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Original article

Teaching tasks in Chemical Kinetics for the initial training of Physical Education teachers

[*Tareas docentes de Cinética Química para la formación inicial de profesores de Educación Física*]

[*Tarefas de ensino de Cinética Química para a formação inicial de professores de Educação Física*]

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ABSTRACT

Introduction: Several studies demonstrate the importance of teaching tasks adapted to specific contexts, strengthening motivation and learning in different subjects; however, no research has been identified on their application in Chemical Science specifically aimed at the initial training of teachers. of Physical Education.

Objective: To develop and apply a system of teaching tasks for Chemical Kinetics to improve the learning of this unit in fourth-year students of the School of Physical Education Teachers.

Materials and methods: The study involved 40 students from the 2018–2019 academic year. An initial and final diagnostic assessment was conducted using a pedagogical test, a survey, and a self-assessment guide, covering three dimensions: content mastery, reflection on learning, and motivation. Percentage analysis and classification into five learning levels were used. The system included 22 tasks, organized into four groups, with stages of motivation, execution, and evaluation.

Results: The initial assessment showed that 62% of students were at a very low level. After implementation, the very high level increased from 10% to 40%, and the very low level decreased to 25%. There was greater participation, motivation, and connection between Chemistry and sports practice, and Chemical Kinetics was no longer the most difficult subject in midterm and final exams.

Conclusions: The application of the system of teaching tasks related to daily life and situations in the profession produced an increase in the learning of Chemistry, which was evidenced by comparing the results of the initial pedagogical test with respect to the final test, and allowed us to verify the feasibility and relevance of this system of tasks.

Keywords : learning; Chemical Kinetics; Physical Education; teaching tasks.

RESUMEN

Introducción: diversos estudios evidencian la importancia de las tareas docentes adaptadas a contextos específicos**,** fortalece la motivación y el aprendizaje de diferentes asignaturas, sin embargo, no se han identificado investigaciones su aplicación en la Cinética Química específicamente dirigidas a la formación inicial de profesores de Educación Física.

Objetivo: elaborar y aplicar un sistema de tareas docentes de Cinética Química para mejorar el aprendizaje de esta unidad en estudiantes de cuarto año de la Escuela de Profesores de Educación Física.

Materiales y métodos: se trabajó con 40 estudiantes del curso 2018–2019 y se aplicó un diagnóstico inicial y final mediante prueba pedagógica, encuesta y guía de autoevaluación, en tres dimensiones: dominio de contenidos, reflexión sobre el aprendizaje y motivación. Se utilizó análisis porcentual y clasificación en cinco niveles de aprendizaje. El sistema incluyó 22 tareas, organizadas en cuatro grupos, con etapas de motivación, ejecución y evaluación.

Resultados: el diagnóstico inicial mostró un 62% de estudiantes en nivel muy bajo. Tras la implementación, el nivel muy alto pasó de 10% a 40% y el muy bajo disminuyó a 25%. Hubo mayor participación, motivación y vinculación de la Química con la práctica deportiva y la Cinética Química dejó de ser el contenido con mayor dificultad en evaluaciones parciales y finales.

Conclusiones: la aplicación del sistema de tareas docentes relacionadas con la vida cotidiana y con situaciones de la profesión, produjo un incremento del aprendizaje de la Química, lo que se evidenció al comparar los resultados de la prueba pedagógica inicial con respecto a prueba final, y permitió comprobar la factibilidad y pertinencia de este sistema de tareas.

Palabras clave: aprendizaje; Cinética Química; Educación Física; tareas docentes.

RESUMO

Introdução: Diversos estudos demonstram a importância de tarefas de ensino adaptadas a contextos específicos. Essas tarefas fortalecem a motivação e a aprendizagem em diferentes disciplinas. No entanto, não foram identificadas pesquisas sobre sua aplicação em Cinética Química, especificamente voltadas para a formação inicial de professores de Educação Física.

Objetivo: Desenvolver e implementar um sistema de tarefas de ensino de Cinética Química para aprimorar a aprendizagem desta unidade entre alunos do quarto ano da Escola de Professores de Educação Física.

Materiais e métodos: Trabalhamos com 40 alunos do ano letivo de 2018-2019. Foram realizadas avaliações inicial e final por meio de uma prova pedagógica, um questionário e um guia de autoavaliação, em três dimensões: domínio do conteúdo, reflexão sobre a aprendizagem e motivação. Utilizou-se análise percentual e classificação em cinco níveis de aprendizagem. O sistema incluiu 22 tarefas, organizadas em quatro grupos, com etapas de motivação, execução e avaliação.

Resultados: A avaliação inicial apresentou 62% dos alunos em nível muito baixo. Após a implementação, o nível muito alto aumentou de 10% para 40%, e o nível muito baixo diminuiu para 25%. A participação, a motivação e a conexão entre Química e esporte aumentaram, e a Cinética Química deixou de ser a disciplina mais difícil nas avaliações intermediárias e finais.

Conclusões: A implementação do sistema de tarefas didáticas relacionadas à vida cotidiana e a situações profissionais levou a um aumento na aprendizagem de Química. Isso foi evidenciado pela comparação dos resultados da prova pedagógica inicial com a prova final, e nos permitiu verificar a viabilidade e a relevância desse sistema de tarefas.

Palavras-chave: Aprendizagem; Cinética Química; Educação Física; tarefas didáticas.

INTRODUCTION

Education and Training (TVET), as an essential part of the Cuban national education system, plays a strategic role in the comprehensive training of future professionals, geared not only towards mastering technical skills but also towards developing a solid scientific and cultural foundation. According to Pérez and González (2019), TVET must integrate vocational training with academic content to guarantee contextualized and socially relevant education, fostering meaningful learning that translates into creative and contextualized application. of knowledge in everyday life and in professional practice (Ausubel, 2002; Novak & Cañas, 2008).

In this context, the School of Physical Education Teachers (EPEF) has the social responsibility of training teachers with pedagogical, scientific, and humanistic preparation, capable of integrating biological, chemical, and pedagogical foundations to respond to current challenges (Ministry of Education of Cuba, 2017; Moreno & López, 2021). However, an analysis of the academic records from the last three years at the EPEF "Manuel Fajardo" in Camagüey reveals low performance in Chemistry, with the highest failure rate and lowest promotion rates among the subjects in the curriculum. The results show that the content of Chemical Kinetics contributes most to these difficulties, accompanied by low student interest and a limited perception of the subject's relevance to their professional development (Clement, 2000; Cardellini, 2012).

This problem reflects a contradiction between the objectives of the Chemistry program, which promote the active and meaningful acquisition of knowledge (Coll, 2004), and the reality of a teaching-learning process with limited connection to the student's professional profile (Talanquer, 2011; Pozo & Gómez Crespo, 2009). In this sense, the teaching task is presented as a methodological resource with the potential to promote contextualization and the integration of knowledge.

In recent literature, Puerta (2023) proposes interdisciplinary teaching tasks for the Agronomy program at the University of Cienfuegos "Carlos Rafael Rodríguez," resulting in 83.3% of students valuing the subject more highly by linking it to their professional profile. Similarly, Mengana, Duany, and Torres (2021) designed a set of tasks related to the comprehensive study of chemical reactions for students entering the Bachelor of Education program, specializing in Chemistry, observing qualitative improvements in their learning and preparation for higher education. For his part, Domingos Ndala (2020) developed a didactic model for systematizing the content of coordination compounds in Inorganic Chemistry, centered on the teaching task as the core of the process and prioritizing experimental and investigative activities, with positive results in professional preparation.

These studies demonstrate that implementing teaching tasks adapted to specific contexts strengthens motivation and learning in university-level chemistry. However**,** no research has been identified that addresses the development and application of teaching tasks in chemical kinetics specifically aimed at the initial training of physical education teachers, which constitutes a gap in the academic literature.

Several methodological proposals support the effectiveness of active and contextualized approaches. Bender (2007) highlights the value of mental analogies for understanding kinetic phenomena; Hernández (2013), Botero (2014), Vargas *et al.* (2020), and Baggio (2021) emphasize the role of information and communication technologies **(** ICTs) as mediators of learning; while López *et al.* (2020), Álvarez (2018), Iniesta and Lirola (2020), and Oliveira (2023) emphasize methodologies such as experiential learning , alignment with the Sustainable Development Goals (SDGs) , and the use of audiovisual resources. These strategies, as noted by Driver *et al.* (1994), not only improve conceptual understanding but also increase motivation and long-term retention.

In response to this scenario, the present study proposes: to develop teaching tasks of Chemical Kinetics that contribute to the learning of Chemistry in students of the EPEF of Camagüey, coherently integrating the scientific content with the demands of the professional training of the future teacher and strengthening the connection between theoretical knowledge and its practical application.

MATERIALS AND METHODS

The research was conducted with a sample of 40 fourth-year students from the EPEF "Manuel Fajardo" in Camagüey, during the 2018–2019 academic year. The main variable of analysis was the learning of the content of Chemical Kinetics within the Chemistry subject.

The dimensions and indicators proposed by Rico Montero and Santos Palma (2002) were used, adjusted to the context of the study:

Dimension 1: Mastery of the content of the Chemical Kinetics unit.

- *Indicator 1A:* Understanding of previous and current content.
- *Indicator 1B:* Evidence of knowledge levels (reproduction and application).

Dimension 2: Reflection on the learning process.

- *Indicator 2A:* Reflection on ways to solve tasks.
- *Indicator 2B:* Self-assessment of performance in tasks.

Dimension 3: Affective-motivational relationship.

- *Indicator 3A:* Effort to fulfill teaching tasks.
- *Indicator 3B:* Emotional satisfaction with the tasks performed.

The instruments used were:

- Initial and final pedagogical test, to measure mastery of knowledge.
- Survey and self-assessment guide to evaluate reflection and motivation.

- Statistical methods, primarily percentage calculation, to analyze the results.

Criteria were established to classify the performance of each indicator (Good, regular, bad) and combinations were defined to evaluate the dimensions and the overall level of learning (very high, high, medium, low, very low).

Taking into account the dimensions and indicators proposed above, the instruments were developed and applied before and after applying the teaching task system.

The instruments consisted of:

Pedagogical test: designed to assess students' current understanding of Chemistry, particularly Chemical Kinetics.

The initial test was designed to assess the prior knowledge required to understand the Chemical Kinetics unit and to explore students' proficiency in applying Chemistry content to their Physical Education teacher training program. The final test It was prepared taking into account the knowledge of Chemical Kinetics that the students had to master for the understanding of the unit and to check the level of application of the knowledge for the career of Physical Education Teacher technician.

In both tests, the student was evaluated as good, fair or poor in dimension one, taking into account the percentage of correct answers: between 80 and 100 (B), between 60 and 79 (R) and less than 60% (M).

The survey and self-assessment guide are applied to the students with the objective of measuring the behavior of dimensions two and three, with their respective indicators.

Mathematical and statistical methods were used to compute the results, mainly percentage calculations and the use of tables to display them.

By combining the results of the assessments achieved by the students in each indicator, the evaluation of each dimension was carried out using the following proposal (Table 1).

Table 1. - *Categories and combinations for the evaluation of indicators*

Evaluation categories of the dimensions	**Possible combinations of the indicators for each student**		
Good	1B2B	1B2R	1R2B
Regular	1B2M	1M2B	1R2R
Evil	1R2M	1M2R	1M2M

Example: if in dimension 1 the student was evaluated as good in indicator 1 and as bad in indicator 2, it corresponds to this combination 1B2M, therefore, it is evaluated as fair in that dimension.

To classify the learning level of each student, the possible combinations in the evaluations of the dimensions were taken into account, resulting in the following proposal (Table 2).

Table 2. *Categories and combinations for level assessment*

Learning level categories	**Evaluation of the dimensions**
Very high	B in all three
High	Two B's and one R'
Half	One B and two R's or three R's
Low	Two R's and one M
Very low	One R and two M's or three M's

For the dimension 1:

Indicator 1A

Category of good (BDC), since it masters the knowledge.

Regular category (RDC), since he/she has mastered some of the knowledge.

Category of evil (MDC), does not master the preceding knowledge for the solution of the exercises proposed in the diagnostics.

Indicator 1B

Good: Evidence, levels of knowledge, reproduction and application in the solution of the proposed exercises.

Regular: Evidence: the level of knowledge reproduction and, in some cases, the level of knowledge application for carrying out the proposed exercises.

Bad: it does not demonstrate the different levels of knowledge required to complete the proposed exercises.

By integrating indicators 1A and 1B of dimension 1, the classifications are:

High level category (NADC): since they master the background content and demonstrate the levels of reproduction and application of knowledge in solving the exercises proposed in the diagnostics.

Intermediate level (NMDC), since they master some of the background content and demonstrate the level of knowledge reproduction and in some cases the level of knowledge application in solving the exercises proposed in the diagnostics.

Low level category (NBDC) in dimension one, since they do not master the background content and do not demonstrate the levels of knowledge in solving the exercises proposed in the diagnostics.

For dimension 2:

Indicator 2A

Good: they reflect on the paths that lead to the solution of the proposed exercises.

Regular: they do not always reflect on the paths that lead to the solution of the proposed exercises.

Bad: they almost never reflect on the paths that lead to the solution of the proposed exercises.

Indicator 2B

Good: choose the option "systematically"

Regular: choose the "sometimes" option

Wrong: Choose the option "almost never"

By integrating indicators 2A and 2B of dimension 2, the rankings are:

Category of good (NARR) in dimension two, since they always or almost always reflect on the ways and value the progress of the execution of the teaching tasks carried out by them and their colleagues.

Regular category (NMRR), since they do not always reflect on the paths that lead to the correct solution of the teaching task and sometimes make assessments of the progress of the execution of the teaching tasks carried out by them and by their colleagues.

Category of bad (NBRR), since they almost never reflect on the paths that lead to the correct solution of the teaching task nor do they make assessments of the progress of the execution of the teaching tasks carried out by them and by their colleagues.

For dimension 3.

Indicator 3A.

Category B (BECT), they always strive to meet the demands of the teaching task of the subject Chemistry.

Regular category (RECT), sometimes they strive to meet the demands of the teaching task of the subject Chemistry.

Category of bad (MECT), they almost never make the effort to meet the demands of the teaching task of the subject Chemistry.

Indicator 3B

Category of good (BSET), when they feel satisfaction in the solution of the teaching task of the subject Chemistry.

Regular category (RSET), since they feel regular satisfaction in solving the teaching task of the subject Chemistry.

Category bad (MSET), students are not satisfied with the solution to the teaching task of the subject Chemistry.

By integrating indicators 3A and 3B of dimension three, the rankings are:

High level (NAEAM) in affective-motivational disposition: students make an effort and feel satisfaction in completing the Chemistry course assignment. Medium level category (NMEAM): students make a moderate effort and sometimes feel satisfied in completing the Chemistry course assignment.

Low level category (NBEAM) in dimension three, since students almost never make an effort, nor are they satisfied with the performance of the teaching task of the subject Chemistry.

By integrating the three dimensions into the diagnoses, each student's learning level is classified as follows:

Very high level ((NADC) (NARR) (NAEAM) (MA)) because it has a high level in all three dimensions,

High level ((NMDC) (NARR) (NAEAD), (NADC) (NMRR) (NAEAD), (NADC) (NARR) (NMEAD) (A)), because it has a medium level, in one of the three dimensions.

Medium level ((NMDC)(NMRR)(NAEAM)(M)), because it has a medium level in two dimensions and a high level in the remaining dimension.

Low level ((NMDC) (NBRR) (NBEAM) (B)), because it has two dimensions with a low level and has a very low level because all three dimensions are evaluated as very low ((NBDC) (NBRR) (NBEAM) (MB)).

RESULTS AND DISCUSSION

The results of the initial pedagogical test are shown in Table 1 below (Table 1).

Table 3. *- Percentage of students by evaluation categories in each indicator according to the results of the initial pedagogical test, survey and initial self* **-** *assessment guide*

Dimension and indicator	% Good	% Regular	% Bad
Dimension 1. Indicator 1st	10	27.5	62.5
Dimension 1. Indicator 1B	10	27.5	62.5
Dimension 2. Indicator 2nd	15	20	65
Dimension 2. Indicator 2B	15	30	80
Dimension 3. Indicator 3A	15	22.5	62.5
Dimension 3. Indicator 3B	55	25	20

Source: *results, pedagogical test,* initial *self-assessment survey and guide*

The results of the research techniques and methods reveal that the students of the EPEF "Manuel Fajardo" in Camagüey, present deficiencies in the learning of the subject Chemistry, since most do not master the preceding content for the understanding of the unit of Chemical Kinetics, they do not demonstrate the levels of knowledge of reproduction and application in the solution of the exercises proposed in the initial diagnosis, they almost never make evaluations about the execution of the teaching tasks of themselves and their classmates, they almost never reflect in relation to the paths that lead to the correct solution of the teaching task, they almost never strive to meet the demands of the teaching task of the subject Chemistry and they are not satisfied with the completion of the teaching task of the subject Chemistry.

System of teaching tasks for Chemical Kinetics

The task system is related to the content of Unit 3, "Chemical Kinetics," of the fourth-year Chemistry program at the Manuel Fajardo School of Physical Education in Camagüey. It consists of 22 teaching tasks, classified into four groups, and were designed taking into account the operations necessary for developing the skill of explaining how the surface area of the reacting substances, the concentration of the reacting substances, the temperature, and the catalysts influence the rate of chemical reactions under different reaction conditions.

Each task involves three fundamental stages: motivational and orientation stage, execution stage, and evaluation stage.

The motivational and orientation stage is an essential element, creating a positive disposition in the student towards cognitive activity, awakening interest in the knowledge of Chemical Kinetics, the chemical reactions that occur in everyday life, in the environment where the athlete lives and develops, the conditions under which sports training takes place, and its relationship to the subject of Anatomy and Physiology, allowing the student to learn and value what they learn. To achieve student motivation, the following questions were used in the development of the unit.

What chemical reactions occur during physical exercise or in our daily lives? How can we connect the content of Chemistry and Anatomy? What substances are used in sports? How does the variation in the rate of chemical reactions manifest itself in everyday life? What does Kinetics study? What are the kinetic factors that determine the rate of chemical reactions? How can we relate the kinetic factors that determine the rate of chemical reactions to the metabolic processes that occur in the body? How do kinetic factors influence the metabolic processes of an athlete? At what points during sports practice do kinetic factors manifest themselves? What other processes in daily life are related to the content of Kinetics?

In the execution phase, the student applies the procedures or strategies outlined in the guidance. The student performs appropriately ordered actions within the following steps: determining the solution path, implementing the solution (carrying out the actions and operations), verifying the solution to the learning task, and self-evaluating and self-monitoring the actions performed by the student and their peers. The self-evaluation and learning monitoring guide should be used.

Students are advised to use the following questions for self-assessment in each task: Did I perform the operations in a logical order? Which operations did I perform correctly? Which ones did I not perform well? What should I do to improve them? How do I self-assess the execution process? How do my classmates and the teacher assess the execution process of the teaching task?

In the evaluation and control stage, the procedures used and the products obtained are monitored to make the necessary adjustments and corrections. The student monitors their progress using the guide to evaluate their learning, taking into account the steps for each group of learning tasks. This allows them to determine if their results are approaching expectations and, if not, to take the appropriate corrective and modification actions.

The teacher should discuss with the students the mistakes they are making. Those who perform best are encouraged, those who are less successful are motivated to continue trying, and their progress is monitored in the observation log.

In summary, this evaluation and control stage allows for constant monitoring of students' learning progress in terms of acquiring knowledge related to the subject matter, while also alerting the teacher to make the necessary changes to methods and procedures in order to plan, organize, and execute other teaching tasks.

Below are some examples of teaching tasks for each group.

Group 1: This group is designed to build upon students' prior knowledge of Chemical Kinetics and is of low complexity. Students will be at a basic level of understanding. These learning tasks will integrate skills such as: describing the qualitative information of chemical reactions, classifying chemical reactions according to their energy level, identifying reactants and products, and writing a diagram of chemical reactions using terminology. Mastery of this content is essential for students to understand the tasks in the other groups.

Tasks for group 1:

1. Define the following concepts: chemical reaction, chemical equation, reactants and products, exothermic chemical reaction, endothermic chemical reaction, and metabolism. Then, create a concept map.

1.1 Give an example of the relationship that exists between the concepts: chemical reaction and metabolism.

2. Observe the following representations:

to)$2\,Mg\,(s)\,+\,O2\,(g)\,=\,2\,Mg\,O\,(s)$

b)$H_2O(s)\,=\,H_2O(l)\,=\,H_2O(g)$

2.1 Which of these does not correspond to a chemical reaction? Why?

2.2 Identify the reactants and products in the chemical equation.

2.3 What do gymnasts and other athletes use the substance produced by the chemical reaction shown for? Is the production of magnesium oxide important for athletes?

Group 2: This lesson is designed to build upon the basic concepts of the Chemical Kinetics unit, and the student's level of understanding is one of reproduction . These learning tasks are used to help students master the unit's concepts for application in more complex learning tasks. The skill to be developed is: defining the concepts of chemical reaction rate, chemical reaction mechanism, catalyst, catalysis, and inhibitor.

Group 2 Tasks

Objective: to define the concepts: reaction rate, reaction mechanism, catalyst, inhibitor and catalysis.

8. Plot the concentration versus reaction time graph:

$$2\,H2\,(g)\;+\;O2\,(g)\;=\;2\,H2O\,(g)\;\Delta H0 < 0$$

8.1 What function does the substance obtained in the reaction have for the human body?

12. Define the concept of catalysis.

a) What are the general characteristics of a catalyst?

b) In the Encarta Encyclopedia, read the article: Chemical Reactions: Energy vs. Reaction Progress Diagrams for Catalyzed and Uncatalyzed Processes . Compare the activation energy values of both processes and explain the differences.

c) Investigate three metabolic processes in the human body in which enzymes act as catalysts.

Group 3: It is designed based on the skill of identifying the factors that influence the rate of chemical reactions . These teaching tasks are used to allow students to interact directly with the knowledge of the Chemical Kinetics unit, fostering meaningful learning.

Group 3 tasks

Objective: To identify the factors that influence the reaction rate based on the conditions of the chemical reaction in order to understand phenomena in everyday life and the profession.

13. Meat is one of the main foods that an athlete should consume in their diet.

a) What is the main nutrient in this food?

b) What kinetic factors are involved in achieving good digestion of this food? How do these factors influence the rate of the chemical reaction?

c) Explain the importance of this nutrient from a kinetic point of view for the athlete.

15. Altitude training is intended for high-performance athletes.

a) What is the objective of this type of training?

b) Compare the characteristics of altitude training and training in low-altitude areas in terms of the amount of dioxygen at the alveolar level.

c) In which of these training sessions does the aerobic respiration process occur most rapidly? What kinetic factor determines the rate of the chemical reaction?

Group 4: This group is based on the skill of explaining the influence of factors on the rate of chemical reactions. It comprises the most complex group of tasks. The learning activities designed to consolidate this unit aim to have students practice, apply, systematize, and generalize the unit's knowledge, taking into account a systemic view of all the material studied and integrating it with previous units.

Group 4 tasks

Objective: To explain how the factors of contact surface, concentration of reacting substances, temperature and catalyst influence the rate of chemical reactions from different reaction conditions for the understanding of phenomena in everyday life and the profession.

17. After consuming protein-rich meals, should we preferably drink water or acidic juices? Why?

a) Give examples of acidic fruits whose juice promotes the process of protein digestion.

18. Taking into account the metabolism of carbohydrates (hydrolysis of sucrose) and proteins, answer the following:

a) These metabolic processes occur in the digestive system.

b) Compare the kinetic conditions under which these metabolic processes occur.

c) Which of these digestive processes occurs fastest? Why?

21. I read the article "Photosynthesis" in the Encarta Encyclopedia. Then answer the following:

a) What type of organism carries out this process? Where does it occur?

b) How many steps does the reaction mechanism have, and what are the names of each step? Represent the overall equation of the process.

c) What are the kinetic conditions for this process to occur? Explain the occurrence of this process from a kinetic point of view.

The results of the final diagnosis are presented in Table 2.

Table 4. *- Percentage of students by evaluation categories in each indicator of the final* ***diagnosis***

Dimension and indicator	% Good	% Regular	% Bad
Dimension 1. Indicator 1st	40	40	20
Dimension 1. Indicator 1B	40	40	20
Dimension 2. Indicator 2nd	45	35	20
Dimension 2. Indicator 2B	40	30	30
Dimension 3. Indicator 3A	50	25	25
Dimension 3. Indicator 3B	55	25	20

Source *: final diagnosis, self-assessment guide and survey*

Through the implementation of the teaching assignment system in Chemistry classes, it was observed that the number of students participating spontaneously increased, and greater motivation for the subject was evident. A sampling of the results from partial quizzes and final exams revealed that the question related to Chemical Kinetics content was not the most influential factor in the quality of academic performance. A review of the documents in the general secretariat confirmed that the Chemistry course saw a decrease in the number of failing students and an improvement in the quality of the graduating class of the fourth year at the EPEF “Manuel Fajardo” in the province of Camagüey (Table 4).

The students' performance during the implementation of the learning task system was systematically evaluated through observation of their acquired knowledge, reflection, self-assessment, effort, and satisfaction with completing the tasks. This allowed for demonstrating the quality of their achievement of the stated objectives. The students indicated that completing the learning tasks provided an appropriate opportunity for dialogue, reflection, evaluation, and self-assessment of their learning in the Chemistry course. They were pleased to learn about the relevance of Chemical Kinetics to their profession and its connection to other subjects within their specialization.

The results of the research techniques and methods show improvements in student learning of the content of Chemical Kinetics, which is evidence that indicates the positive influence of the teaching task system implemented and the results are shown in the comparative table (Table 5).

Table 5. *- Comparison of the results of the variable in the initial and final diagnoses*

Levels of learning	**Diagnosis**	
	Initial	**End**
Very high level (MA)	10%	40%
High level (A)	5%	5%
Intermediate level (M)	20%	22.5%
Low level (B)	2.5%	7.5%
Very low level (MB)	62%	25%

Source *: results of the integration of the three dimensions.*

CONCLUSIONS

The initial diagnosis showed that the fourth-year students of the EPEF "Manuel Fajardo" in Camagüey had a low level of prior knowledge for understanding Chemical Kinetics, which was reflected in the fact that only a minority reached the very high level of learning.

The system of teaching tasks designed to promote the learning of Chemical Kinetics in these students facilitated the linking of Chemistry content with other subjects of the specialty and with their future professional practice, also promoting reflection and self-regulation during the teaching-learning process.

The implementation of the teaching task system in practice produced positive results, evidenced by a 30-percentage point increase in the number of students who reached the very high level of learning, compared to the results of the initial diagnosis.

BIBLIOGRAPHIC REFERENCES

Álvarez, M. (2018). Innovación educativa y enseñanza de la química: Retos y oportunidades. *Revista Eureka sobre Enseñanza y Divulgación de las Ciencias, 15*(1), 1101–1113. https://doi.org/10.25267/Rev_Eureka_ensen_divulg_cienc.2018.v15.i1.1101

Ausubel, D. P. (2002). *Adquisición y retención del conocimiento*. Paidós. https://dialnet.unirioja.es/servlet/libro?codigo=30372

Baggio, R. (2021). Uso de recursos tecnológicos para la enseñanza de la cinética química. *Educación Química, 32*(3), 245–253. https://doi.org/10.22201/fq.18708404e.2021.3.79025

Bender, C. (2007). Analogías y modelos mentales en la enseñanza de la química. *Revista de Enseñanza de la Física, 20*(1), 45–54.

Botero, C. (2014). Integración de TIC en la enseñanza de la química: Estudio de caso. *Educación Química, 25*(1), 42–49. https://doi.org/10.1016/S0187-893X(14)70536-2

Cardellini, L. (2012). Problem solving in chemistry education: Background, theory and practice. *Chemistry Education Research and Practice, 13*(3), 193–206. https://doi.org/10.1039/C2RP90004A

Clement, J. (2000). Model-based learning as a key research area for science education. *International Journal of Science Education, 22*(9), 1041–1053. https://doi.org/10.1080/095006900416901

Coll, C. (2004). *Psicología de la educación*. Paidós.

Domingos Ndala. (2020). Modelo didáctico de sistematización del contenido compuestos de coordinación de la química inorgánica para los estudiantes de la Licenciatura en la Enseñanza de la Química. *Revista Cubana de Educación Superior, 39*(1), 97–111. https://dialnet.unirioja.es/servlet/articulo?codigo=10319221

Driver, R., Asoko, H., Leach, J., Mortimer, E., & Scott, P. (1994). Constructing scientific knowledge in the classroom. *Educational Researcher, 23*(7), 5–12. https://doi.org/10.3102/0013189X023007005

Hernández, J. (2013). Aplicación de recursos TIC en la enseñanza de la cinética química. *Revista Electrónica de Enseñanza de las Ciencias, 12*(1), 150–169.

Iniesta, A., & Lirola, M. (2020). Experiencias innovadoras en la enseñanza de la química. *Revista de Educación en Ciencias, 21*(2), 85–96. https://doi.org/10.11144/Javeriana.revc21.eiec

López, A., Torres, M., & García, P. (2020). Recursos audiovisuales como estrategia para la enseñanza de la química. *Enseñanza de las Ciencias, 38*(1), 113–128. https://doi.org/10.5565/rev/ensciencias.2844

Mengana, L., Duany, N., & Torres, M. (2021). Conjunto de tareas docentes relacionadas con el estudio integral de las reacciones químicas para elevar el aprendizaje de los estudiantes del colegio universitario en el ingreso a la carrera Licenciatura en Educación, Química. *Revista Educación y Sociedad, 19*(2), 45–59.

Ministerio de Educación de Cuba. (2017). *Programa de la Educación Técnica y Profesional*. La Habana: MINED.

Moreno, E., & López, J. (2021). Competencias profesionales en la formación del educador físico. *Revista Iberoamericana de Educación, 86*(2), 155–171. https://doi.org/10.35362/rie8624258

Novak, J. D., & Cañas, A. J. (2008). The theory underlying concept maps and how to construct and use them. *Technical Report IHMC CmapTools 2006-01 Rev 2008*. Florida Institute for Human and Machine Cognition.

Oliveira, F. (2023). Sustainable chemistry education and kinetics teaching. *Journal of Chemical Education, 100*(5), 2178–2187. https://doi.org/10.1021/acs.jchemed.2c00967

Pérez, L., & González, M. (2019). Integración curricular y formación profesional en la ETP cubana. *Revista Cubana de Educación Superior, 38*(1), 67–80.

Pozo, J. I., & Gómez Crespo, M. A. (2009). *Aprender y enseñar ciencia: Del conocimiento cotidiano al conocimiento científico*. Morata.

Puerta, L. (2023). Tareas docentes con enfoque interdisciplinario para la disciplina Química de la carrera de Agronomía. *Revista Científica Universidad de Cienfuegos, 15*(3), 55–68. https://revistamapa.org/index.php/es/article/view/359/537

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15*(2), 4–14. https://doi.org/10.3102/0013189X015002004

Talanquer, V. (2011). Macro, submicro, and symbolic: The many faces of the chemistry "triplet". *International Journal of Science Education, 33*(2), 179–195. https://doi.org/10.1080/09500690903386435

Vargas, C., Hernández, R., & Martínez, L. (2020). TIC y aprendizaje significativo en química. *Revista Educación Química, 31*(4), 328–335. https://doi.org/10.22201/fq.18708404e.2020.4.76294

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The authors have participated in the writing of the work and analysis of the documents.