Tools, Computer, Acquisition of Scientific Concepts

Introduction

We are currently living in the era of technological advancements, characterized by rapid changes and developments driven by scientific and technical progress, particularly in the last decade of the twentieth century and the beginning of the twenty-first. One of the most significant manifestations of this progress is the widespread development and use of computers and information and communication technologies (ICT), which have impacted various fields—most notably the field of education. This modern era is marked by scientific, cultural, and technological advancement, faster means of communication, and a growing reliance on modern technologies in education to achieve pedagogical objectives in response to the rapidly evolving global landscape.

Traditional teaching methods, however, have struggled to keep pace with these technological changes. The sheer volume of new information has made it increasingly difficult for conventional textbooks to encompass all the necessary scientific knowledge. As a result, the integration of modern technologies into the educational process has proven to be an effective means for enhancing and facilitating learners' acquisition of diverse forms of knowledge. Numerous studies have demonstrated the effectiveness of information technology tools—such as computer networks, video conferencing, multimedia systems, and CD-ROMs—as powerful instructional media. These tools have enabled the implementation of new learning patterns and strategies, transforming the educational experience.

Scientific concepts represent a core objective of science education, as they hold a prominent position in the structure and hierarchy of scientific knowledge. The proper acquisition of scientific concepts plays a critical role in explaining natural phenomena and in fostering scientific thinking and behavior, such as predicting and controlling scientific events. Helping students acquire these concepts is one of the fundamental aims of science education, as concepts constitute a foundational level of the scientific knowledge structure upon which more complex knowledge is built. Moreover, scientific concepts serve as essential outputs of scientific inquiry that help organize and structure knowledge.

The formation and development of scientific concepts among students is a central goal of science education across all academic stages. It also represents a cornerstone of scientific literacy, essential for understanding the general framework of science and facilitating the transfer of learning. Therefore, the effective formation and refinement of scientific concepts among learners at various educational levels requires appropriate instructional approaches that ensure the accurate development, retention, and long-term comprehension of such concepts (Najdi et al., 2003, p. 349).

Every academic subject inherently contains fundamental scientific concepts. The cognitive structure of any scientific topic begins with clarifying the concepts that underpin it, as these concepts tend to be more stable and enduring than isolated facts. Concepts are regarded as the language of science and the key to scientific understanding. They are essential for the formation of principles and generalizations, for self-directed learning, for lifelong education, and for enabling mutual understanding and effective human interaction (Al-Shayyab, 2005, p. 112).

1. Research Problem and Related Aspects

1.1 Research Problem

Modern instructional strategies emphasize the **active role of the learner** and are instrumental in facilitating the acquisition of scientific knowledge, particularly **scientific concepts and principles**. However, many teaching methods still rely heavily on the teacher's efforts while neglecting the role of the student in exploration and inquiry. This imbalance often results in **weakened student performance** and limited conceptual understanding.

The teaching of educational content, whether it involves **concepts, principles, procedures, or facts**, and the methods used to teach it, has long been a topic of significant interest among educators and educational researchers. One of the most notable contributors in this domain is the

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American educator **David Merrill** (1983). Due to the diversity of instructional models and strategies, the field has been enriched with numerous studies that aim to test the effectiveness of these teaching methods across different cognitive domains (Judeh & Al-Yousef, 1988, p. 97).

Traditional teaching methods, however, have often failed to meet the evolving needs of students, particularly in light of the transformations brought about by **modern technologies** and the emergence of various **educational technologies**, including **computer-assisted instruction**. This shift has led to substantial criticism of traditional science teaching methods across various educational levels. Such critiques align with the findings of several studies, including those conducted by **Shannaq (2002)**, **Al-Aboushi (2002)**, and **Affaneh (2003)**, all of which emphasized the **positive and effective role of computers** in the teaching and learning process.

Zaytoun Ayesh Mahmoud has noted that science instruction should not be limited to the transmission of scientific knowledge alone; rather, it must address the student intellectually and emotionally, teaching them **how to think** and apply what they learn in real-life situations. Students acquire many scientific concepts throughout their formal education and in practical, real-world contexts. However, much of this knowledge is often quickly forgotten—within a day or a week—except by a small group of learners who retain it for a longer period. The number of students who **apply** this knowledge meaningfully is even smaller. In such an educational climate, students are unlikely to engage in **deep, stable thinking**, especially when they are assessed based only on **rote memorization** of information (Zaytoun, 1996, p. 46).

The use of **computer-based instructional programs** has transformed the learning environment from one of rigidity and passivity to one characterized by **engagement, activity, and greater participation**. These programs enhance cognitive capabilities by stimulating curiosity and motivation, encouraging learners to achieve success in acquiring scientific concepts and expanding their knowledge base. Computers move the learning experience away from boredom and routine, fostering responsiveness and active participation. Students, in such environments, feel empowered to choose the content and skills they wish to engage with and apply them in a variety of contexts.

Moreover, computers support the teacher's role by enabling them to review students' responses, analyze and discuss them, monitor progress, and offer guidance on how to effectively use these technologies.

Research Problem

From this perspective, the core of this study revolves around understanding the **role of computer-assisted instruction in the acquisition of scientific concepts among university students**. This leads us to the following **general research question**:

- **Does teaching using computers contribute to the acquisition of scientific concepts among university students?**

This general question is operationalized through the following **statistical sub-questions**:

1. Research Questions

- Is there a statistically significant correlation between computer-assisted instruction and the acquisition of scientific concepts among university students?
- Are there statistically significant differences in students' scores in acquiring scientific concepts attributable to gender?
- Are there statistically significant differences in students' scores in acquiring scientific concepts attributable to academic specialization?

2. Research Objectives

The primary objectives of this study are:

- To identify the correlation between computer-assisted instruction and the acquisition of scientific concepts among university students.
- To examine whether statistically significant differences exist in students' acquisition of scientific concepts based on **gender** and **academic specialization**.

3. Significance of the Study

- The significance of this study stems from the importance of using **modern technological tools** in the educational process in general, and in the teaching process in particular. These tools can help address several educational challenges, such as individual learner differences, information overload, the knowledge explosion, overcrowded classrooms, and the shortage of qualified instructors.
- It highlights the importance of the **computer as a modern technological tool** and its educational applications.
- It emphasizes the **critical need for acquiring scientific concepts** in university education, where these concepts are more essential than at any other educational level.
- It aims to encourage faculty members to **integrate modern technologies** in teaching by providing information about their benefits and urging their implementation.
- It may inspire future researchers to explore the use of other media that could enhance teaching and learning processes.

4. Research Scope

The study was conducted in **late October 2023** at the **University of Constantine 2**. The participants were undergraduate students (first, second, and third year) from the **Faculty of Humanities and Social Sciences** and the **Faculty of Psychology and Educational Sciences**. The final sample consisted of **185 students**, including **124 female** and **61 male** participants.

5. Definitions of Research Variables

- **Instruction (Teaching):** Teaching refers to the purposeful organization of educational experiences. It is an intentional educational communication process carried out by the teacher to transmit knowledge, values, and skills to learners, with the aim of inducing

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change and achieving educational outcomes through structured activities between the teacher and the student (Jalal, 2008, p. 114).

- **Computer:** A computer is a collection of electronic devices capable of automatically storing, processing, and retrieving vast amounts of data and information with high speed and accuracy. It is, essentially, a machine for processing and managing information (Tayti et al., 2008, p. 63).

- **Scientific Concepts:** As defined by Shehata Hassan and Al-Najjar Zain, a scientific concept is a mental construct formed by abstracting one or more features from a set of specific instances that share these features. This abstraction process isolates a characteristic from its surrounding context, giving it a term or name (Shehata & Al-Najjar, 2003, p. 286). In educational settings, learning often focuses on acquiring and refining concepts, which are foundational for more complex cognitive behaviors such as reasoning, applying principles, and problem-solving (Al-Heela, 2009, p. 20).
  It can also be described as a mental image or idea formed through successive direct or indirect experiences encountered by the individual.

6. Review of Related Studies

Study by Duwaili, Ali Mohammed (1996): This study investigated the effect of using computers and transparencies on the academic achievement of first-year secondary science students in Al-Madinah Al-Munawarah. The sample consisted of 71 students divided into three groups: one control group taught traditionally, and two experimental groups—one taught using computers, the other with transparencies. Post-test results revealed significant progress in all three groups, with the computer-assisted group showing the highest improvement, confirming the effectiveness of using computers in science instruction (Duwaili, 1996).

Study by Treagust & Kearney (1999): This study examined the effect of computer- and video clip-based lessons on students' understanding of physics concepts among 10th and 11th-grade students. Using the Predict–Observe–Explain (POE) approach, the sample included two

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classes from each grade level. One class was taught using computer-assisted instruction (the experimental group), and the other used traditional methods (the control group). Data collection included computer-based responses, teacher and student interviews, classroom observations, and student questionnaires. The results indicated a statistically significant improvement in physics concept understanding among students in the experimental group compared to the control group (Abu Hola & Al-Mutairi, 2010, p. 363).

Study by Al-Masri, Huda Ataimah (2020): This study aimed to identify the difficulties associated with teaching scientific concepts from the perspective of science teachers in Irbid, Jordan. The sample included 56 science teachers, and the instrument comprised 24 items, each representing a common difficulty in concept learning. The tool's validity and reliability were confirmed. Results indicated that difficulties were perceived as moderate, and there were no statistically significant differences based on gender or academic qualification at the 0.05 significance level (Al-Masri, 2020).

Commentary on Previous Studies:

- All previous studies focused on the **acquisition of scientific concepts** across different educational levels using **various teaching strategies**, particularly those involving **modern technologies** such as computers. The current study specifically focuses on **university-level students**.
- The reviewed literature consistently supports the **positive impact** of computers in enhancing concept acquisition and advocates for their use in science education.
- There is alignment between the previous studies and the present one in terms of recognizing the role of **technological tools** in promoting scientific concept development in higher education.
- This study seeks to **complement and support previous research** by adopting a **descriptive correlational approach** to examine the variables within the university context. It aims to contribute new insights to the literature on teaching with modern technologies and demonstrate the impact of technological media on students' conceptual

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understanding in science. The findings could inform **policy decisions** regarding the integration of technology in all educational stages.

Positioning of the Current Study Among Previous Research:

- The study benefited from prior research in terms of understanding the **principles and foundations** for integrating technological tools into instruction.
- It differs in its **methodology**, as this study adopts a **descriptive correlational design**, whereas the previous studies used **experimental**, **analytical**, or **constructivist** approaches.
- It shares with earlier studies the use of **similar statistical methods** for data analysis.

Second: Methodological Procedures of the Study

1. Research Method, Population, Sample, and Statistical Tools

a. Research Method:

Given the nature of the present study, which falls under descriptive research in the fields of psychology and education, the appropriate methodology is the descriptive correlational method.

b. Research Population and Sample:

The study was conducted among students from the University of Constantine 2, specifically from the Faculty of Humanities and Social Sciences and the Faculty of Psychology and Educational Sciences. The participants included first-, second-, and third-year students, selected using a random sampling technique. After verifying and collecting the completed questionnaires, the final sample consisted of 185 students, including both male and female participants.

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Table 1: *Distribution of the Sample According to Gender*

Academic Year	Female	Male	Total	Percentage (%)
First Year	62	51	113	61.08%
Second Year	34	6	40	21.62%
Third Year	28	4	32	17.30%
Total	**124**	**61**	**185**	**100%**

The research sample was also distributed according to academic specialization as follows:

Table 2: *Distribution of the Sample According to Academic Specialization*

Academic Year	Faculty of Humanities and Social Sciences	Psychology	Educational Sciences	Total	Percentage (%)
First Year	113	0	0	113	61.08%
Second Year	0	21	12	33	17.84%
Third Year	0	16	23	39	21.08%
Total	**113**	**37**	**35**	**185**	**100%**

c. Statistical Methods

The **arithmetic mean** and the **correlation coefficient** were used to measure the relationship between computer-assisted instruction and the acquisition of scientific concepts. In addition, the **T-test** for independent samples was used to determine the significance of differences between two groups.

2. Research Instruments

This study relied on two instruments:

- A **questionnaire on the use of computers in instruction**, and
- A **questionnaire on the acquisition of scientific concepts**, as detailed below:

2.1 Questionnaire on the Use of Computers in Instruction

a. Development of the Questionnaire Items

The items of the questionnaire were developed based on responses to an **open-ended question** posed to a sample of **30 randomly selected students** from the University of Constantine 2 (Faculty of Humanities and Social Sciences, and Faculty of Psychology and Educational Sciences). The question was: *"Do you use a computer in your learning or instruction?"*

Additionally, insights were drawn from previous studies, particularly the study by **Duwaili Ali Mohammed (1996)**. Based on the collected data, a preliminary version of the questionnaire was developed consisting of **38 items** describing various aspects of computer use in instruction among university students.

The items were grouped into **three categories**:

1. **Mastery of information and skills**
2. **Enhancing the active role of the learner**
3. **Learning dialogue-intensive or practice-based topics**

Each item had **three response options**: *(Yes – Neutral – No)*. Participants were asked to indicate the extent to which each statement applied to them.

To ensure **face validity**, the initial version of the questionnaire was reviewed by a panel of experts in psychology and educational sciences from the University of Constantine 2. They were asked to suggest any modifications or eliminations of inappropriate or unrepresentative items. An **85% agreement threshold** was adopted for item retention.

As a result of expert feedback:

- **10 items were removed**: (5, 9, 12, 17, 20, 23, 24, 32, 37, 38)
- **6 items were revised**: (6, 15, 19, 21, 28, 35)

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Following these revisions, the **final version** of the questionnaire consisted of **28 items**, distributed across the three domains as follows:

- **Domain 1: Mastery of Information and Skills** – 10 items (Items 1 to 10)
- **Domain 2: Enhancing the Active Role of the Learner** – 10 items (Items 11 to 20)
- **Domain 3: Dialogue-Intensive Topics** – 8 items (Items 21 to 28)

b. Psychometric Properties of the Questionnaire

To assess the **psychometric properties** of the computer use questionnaire, it was administered to a **pilot sample of 30 students** from the Faculty of Humanities and Social Sciences and the Faculty of Psychology and Educational Sciences.

Discriminative Validity (Extreme Group Comparison):

Discriminative validity was assessed using the pilot study sample. The results are presented in **Table 3** below:

Table 3: *Discriminative Validity of the Computer Use in Instruction Questionnaire*

Item	High Group Mean (M_1)	High Group SD (SD_1)	Low Group Mean (M_2)	Low Group SD (SD_2)	t-value	Statistical Significance
Item 1	64	8.71	53	2.85	8	Significant at 0.01 level

Table 3 above indicates that the calculated **T-test value** was **8**, which is statistically significant at the **0.01 level**. This result suggests that the questionnaire has a **high discrimination index**, which justifies its use in the main study.

Reliability

Reliability refers to the **consistency of results** produced by a stable instrument. If the instrument were reapplied to the same sample under similar conditions after a suitable time interval, the results would remain largely unchanged—indicating the instrument's stability (Al-Mashhadani, 2019, p.169).

- **Split-half reliability** was used to calculate internal consistency. The **Pearson correlation coefficient** (Muqaddam, 1978, p.21) was computed between the scores on **odd-numbered**

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items and **even-numbered items** of the scale. The resulting correlation coefficient was **0.78**.

- The overall **reliability coefficient** for the entire questionnaire was then calculated using the **Spearman-Brown formula** (Al-Tayeb, 1999, p.226), which yielded a value of **0.87**.

These results indicate a **high level of reliability**, making the instrument suitable for use in the main study.

It is also worth noting that the questionnaire uses **graded scoring** based on the **positive direction of each item**. For positively worded (even-numbered) items, response options were scored as **(3, 2, 1)** respectively. For negatively worded (odd-numbered) items, the scoring was reversed: **(1, 2, 3)**. Accordingly, the **maximum total score** a respondent could obtain was **84**, while the **minimum** was **28**.

2.2 Questionnaire on the Acquisition of Scientific Concepts

a. Development of Questionnaire Items

This questionnaire was based on responses to an **open-ended question**: *“Does the use of computers in teaching help you acquire scientific concepts?”*

The question was posed to a random sample of **30 students** from the **Faculty of Humanities and Social Sciences** and the **Faculty of Psychology and Educational Sciences** at the University of Constantine 2. In addition, several previous studies were consulted, including:

- Saber Malika Hussein (2000)
- Al-Rajeh, Nawal Mohammed bin Abdulrahman (2002)
- Al-Mutairi, Sultan Huwaidi (1998)

Based on this input, the items were adapted to fit the context of the current study. The final version included **39 items** designed to assess how computer use supports university students’ acquisition of scientific concepts. These items were grouped under **three main dimensions**:

1. **Recall**
2. **Understanding**
3. **Application**

Each item had **three response options**: *(Agree – Neutral – Disagree)*. Respondents were asked to indicate how well each item applied to them.

To ensure **face validity**, the initial version of the questionnaire was reviewed by a panel of faculty experts in psychology and education from the University of Constantine 2. Based on their feedback:

- Items removed: (4, 7, 10, 16, 22)
- Items revised: (9, 14, 32, 35)

Following these revisions, the final version consisted of **34 items**, distributed across the three dimensions as follows:

- **Dimension 1 – Recall**: 11 items (Items 1 to 11)
- **Dimension 2 – Understanding**: 12 items (Items 12 to 23)
- **Dimension 3 – Application**: 11 items (Items 24 to 34)

Psychometric Properties of the Scientific Concepts Acquisition Questionnaire

To evaluate the psychometric characteristics, the questionnaire was administered to a **pilot sample** of 30 students from both the **Faculty of Social Sciences** and the **Faculty of Psychology and Educational Sciences**.

- **Discriminative Validity (Extreme Group Comparison):** The discriminative validity was assessed using the pilot sample. The results are presented in **Table 4** below:

Table 4: *Discriminative Validity of the Scientific Concepts Acquisition Questionnaire*

Questionnaire	**High Group (n = 8)**		**Low Group (n = 8)**		**t-value**	**Statistical Significance**
	Mean (M_1)	**SD_1**	**Mean (M_2)**	**SD_2**	**4.09**	Significant at 0.01 level
Scientific Concepts Acquisition Questionnaire	39.9	4.29	36.5	2.05		

We conclude that the calculated **t-value of 4.09** is **statistically significant at the 0.01 level**, indicating a **high discriminative validity** of the test. This confirms that the instrument effectively differentiates among individuals in the sample and can therefore be reliably used in the main study.

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Reliability

Reliability was calculated using the **split-half method**. The **Pearson correlation coefficient** (Muqaddam, 1978, p.21) was computed between scores on the **odd-numbered items** and those on the **even-numbered items** in the pilot sample. This result reflects the correlation between the two halves of the questionnaire.

The **overall reliability** of the questionnaire was determined using the **Spearman-Brown formula** (Al-Tayeb, 1999, p.226), yielding a coefficient of **0.93**.

It should be noted that the scoring of the questionnaire items followed a **graded scale** based on the **positivity of the statement**:

- For **positively worded (even-numbered) items**, the responses were scored as: **(3, 2, 1)**
- For **negatively worded (odd-numbered) items**, the scoring was reversed: **(1, 2, 3)**

Accordingly, the **maximum total score** a respondent could obtain was **102**, and the **minimum score** was **34**.

III. Presentation and Analysis of Results

Presentation of Results for Research Question 1:

The **first research question** was stated as follows:

"Is there a statistically significant correlation between computer-assisted instruction and the acquisition of scientific concepts among university students?"

To address this question, **Pearson's correlation coefficient** was calculated between students' scores on the **Computer Use in Teaching Questionnaire** and their scores on the **Scientific Concepts Acquisition Questionnaire**.

The results are presented in **Table 5** below:

Table 5: *Pearson Correlation Between Computer-Based Teaching and Acquisition of Scientific Concepts Among the Study Sample*

Type of Relationship	**Correlation Coefficient (r)**	**Significance Level (p)**
Mastery of information and skills vs. acquisition of scientific concepts	-0.59	0.01
Activation of the learner's role vs. acquisition of scientific concepts	-0.75	0.01
Student interaction with the computer vs. acquisition of scientific concepts	-0.84	0.01
Overall computer-based instruction vs. acquisition of scientific concepts	-0.81	0.01

The results presented in **Table 5** indicate that the **correlation coefficient is -0.59** for the relationship between *mastery of information and skills* and *the acquisition of scientific concepts*. It is **-0.75** for the relationship between *activation of the learner's role* and *concept acquisition*, **-0.84** for *student interaction with the computer*, and **-0.81** for the overall relationship between *computer-assisted instruction* and *scientific concept acquisition*. All correlations are statistically significant at the **0.01 level**, which indicates a **statistically significant positive relationship** (taking scoring direction into account) between computer-assisted teaching and the acquisition of scientific concepts among university students.

Presentation of the Results Related to Research Question Two:

The second research question was formulated as follows:

"Are there statistically significant differences in students' scores for the acquisition of scientific concepts attributable to gender?"

To answer this question, an **independent samples t-test** was conducted to compare the **mean scores of male and female participants** on the *Scientific Concepts Acquisition Questionnaire* and its subscales. The results are shown in **Table 6** below:

Table 6: *Differences in Mean Scores on the Scientific Concept Acquisition Questionnaire by Gender*

Subscale	Males (n = 61) *Mean (M_1)*	*SD (σ_1)*	Females (n = 124) *Mean (M_2)*	*SD (σ_2)*	t-value (t)	Statistical Significance
Recall	99.00	8.51	98.95	7.34	0.02	Not statistically significant
Understanding	27.93	5.29	26.42	5.87	1.18	Not statistically significant
Application	7.23	3.24	6.76	1.43	1.17	Not statistically significant
Total Score	**99.55**	**7.12**	**98.48**	**8.53**	**0.60**	**Not statistically significant**

The results recorded in Table 6 above indicate that the **t-values**, whether for the overall score of the Scientific Concept Acquisition Questionnaire or for each individual subscale, are **not statistically significant at the 0.01 significance level**. These results suggest that **there are no**

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statistically significant differences in scientific concept acquisition scores among students at Constantine 2 University , specifically within the Faculty of Humanities and Social Sciences and the Faculty of Psychology and Educational Sciences , that can be attributed to **gender**.

Results Related to the Third Research Question:

The third research question was formulated as follows: **"Are there statistically significant differences in students' scores on scientific concept acquisition that can be attributed to academic specialization?"**

To answer this question, an **independent samples t-test** was conducted to compare the **mean scores** of the study sample on the Scientific Concept Acquisition Questionnaire, as well as on each of its subscales, based on their **academic discipline**. The results are presented in **Table 7** below:

Table07. *The differences between the mean scores of the sample members on the Scientific Concepts Acquisition Questionnaire according to the variable of academic specialization.*

Scientific Concept Acquisition Scale	Humanities & Social Sciences (n_1 = 113)		Psychology & Education Sciences (n_2 =72)		t-value	Statistical Significance
	Mean (M_1)	SD_1	Mean (M_2)	SD_2		
Recall	18.06	3.42	16.55	2.10	3.11	Significant at 0.01 level
Understanding	22.67	5.76	20.19	4.80	4.56	Significant at 0.01 level
Application	54.55	10.09	39.77	8.43	3.65	Significant at 0.01 level
Total Score	27.25	5.84	31.18	6.00	5.45	Significant at 0.01 level

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The results presented in Table 7 indicate that the calculated (T-test) value, both for the overall scientific concept acquisition questionnaire and for each of its individual dimensions, is statistically significant at the 0.01 level. These findings suggest that there are statistically significant differences in the scores of students at the University of Constantine 2, specifically in the Faculty of Social Sciences and the Faculty of Psychology and Educational Sciences, with respect to their acquisition of scientific concepts based on the variable of academic specialization. These differences favor students in the Faculty of Social Sciences.

4. Discussion and Interpretation of Results

Discussion and Interpretation of Results Related to Research Question 1:

The findings related to the first research question revealed a significant positive correlation between computer-based instruction and the acquisition of scientific concepts among university students. These results are consistent with those of Duwaidi Ali Mohammed (1996), who found that teaching science using computers was effective. They also align with the findings of Kernell and Trigest (1999), which showed that computer-assisted instruction had a statistically significant effect on improving students' understanding of physical science topics compared to their peers in control groups.

These findings indicate that incorporating computers into instruction positively impacts university students' acquisition of scientific concepts. The more computers are used in delivering content and knowledge to students, helping them master information and skills, activating their engagement, and promoting interaction with instructional software, the more students acquire embedded scientific concepts.

This can be attributed to the computer's role in enhancing student skills, capabilities, and access to information and ideas. It also reflects the proper and effective use of modern technological tools by students in service of the learning process. Concepts are better understood and retained when presented using various approaches and tools. Providing students with multiple

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opportunities and diverse methods for presenting concepts allows them to better integrate new knowledge into their conceptual frameworks.

Scientific concepts are particularly important because they simplify the complexity of the environment, serve as the language of science, and provide the keys to scientific understanding. They organize and describe a wide range of events, objects, and phenomena that collectively represent core scientific principles and conceptual structures. Furthermore, scientific concepts assist individuals in addressing and understanding everyday life challenges (Khataybeh & Al-Jalil, 2001: 97).

The success of computer-based instruction is further attributed to students' enthusiasm and high levels of engagement. This enhances both learning outcomes and concept acquisition. Students feel more confident, eager to participate, and open to sharing opinions, generating positive interactions with various learning activities tailored to their needs and interests.

Computers also facilitate students' critical reading, summarization, and modification of information during discussions. This process leads to continuous revision of the learner's cognitive structure, allowing less comprehensive concepts in one learning context to become more comprehensive in another. As a result, learners integrate new knowledge with previous understandings to form logical connections, aiding comprehension, retention, and concept reinforcement. The technological tools used to deliver educational content to students offer novelty, stimulation, and relevance.

Technological media are inherently engaging, motivating learners and presenting material in new, attractive, and easily digestible ways that differ from traditional lecture methods. These tools foster autonomy in learning and encourage self-reliance. They offer diverse and aesthetically pleasing visual formats, enhancing artistic sensitivity. Ausubel's theory of concept learning also supports this interpretation, stating that students first associate verbal or written symbols with conceptual meanings and later understand their equivalence through visual representations.

Discussion and Interpretation of Results Related to Research Question 2:

The results addressing the second research question indicate no statistically significant differences in the scores of students from the University of Constantine 2, whether from the Faculty of Social Sciences or the Faculty of Psychology and Educational Sciences, in acquiring scientific concepts based on gender. This aligns with the findings of Huda Attaimeh Al-Masri (2020), who reported that difficulties in learning scientific concepts were moderate and showed no statistically significant differences based on gender or academic qualification.

This finding may be attributed to the diminishing gender gap in technology usage in Algerian society, where both male and female students now equally access and engage with modern educational technologies. Previously, cultural reservations might have limited female students' access to such tools.

Additionally, the absence of gender-based differences in concept acquisition could be due to the nature of the instructional tools—specifically computers—used to transmit these concepts. These tools have been equally embraced by both genders, fostering excitement and motivation for learning. This mutual enthusiasm has likely enhanced scientific concept acquisition in various disciplines. The use of modern technologies and the guidance students receive in integrating these tools into their studies stimulate their cognitive skills, making concept acquisition more balanced across genders and positively influencing both groups' learning experiences.

Discussion and Interpretation of Results Related to Research Question 3:

The findings related to the third research question indicate statistically significant differences in scientific concept acquisition between students in the Faculty of Social Sciences and those in the Faculty of Psychology and Educational Sciences at the University of Constantine 2, favoring the former.

These differences may be attributed to the structural and educational separation between the two faculties, which could lead to varying levels of academic motivation and self-efficacy. Students in the Faculty of Social Sciences may exhibit higher ambition and achievement drive, particularly as they transition from the highly dynamic and competitive baccalaureate stage, leading to greater concept acquisition, especially when these concepts are taught using interactive computer-based technologies.

These tools, with their attractive graphics, animations, and ability to address individual differences, enhance engagement and promote deeper understanding by linking various areas of knowledge. They provide educational activities that reflect students' real-world contexts, supporting memory recall, comprehension, and long-term retention of concepts.

Furthermore, students with lower academic performance often face multiple challenges in acquiring scientific concepts, including psychological, social, and cognitive factors. For students in the Faculty of Social Sciences, exposure to new, visually rich, and interactive content, delivered via computers, may offer an advantageous learning environment. These tools allow learners to control the pace and repetition of content, increasing comfort and enhancing interaction with the material.

Moreover, students in the Faculty of Social Sciences are often more driven to keep up with technological advancements, which motivates them to develop research skills, manage information efficiently, and improve their technological fluency, key factors in effective scientific concept acquisition.

Conclusion

The study concludes that modern technological tools—particularly computers—play a vital and positive role in enhancing the quality of education. Their integration has transformed traditional teaching roles and strategies, making them essential complements to curricular content. Based on the study’s findings, it is recommended that Algerian universities prioritize the inclusion of educational technologies, especially computers, in their instructional strategies. Encouraging both students and faculty to incorporate these tools into teaching and learning processes will significantly enhance students' ability to acquire and retain scientific concepts due to the flexibility, accessibility, and cognitive support offered by such technologies.

Algerian universities should, therefore, embed educational technologies into their strategic goals and continuously work to update and improve their integration in line with global technological advancements.

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