

***The impact of teachers' digital skills for conducting research activities on the integration of digital resources, considering the mediating role of anxiety regarding the use of digital resources (case study: Secondary school teachers in Tehran)***

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***Abstract***

This study aimed to investigate the impact of teachers' digital skills for conducting research activities on the integration of digital resources, considering the mediating role of anxiety regarding the use of digital resources among secondary school teachers in Tehran. The research is applied in purpose and quantitative in data collection methods. The statistical population of this study consisted of all secondary school teachers in Tehran, from which a sample of 202 individuals was selected based on the minimum sample size rule. Cluster sampling method was employed to select the secondary school teachers in Tehran. Data was collected through both library and field methods. In the field section, information was gathered using a questionnaire, whose reliability and validity were examined and confirmed. Descriptive and inferential statistical methods were used for data analysis. In the descriptive section, demographic characteristics including age, gender, education, and work experience were described using percentage, frequency, tables, and charts, as well as means, standard deviation, skewness, and kurtosis with IBM SPSS-23 software for the study variables. Additionally, for testing the research hypotheses, confirmatory factor analysis was conducted using Smart PLS software. The results of the path analysis indicated that teachers' digital skills for conducting research activities have a positive and significant impact on the integration of digital resources. Furthermore, the results showed that anxiety regarding the use of digital resources can act as a mediating variable in this relationship.

***Keywords:*** Digital skills, integration of digital resources, digital anxiety.

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## **Introduction**

Today, digital transformation is one of the important topics in the history of organizational change, and its realization provides organizations with not only technological superiority but also strategic and competitive advantages (Savik, 2020). Digital transformation refers to the innovative implementation of new digital technologies aimed at improving the organization's business (Mergel et al., 2019). This term also encompasses the use of new technologies for co-creation, co-design, co-production, and co-distribution of products in interaction with customers and partners, leading to enhanced competitiveness for the organization (Brown & Brown, 2019). The digital transformation of industries, often referred to as the Fourth Industrial Revolution, paves the way for various developments in products, processes, and new services (Verhoef et al., 2021).

In this context, education and research are two interdependent concepts, where the progress or regression of one affects the other. The educational process requires the application of research skills and processes, while the enhancement and development of research also rely on education. Therefore, it can be said that both require a common platform for growth and advancement, which should be provided by those involved in research and education (Aboui et al., 2023). Research has shown that research activities and their two components (research literacy and research on teaching profession) directly and indirectly (through active learning) lead to the development of professional competencies for students and teachers (Moteharinejad et al., 2023). The role of research in education goes far beyond mere participation in decision-making at high administrative and executive levels. Research is deeply interconnected with education, and it cannot merely be considered as a structural and incidental presence. Research, as the most important method of instruction, has a prominent role in teaching and in the dynamism and deepening of the teaching-learning process (Mohammadlou et al., 2023). Thus, teachers require essential knowledge for effective decision-making in the classroom; a portion of this knowledge can be derived from the research findings of scholars outside the classroom and school, serving as foundational principles for teaching. However, the research of others cannot meet the needs of teachers in all dimensions and areas.

Empowering teachers in the field of educational technology not only enhances teaching productivity but also improves students' learning experiences (Arabi et al., 2024). In fact, today's teacher must not only master technological skills but also be capable of designing personalized learning, analyzing learner performance data, facilitating educational dialogue, and playing the role of a coach for emotional and ethical growth (Rostami et al., 2024). The use of digital tools and online resources can facilitate the research process and enable students to utilize up-to-date scientific resources. Additionally, research-based educational approaches, such as problem-

based learning and the use of real-world issues in the classroom, will significantly contribute to the development of research skills and creative thinking in students. Furthermore, training teachers in the use of research methods and innovative technologies to guide students in the research process is essential (Shahrud et al., 2023). Research skills can be defined as a practical domain in which an individual seeks a problem and its solution through scientific methods, utilizing information and communication technology in this process (Hasani, 2015), enabling them to search for information, manage data, and establish effective communication. (García et al., 2018).

The integration of digital technologies into the teaching and learning process is a global phenomenon that is primarily recommended in educational institutions with the goal of improving the educational system (Saidi & Meybodi, 2024). However, in recent years, particularly with the expansion of virtual education and the increasing use of digital technologies in teaching processes, a phenomenon known as “digital fatigue” has emerged among teachers. This type of fatigue, resulting from prolonged exposure to digital tools and environments, can lead to psychological and physical symptoms such as reduced concentration, mental exhaustion, headaches, anxiety, and feelings of demotivation. This issue, especially in virtual and blended learning environments, significantly negatively impacts interactions with students and classroom management. Moreover, the lack of adequate training in digital skills and organizational support has further complicated the problem (Zanganeh et al., 2024).

Anxiety regarding information and communication technology (ICT) is a mental state that manifests externally. Some authors have classified attitudes toward ICT based on anxiety or stress (Tels et al., 2022), which is understood as the level of reluctance or negative emotional state of an individual when integrating ICT into their professional tasks (Simonson et al., 1987).

Since research is one of the most important needs of both developed and developing countries, all nations strive to enhance research efforts within their countries, removing obstacles and challenges that hinder it and creating an environment conducive to deepening research across all areas. In this context, the education system is the most prominent scientific and progressive organization that necessitates attention to research and the conduct of studies. Unfortunately, in the educational system, instead of emphasizing innovation, creativity, and the promotion of scientific methods, there is a focus on memorization and the cultivation of cognitive abilities, and research does not hold a defined position among teachers (Chouhang, 2022).

Undoubtedly, the lack of a proper attitude and belief among educational system leaders regarding the significance and importance of research, the failure of teachers to perceive the necessity of this issue, the lack of a research culture in society,

insufficient and inadequate financial resources, and the absence of motivational factors to encourage researching teachers are among the most significant factors affecting teachers' willingness to engage in research (Akhash, 2023). Research has shown that teachers' lack of awareness about action research, the absence of in-service training on essential topics related to action research, and the lack of necessary facilities for teachers' action research are deterrents to their engagement in research activities. Other studies have identified issues such as the overcrowding of teachers' curricula (Oula, 2018), inadequate training courses on research (Ellis & Loveland, 2016), lack of research skills (Vasquez, 2017), and time constraints for conducting research (Norasman & Chia, 2016) as barriers faced by teachers in pursuing research. It must be acknowledged that teachers' lack of interest in research equates to stagnation in society across all development indicators. Therefore, we need to explore the factors that have led to this deep-rooted weakness within the education community. Achieving this noble goal requires the establishment of various conditions, such as effective management in the research domain, support for specialized personnel, and a shift in the education system toward fostering research (Hosseini, 2020). Ahmad and colleagues (2019) have indicated in their research that teachers' lack of access to information and educational resources is significantly related to their aversion to research. Consequently, it can be asserted that teachers need up-to-date resources to conduct research. In other words, today's society demands teachers who know how to respond to challenges arising from the complex and changing reality with an increasingly positive attitude towards information and communication technologies (Gomez & Granados, 2013), as these technologies constitute tools for transformation. This challenge necessitates the continuous training of teachers in scientific competencies, integrating information and communication technologies (Simsak & Ats, 2022), with the aim of producing scientific knowledge more quickly and effectively among members of the academic community.

In this regard, the present study aims to investigate the impact of teachers' digital skills for conducting research activities on the integration of digital resources, considering the mediating role of anxiety regarding the use of digital resources.

### **Main Hypothesis**

Teachers' digital skills for conducting research activities influence the integration of digital resources, considering the mediating role of anxiety regarding the use of digital resources.

### **Sub-Hypotheses**

- Teachers' digital skills for conducting research activities influence the integration of digital resources.

- Teachers' digital skills for conducting research activities influence anxiety regarding the use of digital resources.
- Anxiety regarding the use of digital resources influences the integration of digital resources.

### **Methodology**

The present study aims to investigate the impact of teachers' digital skills for conducting research activities on the integration of digital resources, considering the mediating role of anxiety regarding the use of digital resources among high school teachers in Tehran. This research is applied in purpose and quantitative in terms of data collection methods. The statistical population of this study consists of all high school teachers in Tehran. Klein (2015) states that for simple models, a minimum sample size of 100 is required, while for more complex models, at least 200 samples are needed. Other prominent theorists in the field of structural equation modeling and confirmatory factor analysis suggest a minimum sample size of 200 as a general and suitable rule for structural equation modeling and factor analysis. In any case, it should be noted that a larger sample size increases statistical power, accuracy, and generalizability of the results. Therefore, considering the minimum sample size required for confirmatory factor analysis, 210 respondents were considered as the sample size, and the questionnaire was distributed among them. Eight questionnaires were discarded due to incompleteness, and statistical operations were performed on 202 respondents. In this study, a two-stage cluster random sampling method was used to select high school teachers in Tehran. For data collection, both library and field methods were employed. In the library section, articles, books, and other scientific documents were used to search the research literature. In the field section, data were collected using a questionnaire. The questionnaire for this study is derived from the research of Gilen Gams et al. (2023), and it has been adapted to the context of Iranian schools. To determine the validity of the questionnaire, content and construct validity were employed. For content validity, the content validity ratio (CVR) and content validity index (CVI) were assessed with the help of ten experts in the field. The content validity index indicated that all questions in the research questionnaire were appropriate in terms of simplicity, clarity, and relevance (the CVR for each question was above 0.79). Furthermore, since the content validity ratio for all questions was above 0.62, no questions needed to be removed. For construct validity, both convergent and divergent validity were evaluated using Smart PLS 3 software, and the findings confirmed construct validity. Additionally, reliability was assessed through Cronbach's alpha coefficient and composite reliability. The values of these coefficients for all dimensions of the questionnaire were above 0.70, indicating the

reliability of the measurement tool. The reported validity and reliability coefficients for the questionnaire can be found in Table 1.

**Table 1: Reliability and Validity of the Research Instrument**

| Dimension/<br>Component                              | AVE  | Cronbach's<br>Alpha | CR   | ASV  | MSV  |
|------------------------------------------------------|------|---------------------|------|------|------|
| Digital Skills                                       | 0.57 | 0.75                | 0.79 | 0.42 | 0.39 |
| Integration of Digital<br>Resources                  | 0.59 | 0.81                | 0.81 | 0.32 | 0.45 |
| Anxiety Regarding<br>the Use of Digital<br>Resources | 0.61 | 0.83                | 0.83 | 0.39 | 0.48 |

The findings in the above table indicate that the AVE (Average Variance Extracted) values for the dimensions are greater than 0.5, which suggests that more than half of the variance of each of these dimensions is explained by their respective items. This supports the confirmation of convergent validity. On the other hand, according to the Fornell-Larcker criterion, which states that the AVE of each construct should be greater than the square of its correlation with other constructs, the results indicate that each of the dimensions is well differentiated from one another and there is no overlap between them, thus confirming divergent validity based on the Fornell-Larcker criterion. Additionally, your research findings show that for all three dimensions under investigation, the maximum shared variance (MSV) and average shared variance (ASV) values are effectively less than the AVE (average variance extracted) of each dimension. These results clearly demonstrate that each of these dimensions independently and effectively measures its respective constructs and is distinct from one another. Therefore, divergent validity is also confirmed based on these indicators. These findings validate the divergent validity for the various dimensions of the research. Specifically, when the MSV of each dimension is less than its AVE, it indicates that the maximum shared variance between each dimension and the other dimensions is significantly lower than its specific variance. In other words, these dimensions are well capable of explaining and measuring their specific characteristics and have minimal overlap with each other. Moreover, since the ASV is also less than the AVE of each dimension, it can be concluded that the average shared variance between each dimension and other dimensions is also at a low level. To analyze the data, both descriptive and inferential statistical methods were used. In the descriptive section, to describe demographic characteristics including age, gender, education, and work experience, percentages, frequencies, tables, and charts were utilized. Additionally, to describe the research variables, mean, standard deviation, skewness, and kurtosis were calculated using IBM SPSS Statistics version 23 (2015). In the inferential section, to test the research

hypotheses, confirmatory factor analysis was performed using SmartPLS version 3 (2016).

### **Findings**

In the findings section, the demographic information of the participants is described, with the results

**Table 2: Demographic Characteristics of Participants**

| Demographic Characteristic | Category         | Percentage | Frequency |
|----------------------------|------------------|------------|-----------|
| Age                        | Under 30 years   | 4.95%      | 10        |
|                            | 31 to 40 years   | 46.03%     | 93        |
|                            | 41 to 50 years   | 43.56%     | 88        |
|                            | Over 50 years    | 5.44%      | 11        |
| Gender                     | Male             | 77.72%     | 157       |
|                            | Female           | 22.27%     | 45        |
| Education                  | Bachelor's       | 24.75%     | 50        |
|                            | Master's         | 55.94%     | 113       |
|                            | Doctorate        | 19.30%     | 39        |
| Work Experience            | Less than 1 year | 16.83%     | 50        |
|                            | 1 to 3 years     | 20.29%     | 41        |
|                            | 4 to 6 years     | 43.56%     | 88        |
|                            | Over 6 years     | 19.30%     | 39        |

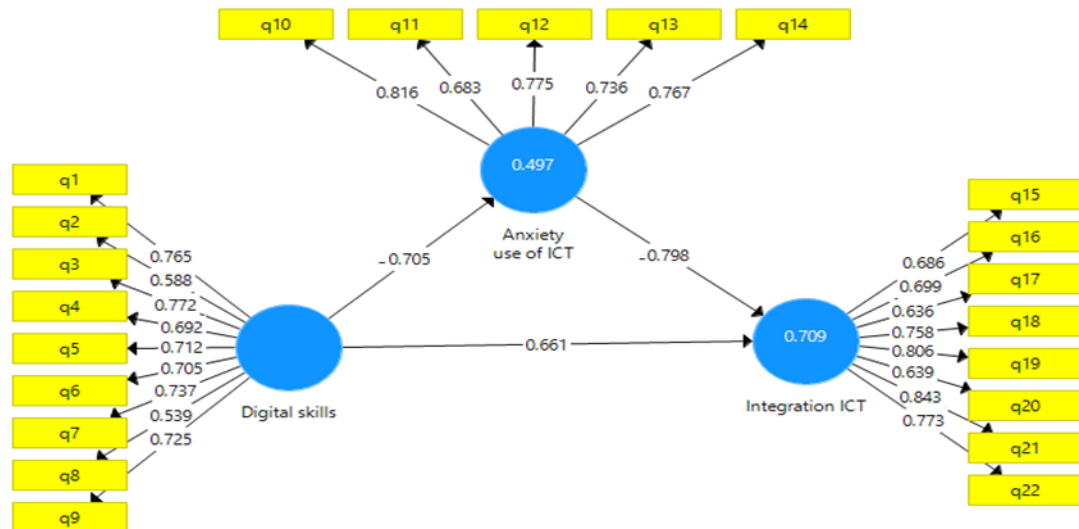
Based on the results, it can be stated that the highest frequency is found in the age group “31 to 40 years,” with 46.03% and 93 individuals, while the lowest frequency corresponds to the age group “under 30 years,” with 4.95% and 10 individuals. This indicates that young teachers are actively engaged in these schools. Additionally, in this study, 77.72% of the respondents are male and 22.27% are female. The highest frequency in terms of education is in the “Master’s” category, with 55.94% and 113 individuals, while the lowest frequency corresponds to the “Bachelor’s” category, with 24.75% and 50 individuals. This result shows that most of the teachers in this research have higher education qualifications. Finally, the results indicate that the highest frequency in terms of work experience is in the “4 to 6 years” category, with 43.56% and 88 individuals, while the lowest frequency corresponds to the “less than 1 year” category, with 16.83% and 34 individuals. This suggests that most of the teachers participating in this research have between 4 to 6 years of work experience.

Next, a description of the research variables was provided. In the table below, the central tendency and dispersion indices related to the research variables are displayed. It is worth mentioning that the minimum and maximum values for each of the variables below are 1 and 5, respectively.

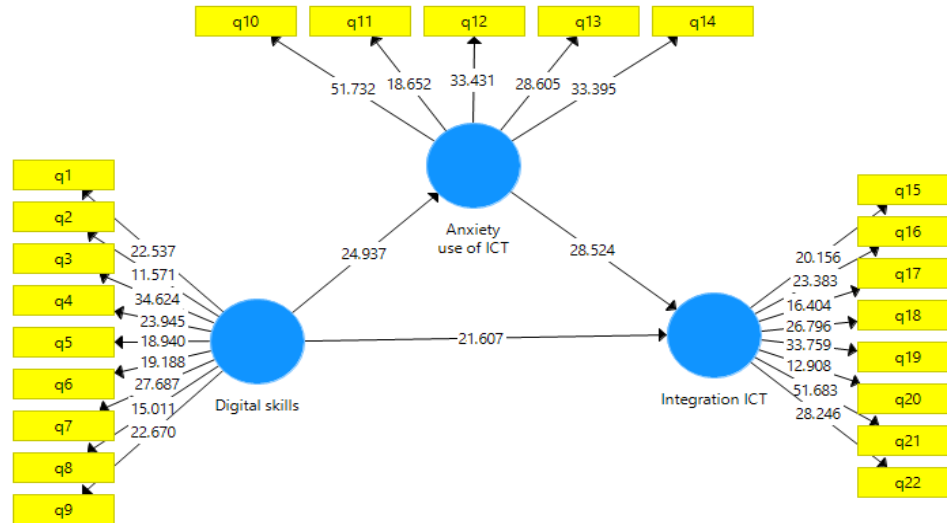
**Table 3: Statistical Characteristics of the Research Variables**

| Dimension/ Component                           | Mean | Standard Deviation | Kurtosis | Skewness |
|------------------------------------------------|------|--------------------|----------|----------|
| Digital Skills                                 | 3.23 | 0.78               | -0.06    | 0.37     |
| Integration of Digital Resources               | 3.22 | 0.79               | -0.02    | -0.15    |
| Anxiety Regarding the Use of Digital Resources | 3.26 | 0.75               | -0.04    | -0.19    |

The information in the above table presents statistical characteristics such as mean, standard deviation, skewness, and kurtosis for the research variables. Additionally, considering the values of skewness and kurtosis which fall within a reasonable range (between -2 and 2) for testing the normality of the data, we can propose and accept the assumption of normality for the data. Based on the results from the table above, the highest mean is associated with anxiety regarding the use of digital resources, while the lowest mean is related to the integration of digital resources. Following this, structural equation modeling was used to test the hypotheses, with the results presented as follows:



**Figure 1: Path Coefficients and Factor Loadings of the Model**



**Figure 2: Significance of the Model**

The structural model is a model that considers the relationships between independent latent variables (exogenous) and dependent latent variables (endogenous). The structural model examines only the latent variables along with the relationships among them. The numbers written on the paths represent the path coefficients as well as the factor loadings. To test the significance of the path coefficients, the t-Student test values were calculated using the bootstrap method. If the t-Student test values are greater than 2.58, the path coefficient is considered significant at the 0.05 level.

#### **Coefficient of Determination ( $R^2$ ) for Dependent Variables**

The  $R^2$  coefficient related to the endogenous latent variables (dependent) indicates the effect of an independent variable on a dependent variable. The values of 0.19, 0.33, and 0.67 are considered as benchmarks for weak, moderate, and strong  $R^2$  values, respectively. The calculated values for the constructs of the model are 0.497 and 0.709.

#### **Predictive Relevance Index ( $Q^2$ )**

This criterion indicates the predictive power of the model for the dependent variables. The interpretation criteria for  $Q^2$  are three values: 0.02, 0.15, and 0.35, representing low, moderate, and strong predictive power, respectively. If this index is positive, it is desirable. The  $Q^2$  values for the research variables are 0.298, 0.255, and 0.236, which are positive and at a desirable level. Therefore, it can be stated that the predictive power of the model regarding the variables is satisfactory.

#### **Goodness-of-Fit Index (GOF)**

This index, introduced for fit assessment by Tenenhaus et al. (2005), is a general fit criterion that is calculated by the geometric mean of the average communality as follows:

This index operates similarly to the fit indices of LISREL models, lying between zero and one, where values close to one indicate a good quality model. However, it should be noted that this index, unlike the chi-square-based indices in LISREL models, does not assess the goodness of fit of the theoretical model with the collected data but rather evaluates the overall predictive capability of the model and whether the tested model successfully predicts the endogenous latent variables.

$$GOF = \sqrt{\overline{communality} \times \overline{R^2}} = \sqrt{0.59 \times 0.60} = .596$$

Structural modeling specialists using the PLS method consider a GOF index of less than 0.10 as small, between 0.10 and 0.25 as moderate, and over 0.36 as large. Considering these criteria, the goodness-of-fit index for the model in the examined sample is 0.596, which is categorized as a large size. Based on these findings, it can be concluded that the tested model in the examined sample has a suitable fit. Additionally, given that the factor loadings of all observable variables in the model are greater than 0.5 and the significance is greater than 2.58, it can be said that the present construct possesses desirable validity.

According to the main model of the research, the research hypotheses are examined as follows.

**Table 4: Results**

| Path                                                                                                                                                         | Path Coefficient (β) | Significance Value (t-value)  | Test Result |       |             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------------------|-------------|-------|-------------|
| Digital skills of teachers for conducting research activities have an impact on the integration of digital resources.                                        | 0.661                | 21.607                        | Confirmed   |       |             |
| Digital skills of teachers for conducting research activities have an impact on anxiety regarding the use of digital resources.                              | -0.705               | 24.937                        | Confirmed   |       |             |
| Anxiety regarding the use of digital resources has an impact on the integration of digital resources.                                                        | -0.798               | 28.524                        | Confirmed   |       |             |
| Mediation Hypothesis                                                                                                                                         | Direct               | Indirect                      | Total       | VIF   | Test Result |
| The digital skills of teachers for conducting research activities, considering the mediating role of anxiety regarding the use of digital resources, have an | 0.661                | -0.705 *<br>0.798 =<br>-0.562 | 1.22        | 0.460 | Confirmed   |

|                                                 |  |  |  |  |  |
|-------------------------------------------------|--|--|--|--|--|
| impact on the integration of digital resources. |  |  |  |  |  |
|-------------------------------------------------|--|--|--|--|--|

## **Conclusion and Recommendations**

As observed, this research addressed the impact of teachers' digital skills for conducting research activities on the integration of digital resources, considering the mediating role of anxiety regarding the use of digital resources among secondary school teachers in Tehran. Addressing this topic is of high importance because having tools to assess the level of development of teachers' digital competencies for conducting research is essential today. The participation of such individuals in knowledge creation and social transformation is crucial, as a robust scientific community at different educational levels is necessary. The results of this research indicated that teachers' digital skills for conducting research activities have a positive and significant impact on the integration of digital resources. This finding highlights the importance of training teachers in their practical field to utilize technological resources in the scientific process. In fact, teachers with high digital skills can access credible and up-to-date resources and use them to enhance the quality of their research. These skills include the ability to search databases, evaluate the credibility of sources, and utilize data analysis software. By using digital resources, teachers can implement more creative teaching methods. This, in turn, can help improve student learning and increase their motivation to engage in research activities. Research enables teachers to continuously update their knowledge and skills and improve their teaching methods based on scientific evidence.

According to Bandura's social learning theory, which emphasizes the importance of learning through observation and interaction with others, teachers can leverage digital resources to benefit from the experiences and research of others, thereby enhancing their own learning and performance. Additionally, based on the technology in education theory, which addresses the integration of content knowledge, pedagogical knowledge, and technological knowledge, teachers must be able to apply these three types of knowledge simultaneously. Digital skills enable teachers to use technology as a tool for enhancing learning and teaching. The availability and quality of digital resources can influence their integration into the educational process, but it should be noted that "teachers are reluctant to use technology as an educational tool if the tools are inadequate." Therefore, a plausible explanation for these findings is that in Iran, there is a commitment to advancing innovation in technology through incentives.

The results also showed that teachers' digital skills for conducting research activities have a negative impact on anxiety regarding the use of digital resources. A reasonable explanation for these findings is that teachers may experience a high

level of stress regarding the intention to use digital resources for research, but as they gradually integrate these resources into their research tasks, these levels of anxiety diminish. Moreover, anxiety regarding the use of digital resources has a negative impact on the integration of digital resources. These results emphasize the need to encourage teachers to enjoy and be interested in technology for their scientific outputs, whether through incentives or by reducing teaching hours to enhance their research capabilities. If researchers are fully engaged and focused on this process, they can even forget about time, fatigue, and anything else aside from the activity itself.

A positive outcome of this research in practice, not only for teacher-researchers and their professional development but also for novice researchers and classroom teachers who can conduct small experiments with their class groups, is the emphasis on training courses. Free online courses can be beneficial and serve as a foundation for teacher training, encouraging them with strategies on how to effectively incorporate these resources into their educational processes.

Based on the obtained results, the following recommendations are provided for teachers and school administrators:

- Organizing regular training courses for teachers on the use of digital tools and technologies can help increase their confidence.
- Creating and distributing educational resources, videos, and online guides to assist teachers in easily utilizing digital tools.
- Selecting a few specific tools for use in research and focusing on learning and effective use of them instead of using multiple tools simultaneously.
- Utilizing time and stress management applications to help teachers organize their tasks and reduce feelings of pressure.
- Establishing support groups that can facilitate research collaborations between teachers and knowledge-based companies.

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