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ORIGINAL ARTICLES

Relations of the didactic model of the teaching-learning process regarding the software design with a project approach

Relaciones del modelo didáctico del proceso de enseñanza-aprendizaje del diseño de software con método proyecto

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ABSTRACT

Introduction: technological advances and the process of computerization in the health sector, have led to the need to train capable professionals developing tools and applications where Health Information Systems studies play an essential role, however, its graduates, present insufficiencies for the practice of its contents.
Objective: to determine the components and relationships of a didactic model based on the use of the project method, which improves the teaching-learning process of software design related to databases, from the subject Software Engineering and Management, at Pinar del Río University of Medical Sciences.
Methods: the research followed the general dialectical-materialistic methodological approach, which allowed the use of theoretical methods such as analysis and synthesis, induction and deduction, system approach and modeling.

Results: it was possible to determine the relationships in the didactic model that contributes to the theory from its essential components and forms of relation that enrich the Didactics of Informatics from the proposal of new stages and for the development of the process under study, which integrate the stages of the project method and the software design.
Conclusions: the application of this model gives to this process a systemic, integrating, sequenced and contextualized nature.
MeSH: SOFTWARE DESIGN; SOFTWARE; COMPUTER-AIDED DESIGN; RESEARCH DESIGN; TEACHING; LEARNING.

RESUMEN

Introducción: los avances tecnológicos y el proceso de informatización en el sector de la salud, han propiciado la necesidad de formar profesionales capaces de desarrollar herramientas y aplicaciones en lo que la carrera Sistemas de Información en Salud juega un papel esencial, sin embargo, sus egresados, manifiestan insuficiencias para la práctica de sus contenidos.
Objetivo: determinar los componentes y relaciones de un modelo didáctico sustentado en la utilización del método de proyecto, que perfeccione el proceso de enseñanza-aprendizaje del diseño de software relacionados con bases de datos, desde la asignatura Ingeniería y Gestión de Software, en la Universidad de Ciencias Médicas de Pinar del Río.
Métodos: la investigación siguió el enfoque metodológico general dialéctico-materialista, que permitió utilizar métodos teóricos tales como análisis y síntesis, inducción y deducción, el enfoque de sistema y la modelación.
Resultados: se logró determinar las relaciones en el modelo didáctico que contribuye a la teoría desde sus componentes esenciales y formas de relación que enriquecen la Didáctica de la Informática a partir de la propuesta de nuevas etapas para el desarrollo del proceso que se estudia, que integran las etapas del método de proyecto y del diseño de software.
Conclusiones: la aplicación de este modelo le confiere a este proceso un carácter sistémico, integrador, secuenciado y contextualizado.
DeCS: DISEÑO DE PROGRAMAS INFORMÁTICOS; PROGRAMAS INFORMÁTICOS; DISEÑO ASISTIDO POR COMPUTADOR; PROYECTOS DE INVESTIGACIÓN; ENSEÑANZA; APRENDIZAJE.

INTRODUCTION

After several changes in the educational system of Cuban higher medical education, in 2010 started the university studies of Health Information Systems (HIS), with the training of future professionals in the profiles of Medical Records and Health Statistics, Scientific Information and Librarianship, Security and Health Informatics.[1]

The development of tools and applications for the HIS and Information and Communication Technologies is required within the scope of the Health Information Security and Informatics profile, defined in the model of the graduate in Health Information Systems.[1]

In the development of these tools and applications, as well as in the training of this professional, the subject of Computer Science is of vital importance and within it, the subject Software Engineering and Management. A subject that should contribute to the training of students based on the content associated with the management of software projects, which guides and motivates participants to perform satisfactorily, the design of tools and applications that will be implemented in the course Programming and Database Managers, which succeed

this in disciplines, hence the importance given to software design in the training of this professional.

In the observation made by the authors to the teaching-learning process of the software design in the subject Software Engineering and Management, of the studies of HIS at Pinar del Rio University of Medical Sciences, it was evidenced that the software designs made by the students do not always respond to the problems identified in the area of health that require solution by the use of computer. The relationships that must be established among the subjects are insufficient, which guarantee the starting level and continuity to the software design and in the use of the methods of the project, the actions that are developed do not promote a didactic strategy for the teaching-learning process of software design.

These weaknesses show the existence of a contradiction between the reality reflected in the theoretical-practical limitations that affect the Teaching and Learning Process (TLP) of software design related to databases and the need to train a professional who will be capable of creating tools and applications that contribute to the process of computerization of the health sector.

The confirmed contradiction allowed establishing as an objective of this research: to determine the components and relationships of a didactic model, sustained in the use of the project method that improves the teaching-learning process of software design related to databases, from the subject Software Engineering and Management, at Pinar del Rio University of Medical Sciences.

METHODS

A group of research methods, procedures and techniques, based on the theory of Fiallo, Cerezal and Hedesa, are used to carry out this research. [2] Theoretical methods (analysis and synthesis) were applied to reach the specific and general knowledge of the components of the TLP in the subject Software Engineering and Management associated with software design in the profession HIS, defining the essential elements that make it up, as well as the existing links between them and their more general characteristics.

Induction and deduction methods were applied, for the study of theoretical references, and the collection of empirical material to establish the general conclusions, which allowed the development of the didactical model, and then in the process of empirical validation to achieve the inferences obtained.

The system approach, for the purpose of the components and their links, the structure and hierarchical and functional relationships of the didactic model elaborated for the TLP of the software design related to databases from the subject Software Engineering and Management.

The modeling allowed representing the characteristics and fundamental relations of the object to obtain as result the didactic model.

RESULTS

Relationship of the didactic model regarding the professional to be trained, professional problem of the subject and solution of the problems of the area of health by means of computer science (Fig. 1)

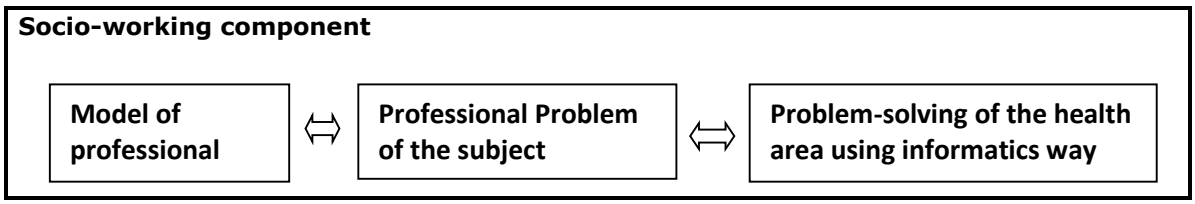

Fig. 1 Socio working component

For Butler J, [3] the best problems are those that come from the student's personal or professional experience of real situations or the one that reflects a real situation. For Guadarrama and his collaborators, practical activity is unthinkable without the social need, interests, ends, means and conditions that serve as premises.[4]

Hence it can be said that every problem is a necessity. In the case of the areas of health, it is a social need, according to the interests of the institution in which the students will be inserted once they graduated, to prepare them to give solution to these problems, it is the best way to project them to the society, these problems must become the professional problems and at the same time in inconveniences to be defined and to solved.

Relationship between the organization, didactics and methodology of software design and technology (Fig. 2)

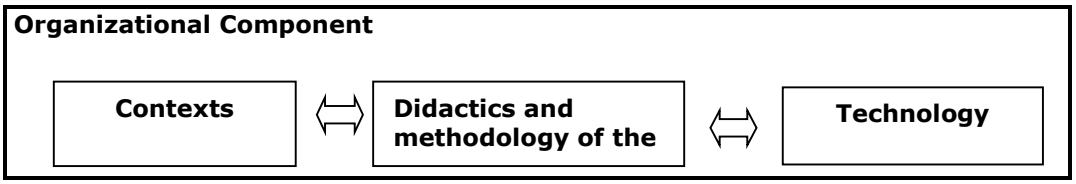

Fig.2 Organizational Component

In order to organize the TLP of software design, related to databases through the use of the project method, it is necessary to take into account the different training contexts of these students, by placing them not only in the analysis of the problem that is solved in the classroom (class), but in the health area in which they accomplish their work practice and identify the problem to know the functionalities to be defined in its design, according to the interests of users, customers and suppliers, so that plays a very important role to the group of students in the health area (work practice) and hours of independent work, which under the supervision of the tutor are completed.

In order for the TLP of the software design related to databases with the use of the project method to be developed with the quality required in each of these contexts, the correct planning and implementation of the didactic categories must be taken into account, along with the methodology for their teaching.

One of these didactic categories to be taken into account is the teaching media, in which technology plays an important role since students need to make frequent use of technologies to support the projects. These requirements include basic tools: word processors, spreadsheets, electronic presentations, databases for the search of scientific information and software for plotting and drawing.

Relationship between the stages of software design and its didactic categories (Fig. 3)

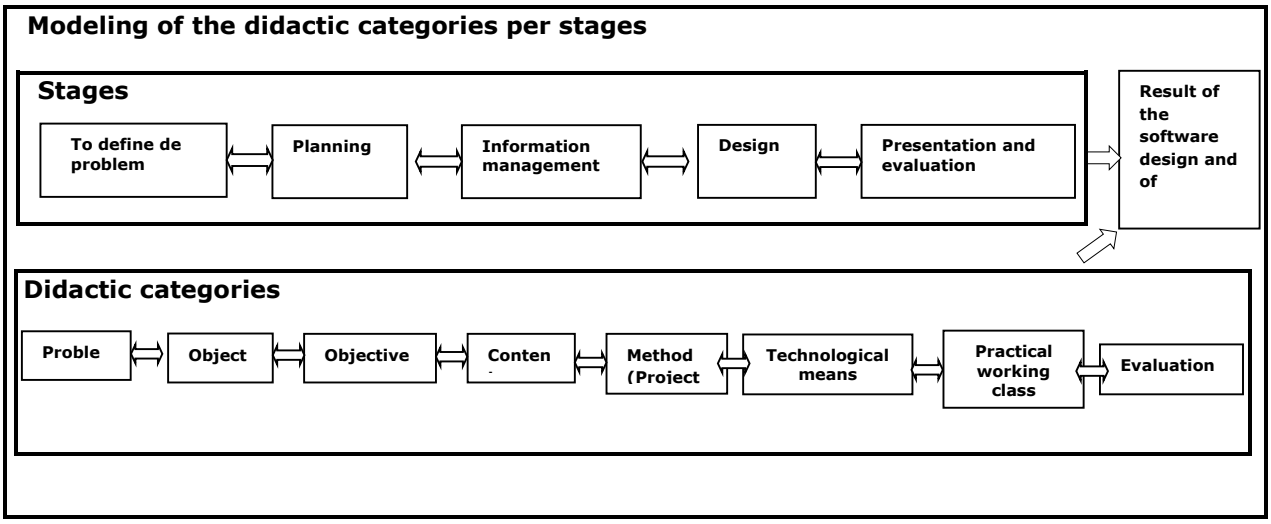

Fig.3 modeling of the didactic categories per stages

In order to structure the TLP from database-related software design to the use of the project method, the stages of project development and software design must be integrated.(5)

If these stages are taken into account and if the student is taken as the protagonist of his/her own learning, or he/she participates in the selection phase of the problem being investigated, the group of stages and tasks to be carried out by a student when designing software related to databases using the project method is considered in the following ways:

1. Define the problem

- Identification of the problem: the students, taking into account the problem bank of each health area, make a selection of the group of problems that can be solved by computer.

- The possible problems to be solved are analyzed in the classroom by the whole group.

- The most suitable ones are selected, considering that they can only develop those projects to which a database or a website is designed, because these are the contents they will study in the subsequent semesters of the studies and will allow them to implement the project that they will carry out.

- The problems are assigned to the student teams.

2. Planning stage

- Define the objective of the project.

- Determine performance specifications: list of criteria or quality standards that the project must meet.

- Elaborate the guidelines or instructions to develop the project. They include the project design guide, short-term goals and duration.

-List of project participants and their assigned roles: team members, experts, community members, staff of the educational institution.

- Prepare the work plan according to the division of work among the members of the group.

3. Information management

The students gather the necessary information for the resolution of the problem or task. For this purpose, they make use of different sources of information.

4. Design or implementation stage

- Elaborate the business model: Business Use Case Diagram (BC), Description of the BC, BC Activity Diagram, and Business Objects Diagram.

- Elaborate the model of use cases of the system: CU System Diagram, CU Description, Prototype, and Additional Requirements.

- Define requirements: functional and non-functional requirements.

- Perform the analysis and design as planned: define the relationship between the main structural elements of the software, transform the model of the information domain created in the analysis into the data structures necessary for the implementation of the software, transform the structural elements of the software architecture into a procedural description of the software components, design algorithms, design human-machine interfaces to facilitate the user's use of the system.

5. **Presentation and evaluation of the design**

- The completed work is presented in the established form. Usually, the whole class participates and together with the professors, offers a constructive feedback.

- Students analyze their products, presentations or final interpretations, rely on the feedback received evaluating the results.

- The professor reflects on the project: what work is well-structured and which of them needs to be improved for the next time in the classroom.

Several experts in the project method, among them Villalobos, [4] Peralta, [6] Jarillo, [7] Marín, [8] agreed that the elaboration of the problem is a "critical" and "central" factor for the success of this method. It is therefore the central axis around which the entire TLP revolves.

According to Butler J, [3] it is usual problems to be selected by the professors, although in some cases they are also chosen by students. In the TLP of software design related to databases, the problem must be identified by the students in the health areas, although the professors involved in this teaching task must already have made a previous diagnosis of these problems and their analysis in the collective of the subject, year and study. The complexity of each problem chosen must be taken into account, since its correct solution depends on it, given that, if the problem is too complex, then it has too many components, saturates the working memory and makes its solution impossible; on the contrary, if it is too simple it will not stimulate the student, on the contrary will become demotivated. [2]

The object according to Álvarez C.: [9] "is the part of reality that bears the problem in which the need to prepare or overcome workers or professionals to participate in the solution of the problem is manifested, which is solved immersed in the process of formation of the citizen".

In the TLP being studied, it is identified as the design of software related to databases. The objectives express the purposes and aspirations, they must respond gradually to the objectives of the subject and the model of the professional to be achieved, having as central axis the design of software for the improvement of the management of the information of the systems to be computerized.[9]

It is important to highlight the relationship established between problem-object-objective in the TLP being researched, since it is presented as an expression of the content of the first law of didactics, which recognizes the problem as the starting point in the process of professional training, from which an object of study is defined, whose state is transformed with the fulfillment of the objective, it expresses the purposes and aspirations to conform in the way of thinking, feeling and acting of the students, indicated in cognitive, procedural and evaluative terms that the dimension the content deserves.(9)

The contents vary according to the stage in which it is worked, which are specified in the relationship between the stages through which the TLP of software design and its didactic categories and in the description of the categories for each of the stages.

The project method will prevail, as a method to be used, although this is put into practice in close relationship with the problems, in addition to methodological approaches and other didactic procedures.

Another important relationship to highlight is the one established between objective-content-method in the TLP of software design. The content, methods and the rest of the didactic components of the process are subordinated to the objective as the guiding component, but it is the method that determines the set of actions to be followed by the professor and the student, for the acquirement of the contents, expressed in the objective of the process.

As material resources, they offer potentialities to direct attention, perception and understanding of what is essential and significant, based on stimulating curiosity, interest in knowledge, and volitional and strategic involvement in teaching and learning tasks and actions. These play an important role in the development of this subject, both for the orientation and execution of tasks as well as for their presentation, where they are not only limited to the use of office automation but also to the use of the virtual classroom in the moodle platform, multimedia, forums, videos, projects of other courses that can be studied as examples, among others. [9, 10]

Lectures and education at work are the forms of organization of the teaching-learning process that will prevail according to the contexts of formation. In the classroom, lectures, practical classes and workshops should be used, depending on the complexity of the contents.

Evaluation is the way to verify the fulfillment of the objective. As TLP, based on the use of the project method, seeks both learning and the development of the autonomous learning capacity of students, it is important to take into account evaluation as a process and as a result. Evaluation takes place throughout the whole process.

What is evaluated? Evaluation should go beyond the measure of the reproduction of knowledge, since traditional tests are not suitable forms of learning that refer to problem solving. It is therefore necessary for evaluation to increase the use of various types of

elements for the solution of which students have to interpret, analyze, evaluate problems and explain their arguments.

How is it evaluated? The multiple purposes of the project method result in the need for a variety of assessment procedures that reflect the objectives pursued in their entirety. Therefore, practical tests, concept maps, peer evaluation, tutor evaluation, oral presentations, and written reports are used.

Who evaluates? Everyone involved. The professor, the inter and intra-disciplinary collective, the collective of workers and the tutor on the one hand, with the participation in the group, the involvement in the resolution of the problems, the work developed and the results obtained in the course of the task; they evaluate the group work. But also the students and the group, as they carry out their own self-evaluation process (of their contribution to the work of the group, of their involvement and taking responsibilities). Similarly, the expert (collective of workers and collective of inter and intra-disciplinary professors), during and at the end of the project, to assess their intervention and the value of their contribution to the group, as well as the results obtained by the student.

There are various results to be achieved in solving problems through the development of a project. A clear example of this is defined by the group of authors who follow the project method, when they state that there is important evidence when it shows that the use of the project method improves very important aspects of the teaching-learning process with respect to the traditional teaching such as: [10, 11, 12]

- The development of self-study skills.

- The acquisition of a general didactic strategy of problem solving through the solution of specific problems within a discipline.

- A better selection and more frequent use of learning materials (books, photocopies, internet, etc.), with greater independence.

- It allows for in-depth learning and, in particular, better understanding, integration and use of what have been learnt.

- It helps to develop not only intellectual, but also social, personal and affective skills that have a positive impact on performance.

- Familiarizes and involves the student in situations of their professional practice.

- Knowledge is given as much importance as acquisition processes.

- It promotes a more strategic processing and retention of information in the mid and long term.

- Through the practice in problem solving, promotion of the ability to solve problems is achieved and above all, it stimulates an active attitude towards searching and inquiry.

- Due to its multidisciplinary character, it allows the integration of knowledge from different disciplinary fields.

- Independence of the student.

- The habitual work that the student must carry out autonomously from the beginning (although supported and guided by tutors and professors) leads the student to learn how to learn.

- Learning social and personal skills by working in small groups.

- Increases student motivation

In order to be able to develop this TLP of software design, related to databases with the successful use of the project method, the participants of the process must be taken into account as a fundamental guide for the training of the student.

Relationship between the collective of professors, the collective of students/group and the tutor/workers' collective (Fig. 4)

It also happens with the tutor and the rest of the employees of the department, which not only take into account those of the department of Informatics, responsible for advising on issues concerning the methodology to apply for the development of the project or the best ways to model the different graphical interfaces to be proposed by the student but also the group of departments in which they work with the models to be computerized, as these are the specialists in this type of activities and therefore those who can best clarify the doubts associated with the functionalities, information flow, among others.

The professor must maintain a constant communication with each of these people and in addition:

To make a previous selection of the projects that can be developed by the students and to have an idea of their solution to be able to value effort and time to invest on their part.

Plan the objectives of the subject in such a way that they pay tribute to the objectives of the discipline and the model of the professional.

Use problem-solving methods based on real, significant problems, with reasonable levels of complexity, which serve as a model in the search and application of effective didactic strategy for software design.

Encourage teamwork as a way to encourage unity, collaboration and assessments about the activity they perform.

Use study guides, video tutorials, multimedia and other teaching media as a way of motivating the instruction.

Lectures and education in the workplace should prevail as a type of teaching organization, although it should not fail to give some lectures, practical classes and workshops, because these will serve to introduce tools, methods and the demonstration of the use of those tools that the student does not know and that can be somewhat difficult to learn from the beginning, in a self-taught way.

To create an atmosphere of trust, security and empathy in the classroom, so that students can select and implement their own solution paths.

Provide help in a timely, necessary, and individual way according to the situation of each subject.

To make use of the error for educational purposes, along with the modeling procedures which favor the analysis of the data computerized.

Master the stages of software design and its specificities.

Must know the evolution shown by each group in the resolution of the project and the degree of involvement of each student (not all students learn equally and in the same way).

Evaluate systematically, partially and finally, through self-evaluation, co-evaluation and hetero-evaluation, according to the fulfillment of the objectives.

Contribute to the education in moral and esthetic values in the students in a non-formal way.

The project is not viable for just one person and requires teamwork, in a cooperative way. The planning of teaching must pay attention to the diversity of ways and styles for learning to solve problems, based on the specificity of individual, collective and cooperative learning. For each type of learning, the appropriate time and space should be taken into account. (12)

When taking into account the above-mentioned elements, it is evident that this didactic model provides the following main qualities: the interaction between its members, which propitiates a constant and dynamic communication that allows the acquisition of knowledge and the development of skills, abilities, values and attitudes already described in the explanation of the relations between the components of the didactic model.

CONCLUSIONS

The components and relationships of a didactic model were determined, based on the use of the project method that perfects the teaching-learning process of software design related to databases, from the subject Software Engineering and Management, at Pinar del Río University of Medical Sciences.

It was expressed, through its three fundamental relations and the systemic articulation of the components that integrate it: the identification of problems from the health areas for their didactic management in classes, the organization of the use of technologies according to the contexts in which the students are trained and the determination of the stages of software design related to databases, with the use of the project method through the integration of the project stages and those of software design, in addition to a didactic strategy structured in actions that allows its practical instrumentation.

Conflict of Interest

The authors state that there is no conflict of interest.

Authors' contribution

The authors contributed equally to the design of the study.

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