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Tareas docentes con carácter desarrollador en la formación de profesionales
Developmental teaching tasks in the training of professionals.

Sucel Garcés Llauger[1]
Loida Bonet Avilés[1]
Dolores Isabel Garcés Llauger[2]
[1]Universidad de Granma. Cuba
[2]Hospital Carlos Manuel de Céspedes. Cuba
ORCID: https://orcid.org/0000-0003-4229-0555
https://orcid.org/0000-0001-9875-2224
https://orcid.org/0000-0001-7242-7853
Correo(s) electrónico(s):
sgarcesl@udg.co.cu
lboneta@udg.co.cu
dali@infomed.sld.cu

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Resumen: Los estudiantes que matriculan la carrera presentan pobre solidez en conocimientos y habilidades de los contenidos químicos precedentes, lo que evidencia un problema en su proceso formativo y la necesidad de cambio de posición del docente respecto a la planificación, orientación, ejecución y control de la tarea docente. Por tal razón, el propósito de la investigación es proponer tareas docentes con carácter desarrollador en la asignatura Química General para el primer año de Ingeniería Mecánica. Se aplicaron métodos del nivel teórico y del nivel empírico que permitieron constatar la pertinencia de las tareas docentes propuestas para su formación integral.

Palabras clave: Plan de Estudios; Didáctica; Tarea docente; Ingeniería Mecánica.

Abstract: The students who enroll in the course present poor solidity in knowledge and skills of the previous chemical contents, which evidences a problem in their formative process and the need for a change in the teacher's position regarding planning, orientation, execution and control of the teaching task. For this reason, the purpose of the research is to propose teaching tasks with a developmental character in the subject General Chemistry for the first year of Mechanical Engineering. Theoretical and empirical methods were applied to verify the relevance of the proposed teaching tasks for their integral formation.

Keywords: Curriculum; Didactics; Teaching task; Mechanical Engineering.

Introduction

Nowadays, the training of professionals in Technical Science careers requires a teaching-learning process that involves students in the solution of teaching tasks so that they are able to learn by doing, according to the accelerated development of science, which demands the training of men in correspondence with individual, political, economic, social and cultural needs and who are also bearers of moral and

professional values in accordance with the transformations that occur according to the perspective of developing a comprehensive general culture in society as a whole.

In this sense, the continuous improvement of the training of professionals takes into consideration the needs stated by the social, technical and economic development of the country in the historical context of the time in which it is framed. That is why the need arises to develop a new Curriculum for the training of the Cuban mechanical engineer, which has a set of general professional skills that allow him/her to achieve a comprehensive cultural and educational training in the broadest sense of these terms, expressed in the Model of the Professional of this career (Ministry of Higher Education, 2018).

For the achievement of this task, the teaching-learning process should consider the teacher as a mediator who fosters the conditions to achieve developmental learning, considers the integration between individual and collective potentialities, the leading role of the student and reveals as a determining characteristic the cognitive-affective, instructive-educational integration, psychological and pedagogical requirements essential for efficient learning. In this way, logical, critical, reflective and self-regulated thinking is developed in students.

In recent years, research has been carried out referring to teaching-learning with a developmental character, in this sense, the work carried out by Labadi, López and Gainza (2016) on student protagonism and the role it plays in the professional pedagogical process in Technical and Vocational Education stands out, demonstrating that the existing potentialities in the students themselves become educational resources for this to occur. Álvarez, Pérez and Durand (2016) made important contributions to favor the research performance of professionals in training. These researchers have analyzed the relevance of considering the work of the teacher as preferably guiding, facilitating, leading to the development of communication, self-learning and critical thinking skills in the student, in order to make him/her an agent of his/her own training and development for social life.

However, in spite of the progress made in the theoretical-methodological order to achieve a developmental teaching-learning process, it is considered that in the first year of the Mechanical Engineering course there are insufficiencies in the learning of

the General Chemistry subject, which leads to a change in the teacher's position regarding the planning, orientation, execution and control of the teaching task to be developed during the independent work. This proposal is particularly important to increase their capacity for permanent self-preparation to face the work context in a creative and transforming way.

The application of the diagnostic study allowed analyzing the following insufficiencies in the teaching-learning process: poor command of knowledge and skills of the students who enroll in the course to face the assimilation of new knowledge; little solidity and durability of the chemical contents.

The above led to the development of the research with the aim of proposing teaching tasks with a developmental character in the subject General Chemistry for the first year of Mechanical Engineering, from the analysis of the theoretical and methodological foundations that support it to contribute to its integral formation.

Development

The Cultural Historical Approach represented by Vigotski constitutes the foundations for the execution of the developmental teaching-learning process, gives particular importance to the role of human activity and considers that it transcends the social environment. Learning is considered as a social activity and not only a process of individual realization, as had been held so far: an activity of production and reproduction of knowledge, through which assimilates social modes of action and interaction (Vigotski, 1998).

His contributions reflect an interest in the study of the way in which social interaction leads to higher psychological functioning, characterized by conscious realization and voluntary control by the subject. According to this author "the preponderant role that society plays in human behavior is manifested in the existence of psychological tools or signs, which can be used to control one's own activity and that of others" (Vigotski, 1998, p.45).

In this sense, the active person is placed at the center of attention, in his interaction with other individuals, with his beliefs and with the object, elements necessary to make possible the transformations within him, that is, his psychic and physical

modifications. The student is conceived as an intelligent social agent immersed in natural, familiar and daily environments, where he develops mediation processes with other peers.

In this regard, studies carried out by the authors allow us to affirm that the effects of this interaction and communication have implications in their development, and thus a conscious learning is conceived, where the learner is able to express through words, not only what he learned, but also how and why he learned it. Knowledge also transcends into knowing how to do, know how to act, know how to live together and know how to be.

From this point of view, it is necessary to take into account that the life of the young person takes place in a complex educational process, of social character, with the intervention of various factors (family, educational institution, society) aimed at the transmission and assimilation of social values as an expression of progressive tendencies orienting their actions. Such considerations, from the point of view of Didactics, have an influence on the methodological order of the teaching-learning process.

As a starting theoretical position, in the methodological order for a developmental Didactics in the teaching of General Chemistry, the one exposed by Zilberstein and Olmedo (2015) is taken.

> Developmental Didactics assumes that school education is the process that organizes, develops and systematizes the teaching institution, in correspondence with the family and the rest of society, in order to ensure that students appropriate the teaching content and as such, the historical and social experience accumulated by humanity, as well as the modes of creative activity, and that leads, if properly structured, to their instruction, learning, development and training. (p.67).

The position expressed in the previous paragraph, in the opinion of the authors of this research, makes it possible to ensure that Didactics is developmental to the extent that teaching enhances the integral development of the student, immersed in an active and

creative learning, which makes possible the fulfillment of the objectives established in the Professional's Model.

In this order, it is necessary to start from the definition of developmental teaching-learning process

> It constitutes the essential mediating channel for the appropriation of knowledge, skills, norms of emotional relationships, behavior and values, bequeathed by humanity, which are expressed in the teaching content, in close connection with the rest of the teaching and extracurricular activities carried out by the students. (Silvestre and Zilberstein, 2002, p. 46).

An exhaustive analysis was carried out on this definition and the tendency is to consider this interactive and reflective process, which favors the development of an integral personality. It refers to fundamental elements such as appropriation, which includes the most diverse forms and resources through which university students make knowledge, attitudes and values their own, in a climate that favors activity and constant communication as an essential way for their integral formation.

The research included methods proper to pedagogical research, among which we distinguish between theoretical and empirical methods.

Hypothetical-deductive: to unify the scientific knowledge hierarchizing the principles, laws and concepts, from logical deductions that contributed to the integral formation of the students of the mechanical engineering career.

Analysis - synthesis: it was used in the analysis of the theoretical aspects that made it possible to form the referential theoretical framework and arrive at the conclusions, that is to say, in the transit through the whole process of scientific research.

Systemic structural functional: to argue the system of relationships between the components of the teaching-learning process that propitiate the developmental character, for the active application in the subject General Chemistry and the realization of the teaching tasks in the independent work.

Observation: to verify the inadequacies during the teaching-learning process of General Chemistry and its dynamics in the Mechanical Engineering course.

In the preparation of the subject, it should be analyzed how it can contribute to the formation of students and encourage interest in it, both through the determination of objectives, contents, methods and evaluation that favor the development of qualities, convictions, points of view and positive attitudes.

With significant influence on the way of acting of the mechanical engineer, the teaching tasks stated start from a problematic situation related to the future profession, including current issues such as environmental protection, energy and material saving, mechanical drawing, use of information and communication technologies, issues that stimulate creative activity, develop interest and satisfaction for research, problem solving, capable of creating a culture of exchange, debate and argumentation of their points of view.

The subject General Chemistry is part of the Chemistry discipline for the first year of the Mechanical Engineering course, it contributes to the formation of the mechanical engineer's mode of action through the logic of science, since its object is the study of concepts, laws, theories related to the structure of substances, their transformations during chemical reactions, it provides basic knowledge about substances related to the future profession, allowing him/her to interpret processes and operations in direct relation with the subject and with other disciplines of the course.

In the analytical program for Syllabus D, the contents of the subject are distributed in five topics during 80 hours/classes: Topic 1. Phase equilibrium. Topic 3. Thermodynamics and Chemical Kinetics. Topic 4. Chemical Equilibrium. Topic 5. Oxidation-reduction reactions (Ministry of Higher Education, 2007).

The proposal of Curriculum E from the course 2019- 2020 conceives the subject in the first year, second period, with 64 and 32 hours/classes for the daytime and meeting courses respectively, the contents related to Phase Equilibrium are eliminated, this allows teaching Thermodynamics and Chemical Kinetics in separate subjects (Ministry of Higher Education, 2018).

Thus emerges the contradiction between the time allocated for the treatment of the contents in the proposed program and the low preparation in knowledge and skills of the students who enroll the career, which reveals the need for the change of position of

the teacher regarding the conception, demands and organization of the teaching task in the orientation of independent work.

Teaching task

The teaching task as a didactic action for the conduction and acquisition of knowledge has been defined in different ways in specialized texts. Its importance is treated from different angles by several authors

> The teaching task is the action that is developed under certain conditions (...) it is the action of the teacher and the students within the process that is carried out in certain pedagogical circumstances in order to achieve an elementary objective: to solve problems stated by the teacher (Alvarez, 1999, p.101). (Alvarez, 1999, p.101).

For their part, Zilberstein and Olmedo (2014), state that "teaching tasks are those activities that are oriented for the student to perform in class or outside of it, they involve the search for and acquisition of knowledge, the development of skills and the integral formation of their personality" (p. 54).

In this conceptual analysis, the definition provided by Segovia, Pinos and Murillo (2017) should be considered when they express that.

> The teaching task is conceived as the basic unit; it expresses the dialectical relationship in the teaching-learning process and constitutes an alternative for the development of knowledge and professional attitudes. It should have a theoretical position that responds to the scientific and pertinent education, in response to the demand in the integrative approach of the Professional Model established by the Curriculum for the formation of human resources. (p.75)

The above definitions lead to think that the teaching task is aimed at a developmental learning in students, an orientation towards the general objectives of the subject from the structuring of the contents according to the logic of this science. It also reorients the use of time during the teaching activity, favors an adequate balance between individual and group work, develops skills in the search for updated scientific information, levels of assistance and discussion of results. At the same time, it

develops a set of learning strategies that enable the assimilation of knowledge, skills and values essential to the integral formation of the future professional.

Another argument of great value is given by the following authors, when they define

> The teaching task with a developmental character as a problemic learning situation of increasing level of complexity, sustained in the integral diagnosis as a tool for the potential development of the student, based on a well-planned, organized, oriented, executed and controlled strategy; which expresses the dialectical unity between the objective and the method; instrumented in the self-regulation of actions, procedures, and study operations to learn to learn, in the discovery of the objective truth as a meaning for the development of the student's personality under the direction of the teacher. (Pascual, Campos and Machado, 2018, p.5)

It is fully agreed with these authors because the teaching task with a developmental character should promote the formation of the future professional from active methods that lead to the assimilation of the contents from the reproductive to the creative level and conceived from the Didactics of General Chemistry. In the conditions of implementation of Curriculum E, these acquire great importance, where under the direction and guidance of the teacher, the student self-manages his knowledge in a responsible, critical and reflective way, in which the following precisions are relevant:

To orient the bibliography, which includes texts in English and digital texts.

Study the main concepts, criteria and theories used to identify the type of bond, the properties of substances according to the type of bond and structure they present, specifying the page and the solved exercises.

To guide the questions and problems to be solved, which will be delivered in written form.

Solve the exercises proposed in the MOODLE Platform Questionnaire.

Perform an internet search related to the contents worked on during the course, for example, environmental pollution caused by chemical substances of interest to the mechanical engineer, which will be used in the laboratory corresponding to each topic and in their future profession.

The following are examples of developmental teaching tasks that will be oriented to the students at the beginning of the period and solved as part of the independent work, with the possibility of evacuating their doubts in the systematic consultations carried out at this stage.

Teaching task No. 1

Objetives: To develop the spatial imagination in a direct graphic way, with an engineering approach, with elementary knowledge of the main technical norms of graphic representation. Consolidate and increase the dialectical-materialistic conception of the world from the comprehension of the contemporary physical picture, with special emphasis on the dialectical unity between object, property and measure. To identify, describe and interpret the oxidation-reduction processes from the electrode potentials in different electrochemical processes.

Contents: Knowledge of Mechanical Drawing. Technical requirements. Fluid mechanics. Oxidation and reduction reactions.

Evaluation: A presentation is made individually with the auxiliary materials that facilitate its development (plates, tables, graphs, others). The final mark will take into account the quality of the report and its delivery on the date oriented, exposition and defense.

In an industry it is required to build a tank for the storage of sulfuric acid whose dimensions are: 4 m diameter and 5 m high.

a) Draw the shape and dimensions of the tank and its accessories according to the general theory of projections using current standards.

b) What measuring instrument do you use to determine the temperature and pressure to which the fluid in the tank is submitted? What scale do you suggest for it? Describe the sources of error that influence the measurements to be made.

c) Specify what material you suggest to build the tank. Justify your answer.

d) Explain which corrosion control and metal protection method you apply in this case.

e) Relate the economic, human and ecological losses as a consequence of the corrosive process in this installation.

f) Explain, in English language, the benefits for the mechanical engineer of the knowledge of corrosion and the methods for its control.

g) Hand in a written answer to each one of the previous items.

h) Make the presentation in slides for the exposition of the work.

The necessary data are available in the basic text of the subject.

Possible solution: The contents of General Chemistry addressed in items c), d) and e) correspond to the prediction of the spontaneity of redox reactions and the corrosion process, corresponding to the content of oxidation-reduction reactions. Item a) is related to the subject Mechanical Drawing, b) to Physics. In the case of items f), g) and h), they provide outlets for the prioritized curricular strategies, in the first case for the correct use of the mother tongue, in the second for the learning of the English language and the last for the use of information and communication technologies.

Teaching task No. 2

Objectives: To consolidate and broaden the dialectical-materialistic conception of the world from the understanding of the contemporary physical picture, with special emphasis on the role of concepts, laws and theories in the knowledge of the object. To interpret chemical reactions according to their thermodynamic aspects.

Contents: Kinetic-molecular theory of substances. Laws of Thermodynamics.

Evaluation: A presentation is made individually with the auxiliary materials that facilitate its development (plates, tables, graphs, others). The final mark will take into account the quality of the report and its delivery on the date oriented, exposition and defense.

In the boiler of an educational institution, domestically produced fuel oil (liquid fuel) is burned to generate steam, which is used for cooking food. For this type of fuel, carbon, hydrogen and sulfur are the main elements of the combustion process and, depending on the amount of oxygen, combustion is complete or incomplete; it is known that the temperature in the furnace is 1273 K (1000ºC).

a) State the complete combustion reactions of C(s), H2 (g) and S(s).

b) State the incomplete combustion reaction of C(s) and compare the ΔHºf values of both reactions (complete and incomplete combustion). Tell which of the two you would choose to perform the combustion process.

(c) Calculate the change in free energy of formation for the H2O (g) formation reaction considering the data in the table. Tell whether or not the process is spontaneous at that temperature under normal conditions.

d) How do the combustion gases affect the environment?

The necessary data are available in the basic text of the subject.

Possible solution: The General Chemistry contents addressed are the approach and adjustment of complete and incomplete combustion reactions, concepts of enthalpies of formation and combustion, calculation of thermodynamic parameters and their mathematical relationship, as well as the thermodynamic spontaneity criterion and finally the affectations produced by combustion gases to the environment. Items a) and b) are related to Materials Science, the latter must take into account the economic criterion to select the complete combustion reaction of carbon, which is the one that releases the most energy. All the items are related to the subject Thermodynamics. Teaching Task No. 3

Objectives: To contribute to scientific rigor in the analysis and solution of problems based on the application of concepts, laws and principles that support the subject in its contribution to the areas of action defined in the Professional's Model, the use of Information and Communication Technologies (ICT) as well as economic and environmental training strategies to achieve an adequate integration between academic, labor and research activities.

Contents: Structure of substances. Oxidation reduction reactions.

Evaluation: The final grade considers the delivery of the manuscript, exposition and defense.

Mechanical installations are frequently affected by corrosion, which implies the oxidation of the metal. If the corrosion process of iron takes place by the direct action of an acid on it, according to the following chemical equation: Fe(s) + 2HCl (ac) → FeCl2 (ac) + H2 (g)

As an engineer who is a member of the team that organizes, executes and controls the maintenance process of such facilities, the following tasks are oriented to you:

Explain the economic importance of iron. To do so, make an abstract of the following documents with their respective links, accessible on the Internet.

- Importance of iron. https://www.importancia.org/hierro.php

- Why does the world keep its eyes on gold and China on iron?

https://www.oinkoink.com.mx/noticias/economia/hierro-importancia-economica-para-china/

- Monograph on the importance of iron in the Venezuelan economy.

https://www.monografias.com/docs/Importancia-Del-Hierro-En-La-Economia-De-P38BDZGFCDU2Y

a) Could this be considered an oxidation - reduction process? If yes, represent the equation of the reaction; identify the species oxidizing agent and reducing agent.

b) Perform an internet search to answer the following questions:

- What corrosion control and metal protection methods do you suggest in this case?
- What are the benefits to the mechanical engineer of knowledge of the corrosion process and control methods?

It is suggested to use the Google Scholar browser, according to the search criteria: corrosion and corrosion control methods.

c) List the industrial applications of hydrochloric acid and its effects on the environment and human health.

In order to answer this aspect, we suggest accessing the following links and others that you consider appropriate:

- https://www.chemicalsafetyfacts.org/es/acido-clorhidrico/
- https://es.wikipedia.org/wiki/%C3%81cido_clorh%C3%ADdrico

Possible solution: The contents of General Chemistry addressed are the structure of substances, identification of oxidation reduction reactions and aspects related to the corrosion of metals. In addition, the applications of a chemical substance with which the mechanical engineer is related and the effects produced by it on the environment and human health. Item a) refers to the curricular strategy of economic training, b) and c) to the oxidation-reduction reactions and d) to the environmental strategy. All the items are related to the training process through the use of ICTs and the achievement of an adequate integration between academic, work and research activities.

The results show that a contribution was made to the developmental learning of General Chemistry, since the students show knowledge of procedures aimed at the reflective analysis of the conditions of the teaching tasks and the search for ways to solve them, as well as individual and group evaluation actions, leading to learning to do. In addition, they passed through different levels of assimilation according to the objectives of the analytical program; they appropriated the contents by adequately establishing the relationship between the structure property application of substances and the thermodynamic, kinetic and equilibrium aspects in chemical transformations, in their relationship with other disciplines of the academic year. The integral development of the student's personality was promoted, since the love for this science, protection of the environment in close relation with the formation of feelings and motivations was fostered; the unity between the cognitive and the affective in the development and personal growth was guaranteed; the transit towards self-regulation of learning was promoted, as well as the development of the capacity to know, control and creatively transform their environment.

Conclusions

There are different contributions of the teaching task from the Developmental Didactics; however, new analyses are needed in order to improve the teaching-learning process of General Chemistry so as to ensure the formation of a culturally integral professional.

The teaching task with a developmental character requires an increasing level of complexity, based on properly planned, oriented, executed and controlled actions, which lead to learning to do, with the mediating and irreplaceable role of the teacher.

Bibliographic references

Álvarez, V.M.; Pérez, D. A. y Durand, R. R. (2016). Metodología para la formación de competencia investigativa en los estudiantes de la Universidad de Guantánamo. *EduSol, 16* (55), pp.38-53. https://dialnet.unirioja.es/servlet/articulo?codigo=5678499

Álvarez, Z. C. (1999). *Didáctica. La escuela en la vida.* Pueblo y Educación.

Labadi, D. E.; López, S. I. y Gainza, G. M. (2016). Modelo pedagógico para propiciar el protagonismo estudiantil en la Educación Técnica y Profesional. *EduSol, 16* (56), 118-127. https://dialnet.unirioja.es/servlet/articulo?codigo=5678391

Ministerio de Educación Superior. (2007). *Plan de Estudios D y Modelo del Profesional del ingeniero mecánico.* Comisión Nacional de la Carrera de Ingeniería Mecánica. La Habana.

Ministerio de Educación Superior. (2018). *Plan de Estudios E y Modelo del Profesional del ingeniero mecánico.* Comisión Nacional de la Carrera de Ingeniería Mecánica. La Habana.

Pascual, Y. R.; Campos R. L. y Machado V. D. (2018). Concepción didáctica de la tarea docente desarrolladora. *Revista Electrónica de Formación y Calidad Educativa (REFCaIE),* *6*(1), pp.1-15. http://refcale.uleam.edu.ec/index.php/refcale/article/view/1310/1440

Segovia, P. P.; Pinos, R. P. y Murillo, S. I. (2017). Tareas docentes sobre contenidos de Anatomía del Aparato Estomatognático de la carrera de Odontología. *Universidad y Sociedad,* *9*(1), pp.74-80. http://scielo.sld.cu/pdf/rus/v9n1/rus10117.pdf

Silvestre, O. M. y Zilberstein, T. J. (2002). *Hacia una didáctica desarrolladora*. Pueblo y Educación.

Vigotski, L. (1998). *Pensamiento y Lenguaje*. Pueblo y Educación.

Zilberstein, T. J. y Olmedo, C. S. (2015). Didáctica desarrolladora: posición desde el enfoque histórico cultural. *Educação e Filosofia Uberlândia*, *29* (57), pp. 61–93. http://hdl.handle.net/20.500.12424/3857945

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