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The Implementation of Teaching Models and the Use of Common ICT Tools for Scientific Literacy in Greece's Second Chance Schools

Vasiliki Trapali
Effie Papageorgiou
Christina Fountzoula
Petros Karkalousos
Maria Trapali
Department of Biomedical Sciences,
University of West Attica, Athens, Greece

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Abstract

Introduction: In recent decades, numerous studies conducted both in Greece and worldwide highlight the lack of student interest in the natural sciences, which contributes to a broader crisis in scientific literacy - including the knowledge, attitudes, and skills associated with it. Therefore, the search for appropriate teaching models, combined with the use of ICT in the educational process - particularly in the field of adult education, including Second Chance Schools (SCS) - has become a modern educational objective. **Purpose:** To study and statistically analyze the teaching approaches and ICT tools incorporated into their instruction by Scientific Literacy educators in Greece's SCS, in comparison to their demographic and professional characteristics. **Method:** The research employed a structured questionnaire distributed via email to Scientific Literacy educators in SCS across Greece. The survey focused on three main research question groups. Using factor analysis, correlations among variables were explored, and the most significant ones were further analyzed using the chi-square test.

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Results:

- 57.6% of SCS Scientific Literacy educators use the "collaborative teaching" model, with 55.3% of them aged 36–45 ($p<0.01$).
- The "experimental teaching" model is avoided by 76.3% of female educators ($p<0.05$), 84.6% of educators under 35 ($p<0.01$), and 100% of those with little or no teaching experience (0–3 years) ($p<0.05$).
- 39.4% of educators apply inquiry-based teaching; of these, 33.3% are second-subject educators ($p<0.01$).
- Of the 39.4% who apply collaborative learning, 55.3% are aged 36–45 ($p<0.05$).
- 85.7% of educators with minimal or no teaching experience do not use project-based learning ($p<0.05$).
- 48.5% of educators use computers daily, with 56.3% being second-subject educators.
- 62.1% do not use interactive whiteboards, 72.7% of whom are physicists, chemists, or second-subject educators ($p<0.05$).
- 87.8% frequently use the Internet, and 38.1% of those who frequently use educational software apply differentiated instruction ($p<0.05$).
- 66.7% use ICT tools primarily for lesson demonstrations. Of the 47.0% who use ICT to support traditional teaching, 67.7% apply the "traditional teaching" model ($p<0.01$).
- 78.3% of the 34.8% who use experimental teaching use ICT tools for simulation experiments ($p<0.01$).

Conclusion: The majority of Scientific Literacy educators in Greece's SCS do not prefer experimental teaching and mainly use ICT tools for demonstration purposes.

Keywords: Adult education, Second Chance Schools, Information and Communication Technologies

Introduction

Second Chance Schools (SCS) operate under the philosophy of Adult Education but are classified within the formal secondary education system (Zepke & Leach, 2006). They provide adults aged 18 and above, who have not completed the nine-year compulsory education, the opportunity to continue their studies and obtain a certificate equivalent to that of lower secondary education (Law 2525/97). The duration of attendance is 18 months (two study cycles: A and B), with 25 teaching hours per week. Since 2000, 76 SCS have been established in Greece, including 12 within correctional institutions and 23 satellite units, across the 13 administrative regions. According to the Hellenic Statistical Authority (2001), the areas where SCS operate are classified as: (a) urban (population >10,000), (b) semi-urban (population

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2,000–10,000), and (c) island/mountainous regions, which, in addition to their geographical features, also have low population density and a high number of small settlements. Recent studies confirm that SCS play a significant role in reducing early school leaving and strengthening employability for vulnerable groups (ReferNet Greece & Cedefop, 2024).

The SCS curricula are not uniform but rather flexible (based on the "Curriculum Specifications for SCS" guide by IDEKE, 2003), in order to address the diverse characteristics of adult learners. In Greece, the programs are founded on the principle of multiliteracies - that is, the idea that modern adults must be literate in multiple scientific domains beyond basic reading, writing, and arithmetic (IDEKE, 2003). Consequently, eight literacies are established: Language, Numerical, ICT, English, Social, Environmental, Scientific, and Aesthetic-Cultural Education. SCS programs aim to combat social exclusion, improve employability, and promote active citizenship in social, economic, political, and cultural life (Prokou, 2009, p. 87), while also familiarizing learners with scientific knowledge applicable to everyday situations (Hurd, 1998). Recent research highlights the importance of scientific literacy for adult learners and proposes structured teaching models specifically adapted for SCS, such as the "2CHANCE" model (Tzampazi & Seroglou, 2023). Choosing an appropriate science teaching model depends on many factors, such as the cognitive content of the lesson and the age and experience of learners (Patapis, 1993).

The most important teaching models in science are:

- Traditional direct instruction
- Experimental teaching
- Project-based teaching
- Inquiry-based learning
- Collaborative learning
- Differentiated instruction

According to the traditional model (knowledge transmission model), the teacher fully controls the learning process, disregards students' preconceptions, and students passively receive new knowledge from the teacher and textbooks (Chalkia, 2012).

Experimental teaching supports cognitive development, introduces students to the scientific method, and fosters a positive attitude toward science (Koumaras, 1998). Especially when experiments are performed by student groups rather than as demonstrations, they contribute to the development of both manual skills - since students handle materials and tools - and social skills - since collaboration is required (Hodson, 1993; Ganiel & Hofstein, 1982).

The project method involves group teaching where all participants decisively contribute, and the learning process is shaped and conducted by

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everyone involved (Frey, 1998). Students take initiative, devise strategies to achieve their goals, and learn to gather, classify, evaluate, and use information independently. In contrast to the traditional model, the inquiry-based approach actively engages students in formulating hypotheses, conducting experiments, and engaging in other scientific activities to understand laws and concepts (Kariotoglou, 2006). In collaborative learning, knowledge is achieved through the development of group dynamics, which is a fundamental mission of the school. Learning becomes meaningful through collective action and systematic analysis of direct, experiential learning (Arends, 1994). Collaborative teaching aims to involve students through interpersonal cooperation and dialogue, equipping them to participate in socio-economic life (Katerelos, 1999). Differentiated instruction is an innovative pedagogical approach. It is a philosophy whereby teachers adapt their pedagogical methods to meet the diverse needs of students, acknowledging that "one size does not fit all" (Willis & Mann, 2000).

Over the past decades, Information and Communication Technologies (ICT) have been integrated into education and are considered essential tools for teaching, research, learning, and knowledge acquisition (Tzimogiannis, 2002). ICT includes technologies that allow the processing of various forms of information and the media that transmit them (Komis, 2004) - e.g., computers, software, audiovisual media, networks, interactive whiteboards, educational software, projectors, e-learning platforms, videoconferencing, email, and blogs (Meleisea, 2007). At SCS, ICT is utilized within the framework of digital literacy, aiming to foster positive attitudes and digital competence in learners. However, it is unclear whether ICT is effectively used in other literacy areas covered in the curriculum (Xepalti, Sergounioti & Koulianou, 2011). More recent research suggests that ICT-based, project-oriented approaches can enhance both linguistic and digital literacies in adult learners (Kaziani & Heliades, 2025; Bairaktari & Mavrogonatos, 2024). Additionally, informatics educators at SCS underline the importance of information literacy as an essential component of adult learning (Jimoyiannis & Gravani, 2023). This highlights the need to further document the frequency and modes of ICT usage in the Scientific Literacy instruction process (Nicolaou, 2022; Papathanasiou, 2023).

Objectives and Methods

Purpose of the Study

The main purpose of this study is to explore the teaching approaches and ICT tools selected by Scientific Literacy educators in Greece's Second Chance Schools (SCS), in comparison with their demographic and professional characteristics. The goal is to draw useful conclusions for shaping

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a framework of empowerment actions aimed at increasing learners' interest in Scientific Literacy.

Specifically, beyond the research questions related to the demographic and professional profiles of the educators, the following categorized research interests were formulated:

- What teaching models do Scientific Literacy educators use during face-to-face instruction?
- What ICT tools do these educators use, and how frequently?
- In what ways do they utilize ICT tools in the teaching process?

Study Sample

SCSs were selected from various regions of Greece, categorized as urban, semi-urban, and island/mountainous areas. This classification aimed to identify potential social factors influencing the educators' responses. The final sample consisted of 66 Scientific Literacy educators out of a total of 103 who were invited to participate. The Research was conducted in June 2021.

Picture 1: The geographical distribution of the Second Chance Schools (SCS) where the educators who participated in the study were employed during the 2020–2021 school year

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Table 1. The demographic and professional characteristics of the educators who participated in the study

Gender	**Number of participants**	**Percentage**
Male	28	42,4%
Female	38	57,6%
Age Group	**Number of participants**	**Percentage**
Up to 35	13	19,7%
36-45	29	43,9%
46-55	19	28,8%
56 and over	5	7,6%
Specialization	**Number of participants**	**Percentage**
Physicist	21	31,8%
Chemist	14	21,2%
Biologist	1	1,5%
Geologist	3	4,5%
Other (secondary assignment)[1]	27	40,9%
Highest Degree	**Number of participants**	**Percentage**
Bachelor's Degree	20	30,3%
Master's Degree	41	62,1%
Doctorate	5	7,6%
SCS Teaching Experience	**Number of participants**	**Percentage**
0-3 years	45	68,2%
4-6 years	13	19,7%
7-9 years	3	4,5%
10 years and over	5	7,6%
Total Teaching Experience	**Number of participants**	**Percentage**
0-3 years	14	21,2%
4-6 years	10	15,2%
7-9 years	9	13,6%
10 years and over	33	50%
School Area	**Number of participants**	**Percentage**
Urban	33	50,0%
Semi-urban	22	33,3%
Island/Mountainous	11	16,7%
Employment Status	**Number of participants**	**Percentage**
Permanent	14	21,2%
Substitute	14	21,2%
Hourly-paid	37	56,1%
Volunteer	1	1,5%
ICT Certification	**Number of participants**	**Percentage**
Yes	44	66,7%
No	22	33,3%

57.6% are women, 43.9% belong to the 36–45 age group, and 40.9% teach Scientific Literacy as a secondary (non-primary) assignment. Among those with a primary assignment, 53.85% are physicists. Additionally, 69.7% hold a postgraduate or doctoral degree as their highest qualification, while 68.2% have 0–3 years of teaching experience in Second Chance Schools

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(SCS). Half (50%) have more than 10 years of overall teaching experience, 50.0% work in urban-area SCS, and 66.7% hold ICT certification.

[1] "Secondary assignment" refers to educators whose primary specialization is in a different field but who also teach Scientific Literacy to fulfill required teaching hours.

Method – Questionnaire Structure – Research Material

A quantitative research methodology (Creswell, 2015) was followed, using a well-structured online questionnaire (via Google Forms) (Isari & Pourkos, 2015), which was distributed via email to SCSs, with the request that it be completed by Scientific Literacy educators who taught during the 2020–2021 school year. A five-point Likert scale was used (1 = strongly agree to 5 = strongly disagree). The estimated completion time for the questionnaire was approximately 10 minutes.

Table 2: The research question groups in the questionnaire and the number of items in each category

Question Group	Question Categories	Number of Items
First	Demographic and professional data	10
Second	Scientific Literacy teaching models	6
Third	ICT tools used in Scientific Literacy instruction	5
Fourth	Ways ICT tools are used in the educational process	8

Table 3. Teaching models applied by Scientific Literacy educators during face-to-face instruction

Science Teaching Models	N	%
Traditional direct instruction	31	47,0
Experiment-based teaching	23	34,8
Project-based teaching	25	37,9
Inquiry-based science teaching	26	39,4
Collaborative teaching	38	57,6
Differentiated instruction	21	31,8

The majority of educators extensively apply collaborative teaching and traditional direct instruction.

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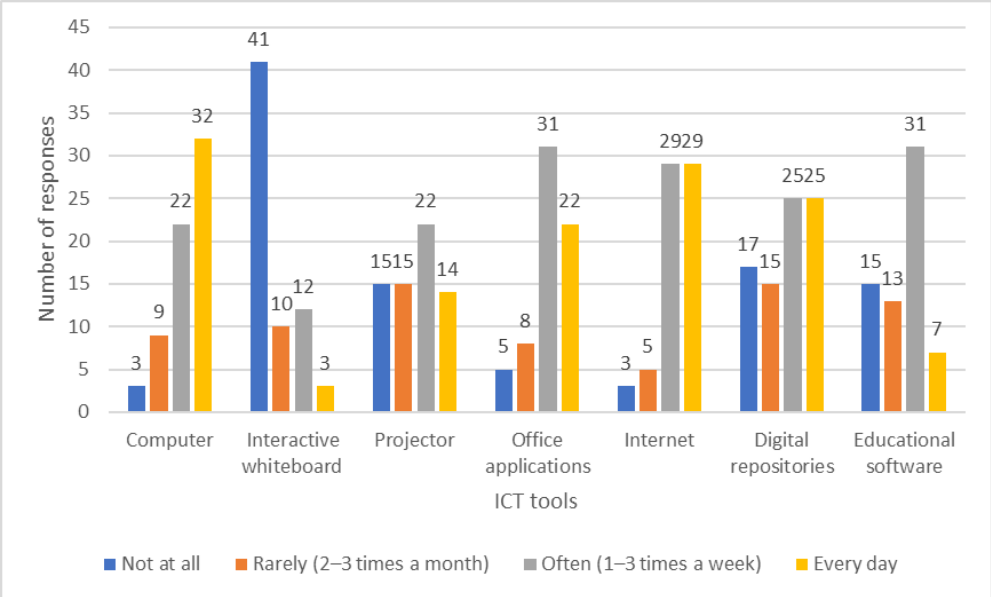

Figure 1. The ICT tools used by educators in the teaching of Scientific Literacy and the frequency with which they apply them

Table 4: Ways in which Scientific Literacy educators utilize ICT

Ways of Utilizing ICT in the Educational Process	N	%
As a support mechanism for traditional teacher-centered instruction	31	47,0
For presenting lesson material through demonstrations	44	66,7
For learners to search the internet and update their knowledge	36	54,5
To promote collaboration among learners	32	48,5
To promote inquiry-based learning	27	40,9
For conducting simulation experiments	29	43,9
For evaluating learners	19	28,8
For developing higher-order thinking skills among learners	30	45,5

The overwhelming majority of educators use ICT tools primarily for presenting lesson content through demonstration. More than 50% also use them to guide learners in searching for information online and updating their knowledge.

Validity and Reliability Check

The questionnaire, during its pilot phase, was distributed to 8 Scientific Literacy educators from SCS in Western Greece through face-to-face meetings, once the schools reopened following the COVID-19 outbreak. Necessary clarifications were provided, and the questionnaires were completed in the presence of the researcher. The number of participants was deemed adequate for an unbiased and representative expression of views (Cohen et al., 2008).

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The Cronbach's alpha reliability coefficient was calculated to assess the internal consistency of the questions. The reliability scores were:

- First research question group: $\alpha = 0.76$
- Second: $\alpha = 0.75$
- Third: $\alpha = 0.815$

Variables/questions with $\alpha < 0.3$ were excluded to enhance internal consistency.

Data Analysis

The data were analyzed using SPSS version 27.0 (academic license). Initially, a descriptive statistical analysis was conducted to present the frequency of all questionnaire variables. This was followed by a factor analysis to explore correlations and dependencies among variables across the four question groups. A chi-square statistical test was then applied to identify the most significant associations.

Ethics and Deontology

The Ethics and Deontology Committee of the University of West Attica (Athens) approved the study, which complies with the principles of the Declaration of Helsinki concerning research involving human subjects. Participants were informed that the questionnaire was anonymous and that the data would be used solely for statistical analysis purposes.

Results

Before addressing each research question, the variables/items were analyzed using the factor analysis method. This allowed us to examine the interaction between the variables in terms of their covariance. The focus was placed only on those variables that appeared to play a primary role in the responses to the research questions posed.

Teaching Models Applied by Scientific Literacy Educators During Face-to-Face Instruction

The study explored whether the choice of teaching model applied by Scientific Literacy educators is related to their demographic and professional characteristics (Figures 2, 3, 4, 5, and 6). The differences in responses were statistically significant ($p<0.05$ and $p<0.01$). Gender, age, field of specialization, and teaching experience all appear to influence the choice of teaching model.

The "experiment-based teaching" model is not chosen by:

- 76.3% of female educators ($p<0.05$),
- 84.6% of educators aged 35 and under ($p<0.01$), and

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- 100% of educators with very limited or no teaching experience (0–3 years) ($p<0.05$).

Of the 39.4% of educators who choose collaborative learning, 55.3% are aged 36–45. Additionally, 84.6% of those who teach Scientific Literacy as a secondary assignment prefer the inquiry-based teaching model ($p<0.05$).

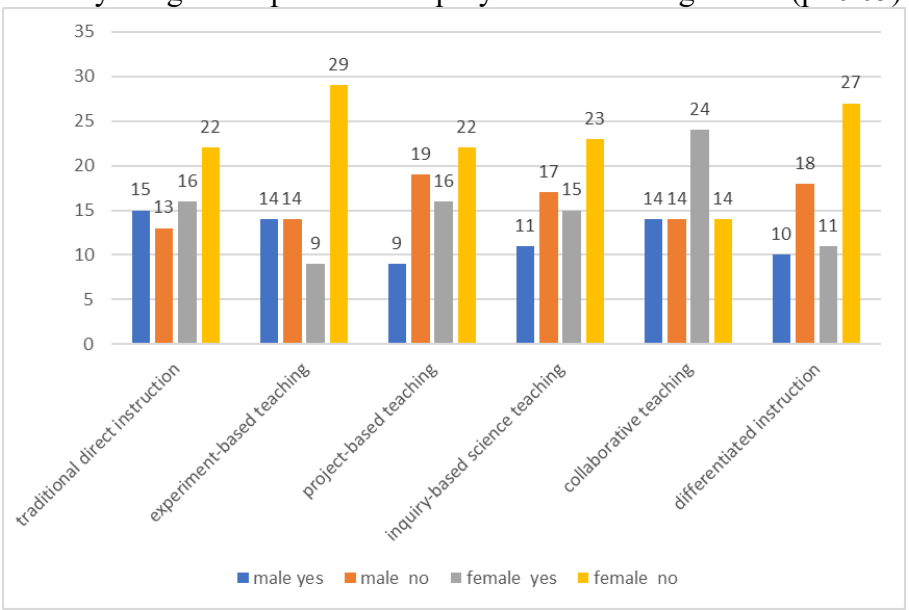

Figure 2: The educators' views on the types of teaching models they apply in the context of Scientific Literacy instruction, in relation to their gender. Very few female educators choose the "experiment-based teaching" model ($p<0.05$)

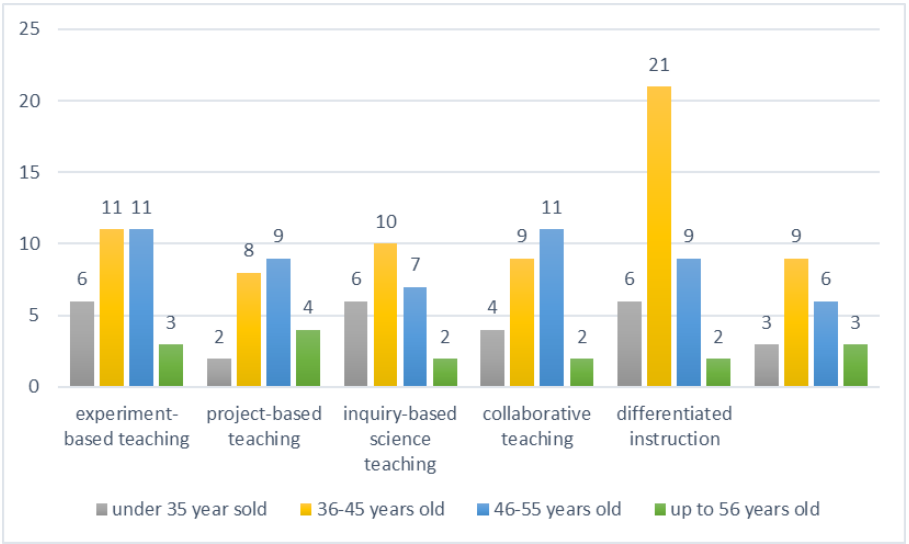

Figure 3: The educators' views on the teaching models they apply in relation to their age group. Very few educators aged 35 and under choose the "experiment-based teaching" model ($p<0.01$), whereas the overwhelming majority of those who select collaborative learning are aged 36–45 ($p<0.01$)

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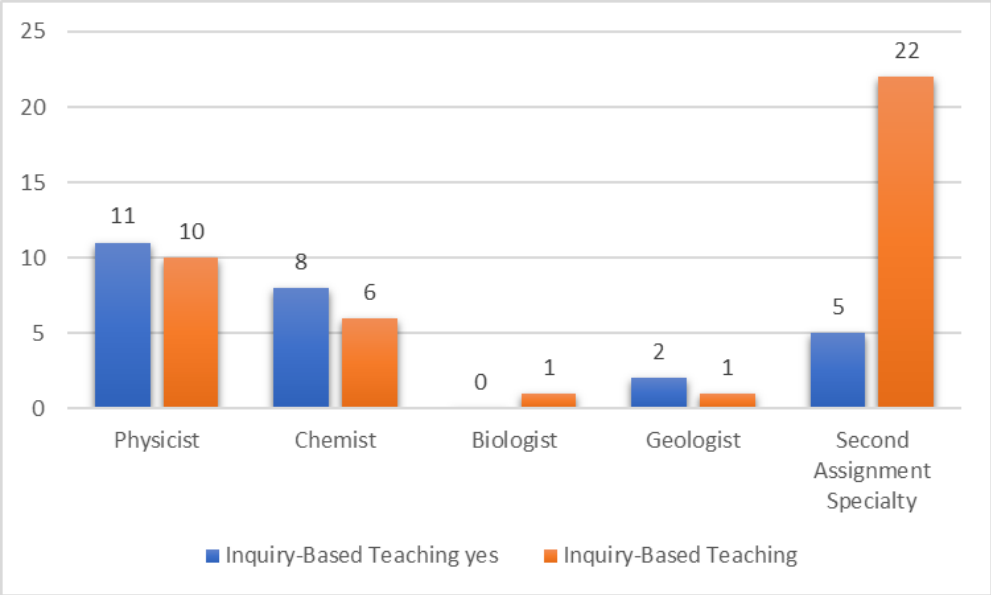

Figure 4: The educators' views on teaching model choices in relation to their field of specialization. The vast majority of educators who apply inquiry-based teaching have Scientific Literacy as a secondary assignment ($p<0.01$)

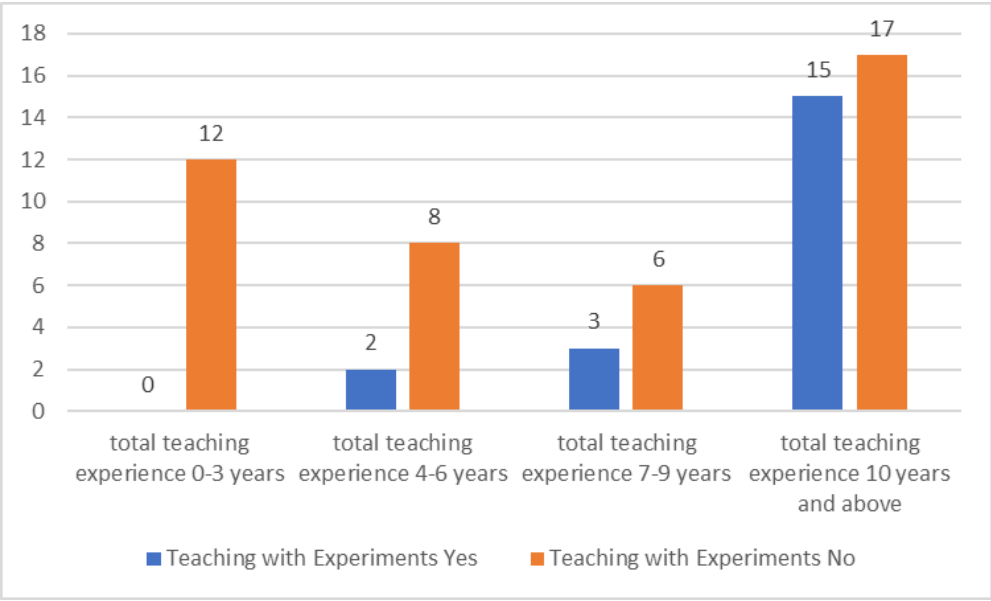

Figure 5: The educators' views on their chosen teaching models based on their total teaching experience. None of the educators with 0–3 years of experience use the "experiment-based teaching" model ($p<0.05$)

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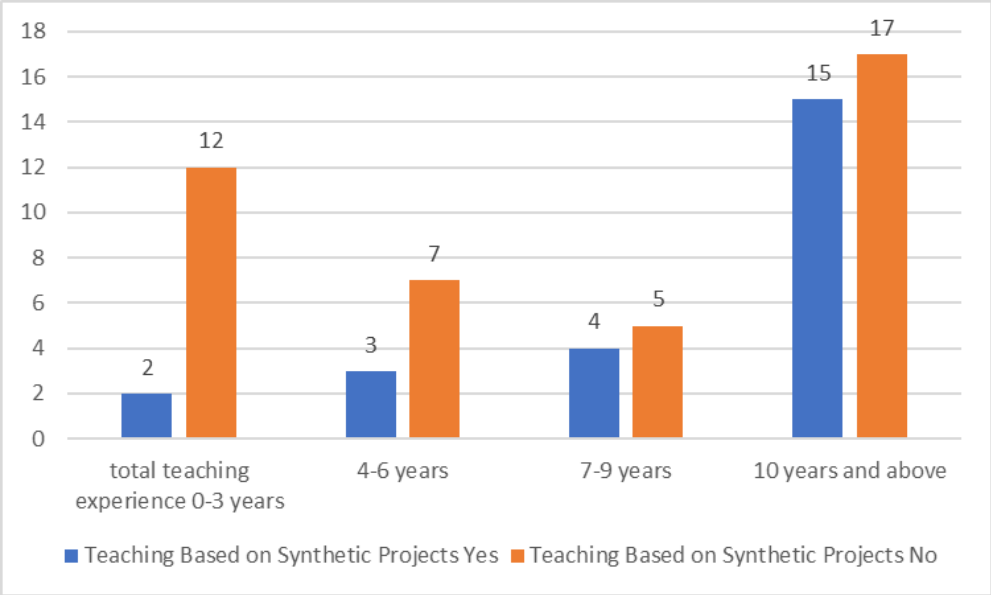

Figure 6: The educators' views on teaching model application in relation to their total years of teaching experience. The vast majority of educators with 0–3 years of experience do not implement project-based teaching ($p<0.05$)

ICT Tools Used by Scientific Literacy Educators in Their Teaching

The study examined whether the selection and frequency of ICT tool usage by Scientific Literacy educators is associated with their demographic and professional characteristics (Figures 7 and 8). The differences in responses were statistically significant ($p<0.05$). The educators' field of specialization appears to influence their choices regarding ICT tools.

- **66.7%** of educators with a secondary teaching assignment use computers daily in face-to-face instruction ($p<0.05$).
- **72.7%** of physicists, chemists, and secondary assignment educators rarely or never use interactive whiteboards ($p<0.05$).

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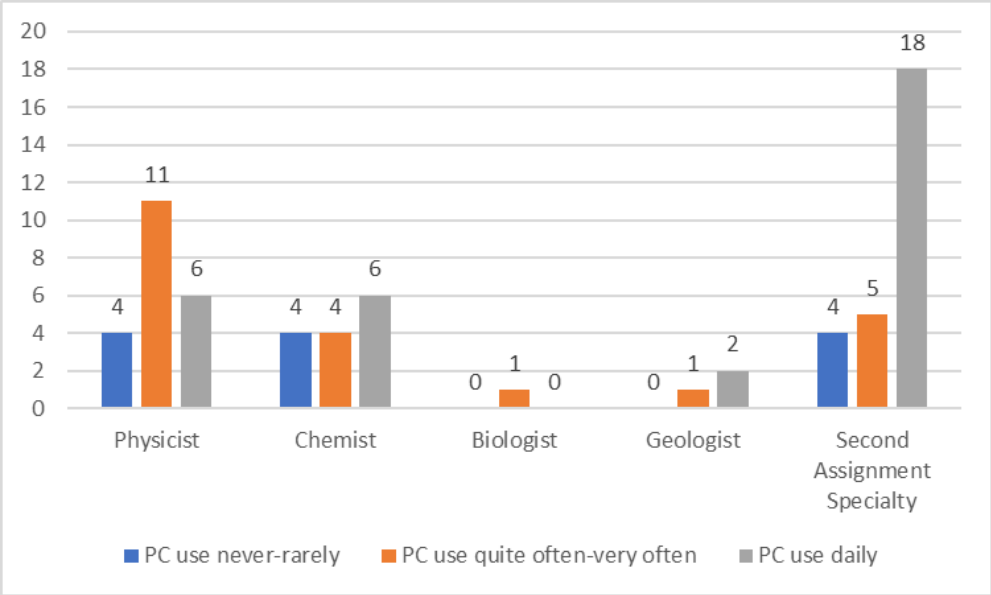

Figure 7: Educators' views on the ICT tools they select and the frequency of their integration into Scientific Literacy instruction, in relation to their field of specialization. The overwhelming majority of educators with a secondary assignment use computers daily ($p<0.05$)

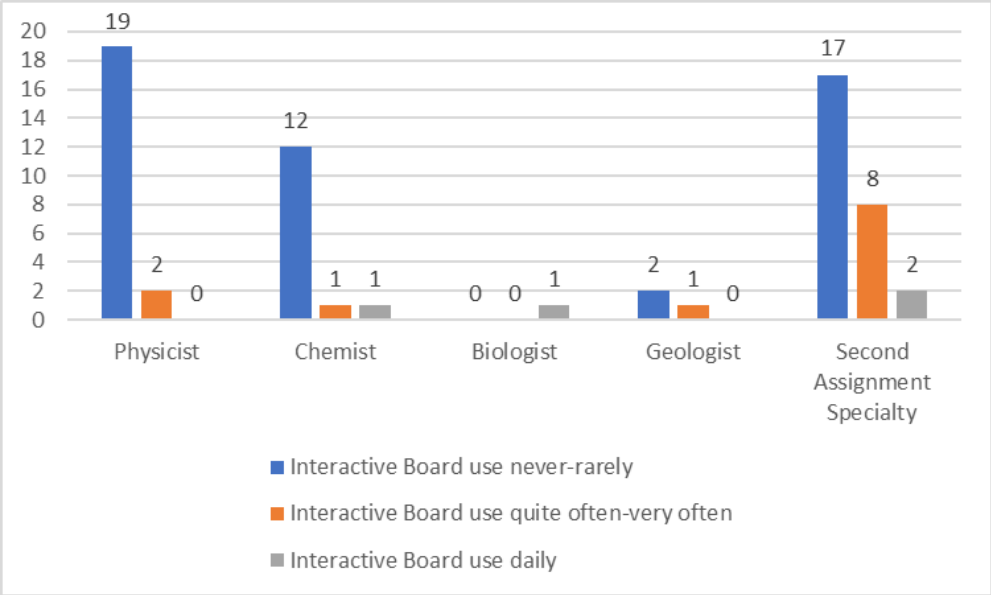

Figure 8: Educators' views on ICT tool selection and usage frequency in relation to their specialization. The vast majority of physicists, chemists, and secondary assignment educators do not use interactive whiteboards at all ($p<0.05$)

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Additionally, the correlation between teaching models and ICT tools was investigated. The differences in responses were statistically significant ($p<0.05$) (Figure 9).

- Among the **57.6%** of educators who frequently or daily use educational software, **38.1%** apply the differentiated instruction model in face-to-face teaching ($p<0.05$).

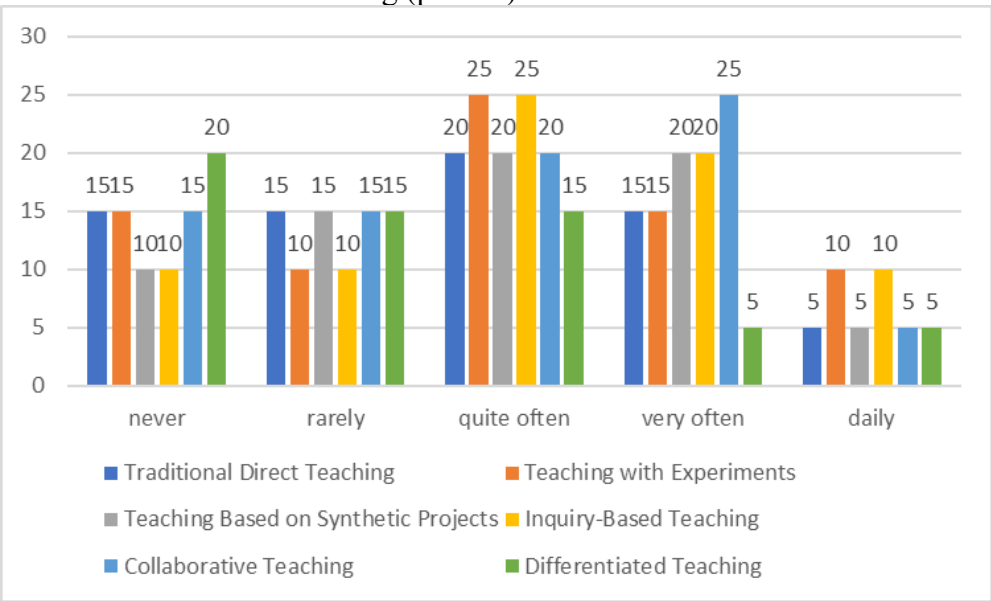

Figure 9: Frequency of educational software usage in relation to the teaching model. More than half of the educators who use educational software apply the differentiated instruction model

Results of the Analysis for the Question: "In What Ways Do Scientific Literacy Educators Utilize ICT Tools?"

The correlation between the ways ICT tools are utilized and the demographic-professional characteristics of Scientific Literacy educators was investigated. The educators' field of specialization appears to be related to how ICT is used (Table 5). The differences in responses were statistically significant (**$p<0.01$**).

66.7% of physics educators use ICT tools to conduct simulation experiments (**$p<0.01$**), while **74%** of educators with a secondary teaching assignment use ICT for presenting lesson material in the form of a demonstration (**$p<0.01$**).

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Table 5: Ways of Utilizing ICT in Relation to the Specialization of Scientific Literacy Educators

Ways of Utilizing ICT		As a support mechanism for traditional teacher-centered instruction	For presenting lesson material through demonstrations	For learners to search the internet and update their knowledge	To promote collaboration among learners	To promote inquiry-based learning	For conducting simulation experiments	For evaluating learners	για την ανάπτυξη δεξιοτήτων υψηλότερου επιπέδου των εκπαιδευόμενων
Specialization	Physicist (%)	47,6	57,1	57,1	47,6	38,1	66,7	23,8	42,9
	Chemist (%)	64,3	57,1	57,1	35,7	50,0	50,0	35,7	21,4
	Biologist (%)	100,0	100,0	100,0	0,0	100,0	0,0	100,0	0,0
	Geologist (%)	66,7	100,0	100,0	33,3	33,3	100,0	33,3	66,7
	Secondary Assignment(%)	33,3	74,1	44,4	59,3	37,0	18,5	25,9	59,3

It appears that the majority use ICT primarily as a support tool for demonstrating instructional material.

In parallel, the correlation between the ways ICT tools are utilized and the teaching models applied by educators during face-to-face instruction was examined (Figures 10 and 11). The differences in responses were statistically significant (**$p<0.01$**).

The choice of **traditional teaching** and **experiment-based teaching** models appears to be associated with how ICT is used.

- Among the **47%** of educators who apply the traditional teaching model, **67.7%** use ICT as a **supportive tool for traditional teacher-centered instruction** (**$p<0.01$**).
- Among the **34.8%** of educators who apply experiment-based teaching, **78.3%** use ICT to **conduct experiments in demonstration form** (**$p<0.01$**).

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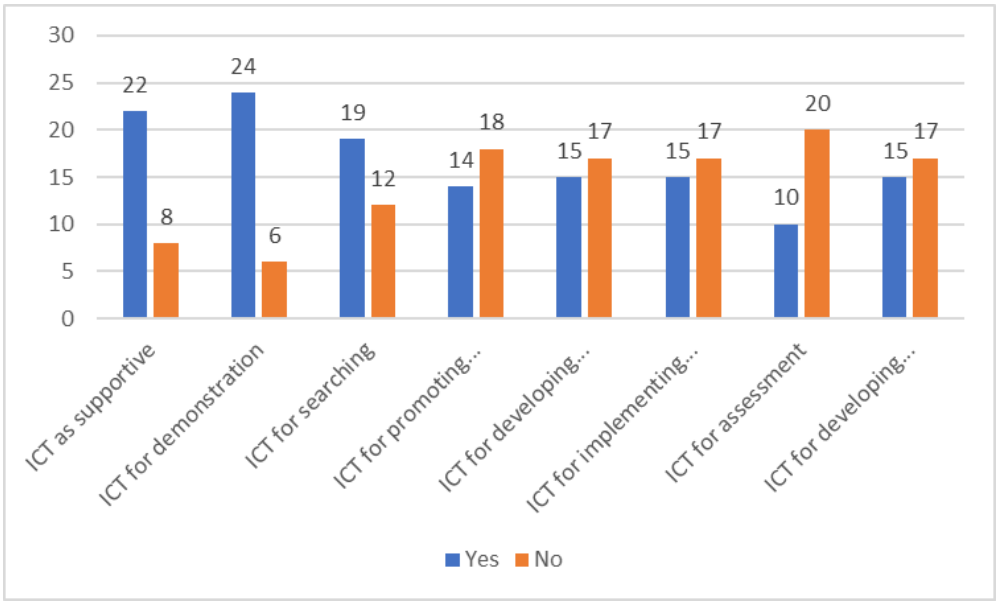

Figure 10: Ways ICT is Utilized by Educators Who Apply the Traditional Teaching Model. The overwhelming majority of educators who apply the traditional teaching model use ICT as a **supportive tool for traditional teacher-centered instruction** (**p<0.01**).

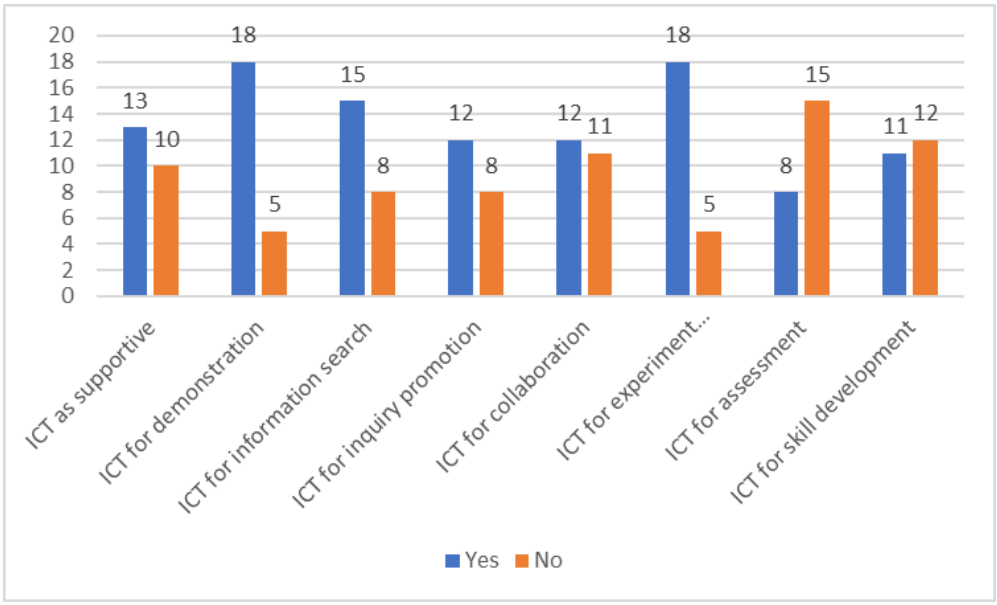

Figure 11: Ways ICT is Utilized by Educators Who Apply the Experiment-Based Teaching Model. The overwhelming majority of educators who apply the experiment-based model use ICT for conducting experiments in demonstration form (**p<0.01**).

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Conclusions

Teaching Models Applied by Scientific Literacy Educators in Face-to-Face Instruction

Gender, age, specialization, and teaching experience are significantly associated with the teaching model selected by Scientific Literacy educators in face-to-face instruction. The overwhelming majority of women, younger educators (up to 35 years old), and those with little or no teaching experience do not choose the "experiment-based teaching" model. These characteristics suggest that such educators often face difficulties in effectively conveying scientific knowledge to adult learners in SCS, particularly in transforming scientific content into teachable material and selecting, designing, organizing, and using it appropriately (Kariotoglou, 2006). According to Tobin et al. (1994), educators tend to avoid live experimentation in the classroom due to unexpected situations, safety concerns, and their own beliefs aligned with traditional teacher-centered instruction.

More recent studies confirm these findings, highlighting that teachers' self-efficacy, prior experience, and pedagogical beliefs continue to play a decisive role in the adoption of experimental and active learning practices (Frontiers in Education, 2023; SciELO Brasil, 2023). In fact, the transition to more interactive and experiment-based approaches is still hindered by challenges such as lack of resources, insufficient training, and limited opportunities for professional collaboration (Talafian et al., 2024). Active learning strategies, which include experimentation and inquiry-based tasks, are increasingly promoted as effective ways to engage learners and enhance conceptual understanding, yet many educators remain hesitant to implement them.

Although science education is inherently and reciprocally linked to the inquiry process, its core component - the experiment - is often downgraded due to pressures from exams, grading, curricula, and exercise-based instruction, especially in mainstream education. However, it remains unclear why experimentation is also downgraded in SCS, where both educators and students are free from the pressure of exams or rigid curricula. Preliminary insights suggest that experiments are more often neglected by women, younger educators, and those without teaching experience. Inquiry-based learning is primarily chosen by educators who teach Scientific Literacy as a secondary assignment. It appears that their anxiety to succeed in teaching outside their primary discipline leads them to adopt more exploratory instructional models.

ICT Tools Used by Scientific Literacy Educators

Educators' specialization and selected teaching models are significantly associated with the types and frequency of ICT tools used in

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Scientific Literacy instruction. The overwhelming majority of physicists, chemists, and educators with a secondary assignment rarely or never use interactive whiteboards - possibly due to inadequate infrastructure and lack of equipment in SCS.

Secondary-assignment educators use computers daily, while educational software is most frequently used by those who apply the differentiated instruction model. Given the increasing integration of ICT in science education - changing goals, teaching methods, and instructional tools (Solomonidou, 1999; Mikropoulos, 2003; Komis, 2005) - one would expect greater variety and frequency in ICT use within Scientific Literacy instruction.

Educators' Views on ICT Use

Most educators use ICT to **present lesson material through demonstration** and to support **student-driven online research**. This suggests that ICT use in SCS Scientific Literacy classes is at a rudimentary stage and is not yet fully integrated into the learning process.

ICT usage is closely related to the chosen teaching model.

- Educators applying traditional instruction use ICT as **support for traditional teacher-centered teaching**.
- Educators applying experiment-based teaching use ICT to conduct **demonstration-style experiments**.

This indicates a preference for the safety of **virtual experiments**, conducted in a controlled and visually appealing computer environment that allows easy, repeatable simulations of phenomena until mastery is achieved.

Discussion – Recommendations

Scientific Literacy educators in Greece's Second Chance Schools are predominantly **female**, **aged 36–45**, **hourly-paid**, and **postgraduate degree holders**, teaching Scientific Literacy as a **secondary assignment**.

The study showed that:

- **Experimentation is downgraded**, and
- **ICT is primarily used for demonstrating content and online information searches**.

Practical Recommendations:

1. **Funding Support** for SCS to equip schools with **fully functional science laboratories**, **interactive whiteboards**, and **appropriate digital equipment**, thus encouraging hands-on experiments and broader ICT use.
2. **Targeted training** for Scientific Literacy educators on **effective teaching methodologies** for integrating ICT into educational practice.

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3. **Practical training and workshops** on both **live experimental techniques** and **simulation-based experiments** using educational software, including design, implementation, and evaluation.

Finally, in an age of rapid technological advancement and its incorporation into education, SCS should not be left behind, whether due to low funding or a lack of professional development opportunities for its educators. As computer technology evolves, simulations will increasingly resemble real-world experiments, potentially **creating misconceptions** among learners. Thus, continuous research is needed to determine **how and which ICT environments** can most effectively support the teaching of Scientific Literacy.

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