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Teaching competencies according to The TPACK model for chemistry teachers in Iraq

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Abstract

The research aims to identify the degree of availability of teaching competencies according to the TPACK model among chemistry teachers in secondary schools in Iraq. The study used a descriptive correlational research method, with 300 teachers from day and evening secondary schools in Baghdad Al-Rusafa Governorate selected randomly for the 2022-2023 academic year. The TPACK model was used to assess teaching competencies, which consisted of 45 items across seven domains: content knowledge, educational knowledge, technological knowledge, content and educational knowledge, technology and content knowledge, technology and educational knowledge, and technology, education, and content knowledge. The results of the research showed that there is a weakness in the degree of availability of teaching competencies according to the TPACK model among chemistry teachers. The questionnaire as a whole indicated this, as shown by the results. The study found a lack of availability in areas of teaching competencies such as educational knowledge, technological knowledge, knowledge of technology and content, and knowledge of technology and education. However, the field of content knowledge was available. The researchers recommended in-service teacher training programs to integrate technology, education, and content knowledge.

Keywords: Chemistry teachers, educational technical knowledge, teacher preparation, teaching competencies, TPACK model.

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1. Introduction

The contemporary trends in preparation programs for on-duty teachers require attention. The quality of the teacher and the quality of their preparation must align with the new educational system. Professional development programs for chemistry

teachers and their in-service training do not take into account integrated standards or the linkage and integration of specialization, education, and educational technologies, according to a single and integrated model. Most of my chemistry lessons reveal that teachers realize the integration of these standards while teaching the subject. They are concerned with cognitive competencies that are limited to obtaining knowledge only, without an interest in creating thought and the process of dealing with this knowledge and managing it in a way that helps students produce more knowledge and deepen their understanding of the content of chemistry. This was reached by listening to and exchanging opinions when interviewing a sample of chemistry teachers and discussing with them. The research problem was reinforced by an exploratory questionnaire of the opinions of a random sample of 30 students from the secondary schools affiliated with the three Rusafa Education Directorates in Baghdad for the academic year 2021-2022. It included many questions to verify a problem. The research results showed that many chemistry teachers indicated non-participation in training courses or seminars that develop their competencies in a way that links specialization, education, and educational technologies. They have restricted themselves to the usual methods in teaching the content of the subject, due to their lack of knowledge of modern applications of educational technology or their lack of knowledge of the appropriate applications for teaching chemistry. Therefore, the research problem was crystallized by answering the following question: "What is the degree of availability of teaching competencies according to the TPACK model among chemistry teachers in Iraq?"

Prepare education A means to provide solutions to challenges and problems, as it works to develop the individual in a comprehensive and integrated way in the mental, physical and technical aspects, and thus prepare a good citizen who is beneficial to himself and society [1] Traditional educational systems emphasize giving and covering the huge amount of information, paying attention to memorization processes, and incoherently giving information, thus causing a gap in the goals to be achieved [2] with the flourishing of science and technology and the rapid developments that accompanied scientific knowledge and technological applications, science in its modern sense has become a material, a method and a means to confront the problems and challenges facing society. Therefore, education has a responsibility to prepare its human cadres capable of keeping pace with this scientific and technical progress to adapt successfully to these accelerating changes [3]. In addition, educational institutions should keep pace with scientific and technological development because of its importance that contributes to enriching the educational process, as the technical tools produced by the contemporary technological revolution must be invested and invested in developing many aspects of the educational process and facilitating many of its tasks [4]. Information and communication technology contributes to helping educational institutions transform the educational process into an active and effective process that is linked to the reality of life, and to prepare outputs that are appropriate to the requirements of modern life. They claim the need for a teacher who is able to apply modern technological methods in teaching, by providing an interactive learning environment with multiple sources to interaction between him and students, as well as develop himself in all the technology available to him which requires him Use of interactive information and communication technologies [5].

Technological developments require professional competencies that require a high level, as there should be a balance between competence in the subject they specialize in teaching and competencies in teaching itself [6] and with the advancement of science and technology, we find that the role played by the teacher changes in the process of teaching and learning, and to go along with that, we find that the process of preparing the teacher acquires special importance in the educational process, and if it is to succeed in achieving its goals, it should focus and before any Another thing to prepare them is the preparation that befits the roles assigned to him [7]. As a result, we find that contemporary trends in teaching call for providing everything new in the scientific arena and supplementing with contemporary scientific information and concepts and linking them to daily practices while performing the teaching profession [8] basing on this, the development of education in the twenty-first century and the massive technological revolution that followed has become an indispensable requirement, which led to the emergence of many challenges for those concerned with education matters that had to be faced to serve this process by developing contemporary technological systems, means and methods of teaching in preparation for keeping pace with technological developments [9]. Therefore, education reform efforts were based on preparing the teacher during service, and taking into account his competencies to reach a high level of professionalism in his teaching performance, as the teacher’s possession of the competencies contributes to strengthening the relationship between work, education and learning, and thus makes his role decisive in the development of education [10] and foundation Therefore, good preparation should go beyond mastering the specialized aspect to cultural and educational preparation, as it acquires competencies and skills that contribute to preparing the generation and developing society, and so lost many studies recommended the necessity of giving attention to the teacher's acquisition of teaching competencies in the classroom, and to be able to use technologies and benefit from the achievements of science and the information revolution [11] the teacher’s success in his profession is closely related to his cognitive, skillful, emotional, personal, social, and cultural competencies, and in the age of knowledge, the goal of cognitive competencies has shifted from merely obtaining knowledge to the process of dealing with this knowledge, manage its flow [12] and as a result, the global interest in many developed countries expanded in the competencies-based education movement and became a distinctive feature of the systems of preparation and training programs before and during service, as it calls for the professional tasks of the teacher to be linked to the requirements of those tasks in terms of competencies [13]. The teacher preparation models focused on two main areas, one of which represents the preparation related to the content of the study material and is called (academic preparation), and the other is called (educational preparation), which is related to teaching methods. It was prepared in the era of information and communication technologies [14] and with the growing interest in the importance of technology integration in the educational process as one of the characteristics that should be available to the teacher in the twenty-first century, the need for a new framework or business model has emerged to help understand and evaluate the knowledge and skills he needs [15] as a result the TPACK model emerged as a proposal to include educational technology and its interactions in teacher preparation and represent stie

back framework (TPACK)(Technological Pedagogical And Content Knowledge) Maar educational technology related to the educational content .and who cares with the integration between (knowledge of technology, knowledge of the content of the study material, with knowledge of teaching methods side by side), and with the same importance and the interactions between these three elements, new elements are generated represented by (educational knowledge related to the educational content, technical knowledge related to the educational content, And educational technical knowledge, as well as educational technical knowledge, related to the educational content (TPACK) Therefore, it contributes to clarifying how the teacher can integrate technical tools in teaching the academic content presented in the classroom learning environments, meaning that the TPACK model focuses on looking at those areas (content, educational knowledge, and technology) as interrelated, each of which affects On the other, and therefore the choice of academic content would affect the educational strategies that can be used, and the technical methods that will be integrated, that will affect how the educational content is taught [16]. The importance of the model lies in the fact that it helps to define broad lines on how to prepare a teacher who is able to properly employ technology in teaching [17] in addition to that it aims to develop competencies necessary for the teacher to enable him to integrate technology into education, as it calls for integration in the academic, educational and technological aspects, with points of convergence between each of them, and a general framework that brings them together [18] Accordingly, the study Sabry [19] recommended "the need to direct the teacher to the importance of the TPACK model (TPACK)And benefiting from it in the educational process by joining teacher preparation programs before service and during service in order to enhance knowledge of the technological pedagogical content" [19]. The areas of the TPACK model can be described as follows:

- Content knowledge (Content Knowledge) (CK): It includes knowledge of one's field of specialization and the nature of the content, and also refers to the teacher's knowledge of concepts, theories, and models in the field of specialization.
- For educational knowledge (Pedagogical Knowledge) (PK): It includes a set of skills that must be known and developed in order for the teacher to be able to organize and manage learning and teaching activities such as lesson planning, class management, stimulating student motivation, as well as evaluating learning. It refers to the teacher's knowledge of teaching methods and appropriate strategies for teaching a particular subject, and the calendar you requested, and provides feedback, knowing the psychological, physical, and social needs of the learners.
- Technological knowledge (TK): It consists of lessons on how to use the computer in its two parts (physical and software) and presentation tools as tools for presenting documents, projects, and other technologies, in order to apply them effectively in teaching the content of the subject, in a way that enables it to adapt and learn technological innovations.
- Knowledge of content and education: PCK (Pedagogical Content Knowledge) consists of knowing the method that suits the content, as well as knowledge of the curriculum, evaluation, and methods of merging and integrating content and teaching methods to achieve better practices in the educational process.
- Knowledge of technology and content (Technological Content Knowledge) (TCK) describes the interrelationship between technology knowledge and content knowledge, and uses technology to display content information in many ways.
- Technological knowledge and Andolsek (Technological Pedagogical Knowledge) (TPK): Deals with the relationship. The exchange between technology and education is very clear, realizing that technology facilitates the application and implementation of particular teaching methods, and new teaching methods can be created through technology and facilitated in their implementation in classroom practices and activities.
- Technological knowledge education and content (Technological Pedagogical Content Knowledge) (TPACK): Focus on how technology can be used to enhance the teaching methods necessary to teach specific content, in the sense that the teacher chooses from the technical applications what suits the scientific content that he is teaching, employing the appropriate teaching methods and methods [20].

And maybe describe the importance of research from a theoretical point of view. Keep pace with global trends in teacher preparation, and consider what the role of the teacher should be in light of the requirements of the times. It provides a clear vision of the TPACK model and its cognitive components, to benefit from it in the educational process in line with the requirements of the twenty-first century. Safer than in practice, it provides the chemistry teacher with a systematic understanding of how to integrate technology, chemistry content, and teaching methods during instruction to develop his competencies. It is hoped that its results will benefit the preparation and training directorates to include models in the content of training programs interested in integrating technology into teaching, taking into account the educational aspect.

Search target and his questions: The research aims to identify the degree of availability of teaching competencies according to the TPACK model for chemistry teachers. By answering the question now, the next hypothesis:

Is there a statistically significant difference at the significance level (0.05) between the average grades of research sample teachers on a questionnaire regarding teaching competency according to the TPACK model as a whole?

The second question is: Is there a statistically significant difference at the significance level (0.05) between the sample mean scores of research sample teachers in each field of resolution regarding teaching competencies according to the TPACK model?

Search limits: The current search is determined by:

1-Human limit: Chemistry teachers in middle and high schools.

2-Time limit the academic year (2022-2023).

3-Spatial limit: General Directorate of Education, Baghdad / Al-Rusafa (1), Al-Rusafa (2), Al-Rusafa (3).

Define terms:
Teaching competencies: know her [21] A set of qualities and capabilities that should be available to a good teacher and make them able to achieve their teaching and educational goals in the best possible way, and these qualities are measurable and observable [21].
- TPACK Model: Define it, Milman and Kilbane Clare [22] that he: "a model to organize the different areas of knowledge that teachers must develop and integrate for effective teaching in the twenty-first century [22].
The procedural definition of teaching competencies according to the TPACK model includes the areas related to knowledge of content, educational knowledge, technological knowledge, knowledge of technology and content, knowledge of technology and education, and knowledge of technology, education, and content, which should be available to chemistry teachers in secondary schools. It is measured by the degree to which the teacher scores on a questionnaire prepared for this purpose.

2. Materials and Methods

The descriptive correlational research method was adopted:

2.1. The Research Community and Its Sample

The research community consisted of all teachers in secondary schools, who numbered (1179) male and female teachers, distributed according to the directorates, with (501) male and female teachers, representing a percentage of (42%), and (394) male and female teachers in the second Rusafa Education Directorate, accounting for (33%), and (284) male and female teachers in the third Rusafa Education Directorate, at a rate of (25%). By gender, there were (371) teachers, representing (32%), and (808) schools, at a rate of (68%). Since the current research community can be divided into strata based on (Directorates of Education) and gender (males-females), the research sample was chosen using the random stratified relative method, and it reached (300) teachers and schools.
Search tool: After reviewing some scientific and educational books, it was prepared for this research, as follows the steps:

- Set a goal resolution: The scale aims to measure the availability of teaching competencies according to the TPACK model for chemistry teachers in secondary schools.
- Drafting paragraphs of the Scale: After reviewing the educational and psychological literature and previous studies, 45 paragraphs were drafted, distributed over seven fields of competencies. It can be described as follows:

The first area, knowledge of the content (CK), consisted of eight paragraphs.
The second field: educational knowledge (PK), consists of nine paragraphs.
The third domain: technological knowledge. TK: It consisted of five paragraphs.
The fourth domain: Knowledge of content and education. PCK consists of six paragraphs.
The fifth domain: Knowledge of technology and content. TCK: It consisted of six paragraphs.
The sixth domain: knowledge of technology and education. TPK consists of six paragraphs.
Seventh Domain: Knowledge of technology, education, and content. TPACK consists of five paragraphs.

Likert method (Likert) with a five-point scale in the preparation of the paragraphs of the scale: (Always applies to me, applies to me often, applies to me sometimes, applies to me rarely, never applies to me) and identified grades B (5, 4, 3, 2, 1) on the scale. The validity of the scale was verified by a group of arbitrators and specialists in the methods of teaching chemistry, educational psychology, measurement, and evaluation. The lowest score for the scale was (45) and the highest score was (225).
Statistical analysis of paragraphs resolution: Each of the following has been extracted:

- Internal consistency validity (constructive validity of the tool): It was found that the relationship between the score of each item and the total score of the scale was statistically significant, and the values of the correlation coefficients ranged between (0.208 - 0.566), which means that there is a positive correlation between the scores of the paragraph and the total score of the scale. The relationship was extracted between the total score of the paragraph and the total score of the field to which the paragraph belongs. The correlation coefficient values ranged from (0.342 - 0.777), and this indicates that there is a positive correlation between the total score of the paragraph and the total score of the domain. It has also been verified from the correlation between each domain and the total score of the scale, where the correlation values for each domain were (Content knowledge, pedagogical knowledge, technological knowledge, Knowledge of content and education, Knowledge of technology and content, knowledge of technology and education, knowledge of technology, education, and content), (0.725, 0.691, 0.606, 0.564, 0.374, 0.734, 0.680), respectively, with the total score of the scale, and this means that these variables have a strong correlation with the total score of the scale.
- Discriminatory power: A t-test for two independent samples has been performed to calculate the difference between the mean scores of each item in the scale between the two groups. It was found that the values ranged between (8.044 - 2.117). When compared to the tabular t-value (1.980) at the level of significance (0.05) and the degree of freedom (298), it was found that the calculated t-values for all items were greater than the tabular t-value; it is a statistically significant function.
- Stability for a resolution: Two methods have been adopted, one of which is the Alpha Crew method (Nabach) that reached a stability resolution as a whole (0.802). As for field stability coefficients at (Content knowledge, pedagogical knowledge, technological knowledge, Knowledge of content and education, Knowledge of technology and content, knowledge of technology and education, knowledge of technology, education, and content) respectively (0.779, 0.823,

0.774, 0.774, 0.762, 0.801, 0.813, 0.750), they are reliable stability coefficients. The other method adopted was Half segmentation, and since the number of paragraphs of the scale is odd, the Rolon method was used. It was found that the stability coefficient is (0.856), which is a good stability coefficient. As for the field stability coefficients at (Know the content, pedagogical knowledge, technological knowledge, Knowledge of content and education, Knowledge of technology and content, knowledge of technology and education, knowledge of technology, education, and content), they were (0.808, 0.840, 0.801, 0.830, 0.845, 0.818, 0.875, 0.856).

3. Results

The first question is: Is there a statistically significant difference at the significance level (0.05) between the average grades of research sample teachers on a questionnaire regarding teaching competency according to the TPACK model as a whole?

For the dependence t-test for one sample, the calculated T-value was (-558.871), which is less than the tabular value of (1.960), with a degree of freedom (298), Table 1.

Table 1.
Results t-test for one sample of the scale of competence teaching according to the TPACK model.

Significance of differences	The value The withdrawn T	Hypothetical average	Standard deviation	Average Arithmetic	The sample
Non d	58.871-	135	9.622	102.293	300

Value (T) tabular at the level of significance (0.05) and degrees of freedom (298) = 1.960.

The second question is: Is there a statistically significant difference at the significance level (0.05) between the school grade average research sample in each field resolution and teaching competencies according to the TPACK model?

The data from the primary research sample were analyzed using the t-test for one sample. The results are shown in Table 2.

Table 2.
The results of the t-test for one sample for the fields of teaching competencies according to the TPACK model.

The meaning of the difference	The value t	Hypothetical average	Standard deviation	Average Arithmetic	MjaLat TPACK model
D	4.242	24	3.606	24.883	Content knowledge
Non d	26.639-	27	2.841	22.630	Pedagogical knowledge
Non d	94.863-	15	1.466	6.970	Technological knowledge
D	24.640	18	2.141	21.046	Knowledge of content and education
Non d	41.102-	18	0.489	6.273	Knowledge of technology and content
Non d	50.047-	18	2.100	11.930	Knowledge of technology and education
Non d	61.057-	15	1.826	8.560	Knowledge of technology, education and content

Tabular t-value at the significance level (0.05) and degrees of freedom (298) = 1.960

Table results can be interpreted (2):

- Content knowledge domain: It was statistically significant, as the calculated t-value (4.242) was greater than the tabular t-value (1.960), at the level of significance (0.05) and with a degree of freedom (298), meaning that this sufficiency is available.
- Field of educational knowledge: It was not statistically significant, as the calculated t-value (26.639) was less than the tabular t-value (1.960), at the level of significance (0.05) and with a degree of freedom (298), meaning that this sufficiency is not available.
- Field of technological knowledge: It was not statistically significant, as the calculated t-value (-94.863) was less than the tabular t-value (1.960), at the level of significance (0.05) and with a degree of freedom (298), meaning that this sufficiency is not available.
- The field of content knowledge and education: It was statistically significant, as the calculated t-value (24.640) was greater than the tabular t-value (1.960), at the level of significance (0.05) and with a degree of freedom (298), meaning that this sufficiency is available.
- Technology and content: It was not statistically significant, as the calculated t-value (-41.102) was less than the tabular t-value (1.960), at the level of significance (0.05) and with a degree of freedom (298), meaning that this sufficiency is not available.
- Knowledge of technology and education: It was not statistically significant, as the calculated t-value (-50.047) was less than the tabular t-value (1.960), at the level of significance (0.05) and with a degree of freedom (298), meaning that this sufficiency is not available.

- The field of knowledge in technology, education, and content: It was not statistically significant, as the calculated t-value (-61.057) was less than the tabular t-value (1.960), at the level of significance (0.05) and with a degree of freedom (298), meaning that this sufficiency is not available.

4. Discussion

Statistical results show weaknesses in teaching competencies according to the TPACK model for the teachers in the research sample based on the questionnaire. As a whole, the statistical results also indicated a weakness in the availability of fields of teaching competencies represented by (educational knowledge, technological knowledge, knowledge of technology and content, knowledge of technology and education, knowledge of technology, education, and content), while the field (knowledge of content, knowledge of content and education) was available. These results are explained as follows:

- The first area: knowledge of the content: The results showed that the chemistry teachers have knowledge of the content. When referring to the scale, it was found that 95% of the chemistry teachers confirmed that they sufficient knowledge of the theoretical material in chemistry and its requirements related to the academic subjects, And This is attributed to the factor of previous experience with the content Chemistry in number programmers and The same subject is repeated every academic year, which gives them experience.it was mentioned [16] That's why availability Knowledge and information in the subject of specialization for most teachers It is due to the fact that preparation programs provide them with the necessary knowledge, experience and basic information [16].
- The second field: educational knowledge: The results showed a weakness in the degree of availability of this field, due to the fact that.
  -75% of chemistry teachers confirmed that they are sometimes concerned with providing students with aspects of learning (cognitive, emotional, and skillful). This is because they focus on the cognitive side more than other aspects, and 80% of chemistry teachers rarely know how to guide the student to build his own knowledge and acquire habits of mind, self-education, and active involvement in learning, due to their focus on the theoretical side of the material in the chemistry book more than other aspects. The student's score is governed by this aspect only.
  - 84% of chemistry teachers confirmed that they are unable to use a wide range of teaching methods that contribute to examining information in light of critical criteria instead of merely imparting information. This is due to the limited class time and the large amount of scientific material that is supposed to be completed within a specific timeframe.
  Chemistry teachers rely on a specific type of evaluation, including paper-and-pencil tests, which is the prevailing method for judging students' success. Eighty-six percent of the sample confirmed that they do not know the various methods of evaluating students' learning, whether formal or informal.

The third field: technological knowledge: The results showed a weakness in the degree of availability of this field, due to: 91% of chemistry teachers may not be using a lot of traditional and modern digital technologies and applying them effectively when teaching a chemistry course. This is due to the difficulty of dealing with digital technologies because the in-service teacher training programs focus on the cognitive aspects more than the technological ones, or they are not available in the school environment because they are expensive, or they cause a waste of class time without completing the planned content during the lesson. In addition to that, many of them prefer the prevailing methods of teaching away from technological applications. 98% of chemistry teachers are unable to use the steps of preparing electronic tests efficiently, and the difficulty of not being able to prepare this type of test is due to a deficiency in the knowledge and competence necessary to employ technology in the educational process, or since most of them prefer regular tests to electronic tests. In addition, on-the-job training programs neglect to pay attention to the process of qualifying them to deal with technology, affecting their ability to keep abreast of technological developments in the educational field.

The fourth domain: Knowledge of content and education: The results showed that the availability of this field has been confirmed by 95% of chemistry teachers. They know how to achieve the required goals and teach the subject in proportion to its nature. This is attributed to the preparation programs, whether before or after service, that provide them with educational knowledge related to the content of chemistry, enabling them to achieve the goals, as well as proper planning for them.

The fifth domain: knowledge of technology and content: The results showed weakness in the availability of this field, as 97% of chemistry teachers do not like introducing the technological aspect in the process of teaching the content of chemistry. Their answers to all the paragraphs in this field indicated that it did not apply to them at all. From their point of view, they see that this aspect causes them to waste time without completing the content of chemistry within the specified time. Therefore, we find that many chemistry teachers have knowledge of the subject they are studying, but they lack the effective use of technology and how to relate it to the topic of the lesson. This can be attributed to the weakness in the rehabilitation of chemistry teachers, whether before or after service in this area.

The Sixth Domain: Knowledge of Technology and Education: The results showed a weakness in the availability of this field due to the fact that 88% of chemistry teachers cannot use multimedia and its programs in the teaching process. Employing many technologies in the educational process, such as email instead of letters, sessions instead of virtual classrooms, Google, Zoom, Teams, and others, is hindered by their lack of training on the effective integration of technology and its educational use in the educational process. Additionally, they lack an understanding of the nature of the interaction that takes place between technical knowledge and educational knowledge, which negatively impacts this knowledge. Preparation programs do not include providing them with sufficient knowledge to use technology to facilitate the education process, which makes them face difficulties in using and employing it educationally in the educational process.

The seventh field: Knowledge of technology, education, and content: The results showed a weakness in the availability of this field. Ninety-six percent of chemistry teachers do not know how to employ technology that fits with the teaching methods required to teach specific content within a specific educational context. The preparation programs that teachers

receive of all kinds are presented separately, as they are provided with content-only programs, teaching methods-only programs, and technology-only programs. This does not contribute to the knowledge of a teacher regarding the nature of the interaction between technological knowledge, educational knowledge, and content knowledge. The researcher agrees with what Chaipidech and Srisawasdi [23] indicated in this regard: "The reason for this is due to the fact that the preparation programs that teachers receive, in all their types, do not meet these needs, since they are provided separately, as they are offered content-only programs, teaching methods-only programs, and technology-only programs. This leads to a lack of integration between this knowledge and thus its weakness. Teachers become more prepared and use technology when the relationship between content, technology, and teaching principles is understood, as their awareness of this relationship is important to achieve this integration and the incorporation of technology into the educational process [24].

5. Conclusions

According to the previous research results, it was concluded that:

1- Availability of knowledge and information about the content of the specialization subject for chemistry teachers.
2- The ability of chemistry teachers to change education and design educational lessons via the integration of pedagogical knowledge and content.
3- Chemistry teachers need to improve their knowledge about how to integrate content, education, and technology.
4- Chemistry teachers need an educational knowledge base and its integration with technical knowledge in teaching.

6. Recommendations

1. Reconsidering the objectives of the programs for preparing chemistry teachers in particular, and teachers in general, focuses on providing them with teaching competencies according to the TPACK model, as well as employing this model, which is one of the necessities of the current era.
2. The need to include technology in the preparation systems of chemistry teachers, as an integral dimension of the preparation based on the TPACK model.
3. Holding training courses for chemistry teachers to train them on how to employ technology in the educational process.
4. Benefiting from the experiences of developed countries in integrating technology into the educational process according to the TPACK model.

6.1. Suggestions

1- Teaching competencies, according to a TPACK model among chemistry teachers based on the variables of experience and academic qualification.
2- Conducting a study dealing with educational competencies according to the TPACK model on pre-service teacher preparation programs in colleges of education.

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