

***La orientación vocacional en la Enseñanza Media
Superior vista desde un sistema informático experto
Vocational guidance in Higher Secondary Education seen
from an expert computer system***

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Resumen: El presente trabajo tiene como objetivo mejorar el proceso de orientación vocacional para estudiantes de la duodécima clase del Colegio Maravilla de Benguela mediante un sistema experto basado en modelos. Para el desarrollo de la investigación se utilizaron los métodos hipotéticos- deductivo, modelación y sistémico, y del nivel empírico la entrevista y la observación. La aplicación fue desarrollada utilizando el lenguaje de programación Prolog y el gestor de bases de datos MySQL. Para la validación se utilizó la experimentación. Como resultado se obtuvo un sistema experto con un 97.51% de confiabilidad que permitirá brindar apoyo a la orientación vocacional.

Palabras clave: Sistema informático; Sistema experto; Orientación vocacional; Prolog

Abstract: This paper aims to improve the vocational guidance process for students of the twelfth class of the Maravilla College of Benguela through an expert system based on models. For the development of the investigation, the hypothetical-deductive, modeling and systemic methods were used, and at the empirical level the interview and observation. The application was developed using the Prolog programming language and the MySQL database manager. For the validation, the experimentation was used. As a result, an expert system with 97.51% reliability was obtained that will allow support to vocational guidance

Keywords: Computer system; Expert system; Vocational orientation; Prolog

Introduction

Vocational and professional guidance is addressed as a process that aims to help people acquire and develop knowledge, skills and attitudes aimed at designing an individual career project in which all life roles are integrated, mainly the study and work (Gilbert & Rader, 2001).

In the context of High School education in Angola, in the vocational guidance process the school psychologist plays an important role. The job of this is to guide students, first, through a group of psychological tests to determine the occupation that best suits each one.

Many authors consider that considering the complexity of vocational guidance; this should not be summarized as a simple test. In an interview conducted by the Angop newspaper to the psychologist and professor at the Agostinho Neto University in Angola, Carlinhos Zassala, he defends the need for the creation of projects aimed at strengthening professional guidance in third-level schools for adolescents in order to reduce the rates of disapproval and improve their performance in order to contribute to their vocations. (Zassala, 2005)

Considering the importance given to this process, researchers from the Higher Polytechnic Institute of Huila studied how it is being developed in the secondary education system in the province of Benguela. The case of study is taken by the Maravilla School, a private institution of secondary education that has been active in the country since 2004 teaching the courses of Physical and Biological Sciences, Human Sciences, and Economic and Legal Sciences.

In visits to the institution it was found that the school psychologist does not have enough time to complete the vocational guidance task, there is no department of support for vocational guidance, in addition to the lack of a specialist to carry out This process.

The interview with a group of 50 students and the institution's pedagogical director showed that 90% of the students do not know what vocational guidance is and its importance and 70% are not sure of the courses they intend to follow in the College. Given the previous situation, the following problem was raised for the present work: how to improve the vocational guidance process at the Maravilla de Benguela School?

To solve this problem, ideas such as the incorporation of a vocational guidance subject in the curriculum taught, or adopt a mechanism to support vocational guidance that allows consultation for their students mainly in two moments: in the 9th grade of schooling, before entering the Secondary School, and in the 12th grade of schooling, before entering the University.

This research aims to support the vocational guidance process for students of the 12th class of the Maravilla de Benguela School, obtaining accuracy and speed in diagnosis. The results obtained from the incorporation of an expert computer system based on model are shown as a tool to support vocational guidance at the Maravilla de Benguela School.

Development

Vocational guidance was developed in the world since the 19th century and has been carried out in several ways, according to the social and employment situation, and according to the different conceptual visions about the human being (Flores, 2013). Vocational guidance is a set of practices aimed at clarifying the vocational problem. It is a preventive work whose objective is to provide the necessary elements to enable the best orientation for each student. It can take place individually or collectively (in groups), once it includes activities linked to both personal exploration and the analysis of realities through information on the academic offer and the particularities of the labor market.

In general, the recipients of vocational guidance are adolescents who are going to complete their secondary and upper secondary education, especially those who are undecided about the choice of the area to follow in the next stage of study.

It is important to emphasize that the vocational search is a personal task where each individual must be the protagonist, even with the necessary resources to favor and enrich that search. In this sense, we must bear in mind that the vocation is not something that is innate once it develops in the plane of action, knowledge and coexistence. By acquiring various experiences consciously and unconsciously, the subject is convinced that he can choose for himself.

Professionals (psychologists, as a rule) who provide assistance in vocational guidance should discover the uniqueness of each person and accompany their decision, not forgetting that the task implies a responsibility for both parties. Research on personal history, tastes, preferences, and attitudes are key elements during the process.

The school towards vocational guidance

The school has a really important role in the life of a person, it is where the first notions of professional education begin and it is because of it that the opinions themselves are formed in order to make decisions. This preparation is also the role of the school along the school trajectory: the transition from Basic Education to Higher Education.

In this sense, school institutions can offer support and vocational guidance through various services and activities: psychological support, talks with professionals, career workshops, vocational guidance projects, visits to companies in different areas. In addition, the school needs to offer support mechanisms for parents, for example, to demonstrate that a non-traditional profession is not synonymous with failure. Family support at that time is essential.

Teachers towards vocational guidance

Secondary school teachers play a fundamental role in determining the professional choice of students, so it is important that they promote: knowledge about the possibilities in Higher Education and different institutions, come into contact with students and professionals already trained in the courses of interest, and investigate the various areas of action

In the institution used as a case study, vocational guidance is carried out in three ways:

- Through the observation of students 'grades where teachers observe their students' grades and in accordance with the notes, they advise students for a specific area. Normally the areas in which the student always has high marks are advised.
- Through the dialogue that teachers have with their students; The teacher while working in his activity talks with the students about what they like, about their interests and about the labor market with the aim of awakening interests in their choices.
- Through some subjects that serve as vocational guidance for certain courses. For each course there are subjects that normally the institution calls keys, these are considered orientation subjects, which mean that if a student attends a certain course and has good results in the key subjects of this course, he will be guided in following areas in which these subjects are part.

Test of identification of vocational and professional interests

A tool used by the school psychologist to diagnose the interests of the students and then to continue the orientation process based on these results is the application of psychological tests. The psychological test to be addressed in this work was prepared by the psychologists Malca de Goldenberg and Magali Merchán. It focuses on measuring the interests of students and is based on a work methodology that associates that dimension to an area of professional interest.

The test consists of two indicators: I am interested, or not interested, with 80 questions distributed in five areas of professional interest that are linked to a list of professions, so that, when examining a person based on their answers, You can identify the profile of interest according to the model and, consequently, propose the occupational framework in which you will have greater chances of success in achieving your goals and personal fulfillment.

The areas of professional interest of the test are:

- Art and creativity: referring to activities related to design, illustration, music, writing, restoration of pieces and works of art, photography, theater. It is intended for those who like to study harmony and composition.
- Social sciences: refers to activities linked to the life of man in society such as digging to discover remains of the past, organizing events and attending to his assistants, defending individual clients or companies in different types of trials, investigating the causes and effects of disturbances , which is one of the most important in the history of science and social science, enjoy helping people around contributing to their formation, and studying everything that means creation and transformation of the hand of man .
- Economic, administrative and financial: related to activities such as: selection, training and motivation of the team of an organization or company planning goals of a public or private organization in the medium and long term, controlling income and expenditure of

funds and presenting the final balance of the investment of an institution; make proposals and formulate strategies to take advantage of economic relations between two countries; develop campaigns to introduce a new product in the market; supervise the sales of a shopping center; advise people about savings and investment plans, have their own business type businesses; organize a distribution and sale plan for a large warehouse; manage a tourism company and / or travel agencies; research and / or experience new markets; that is to say. It is intended for those who like planning, accounting, and study of the supply and demand of goods and services.

- Science and technology: referring to activities such as the design of computer programs and the exploration of new technological applications for Internet use; solution calculation problems to build a bridge, projection and planning of mass production of articles; development of plans for houses, buildings and cities; research to test new pharmaceutical products; design machines that can simulate human activities; manufacture food products for mass consumption; review and maintain electrical, electronic and computer devices; work in an oil company in a technical position as production control. It is intended for those who like to experience, transform, manipulate anatomical, physiological and chemical elements, and their applications in the industry.

- Ecological, biological and health sciences: related to activities such as elevation, care and treatment of domestic and field animals; research of green areas, environmental and climatic changes experiencing plants (fruits, trees, and flowers); food quality control; animal reproduction research, among others.

After the test is carried out, it is evaluated. The number of questions that were evaluated with the indicator concerned is counted by area of professional interest. In order to know which area of professional interest is appropriate for each student, the one with the best result is chosen (this would be the first option of vocational interest). The areas in which a lower score is obtained will be those with less vocational interest.

The psychological test can be applied to students of the last years of Secondary Education, and of Higher Education (university and higher institutes) of the first years.

Expert system

Artificial Intelligence (AI) emerged in the 50s with the aim of developing systems to perform tasks that are currently better performed by humans than by machines, or do not have a viable algorithmic solution by conventional computing.

Ecoppy (2009) adds that one of the goals in AI is to have a machine that accurately simulates the activities of the human mind. According to this author, it can be divided into three independent research areas: one known for natural language processing, another for the development of intelligent robots, and the third through the development of programs that use symbolic knowledge to simulate the behavior of human experts. The main objective of this last area is to use the knowledge of the experts through a machine that allows storage, sequencing of information and self-learning. These characteristics define an expert system (SE).

The expert systems are generally developed to meet a specific and limited application of human knowledge. They are also able to issue a decision and are flexible for the incorporation of new knowledge to improve their reasoning. They use justified knowledge and information bases such as a human specialist from a certain area of knowledge. From the knowledge incorporated in it, a specialist system can make decisions to provide answers to questions using a decision-making process, or by dividing that process through interactions with the human specialist.

Characteristic of the expert system to support vocational guidance.

The proposed tool consists of an expert model-based system, as part of the solution the battery model of the psychological test proposed by Malca Del Goldenberg and Magali Merchán is computerized to support the process of determining the area of vocational interest of the students.

Next, figures 1 and 2 show system screens.



Figure 1 Student screen

Source: self made

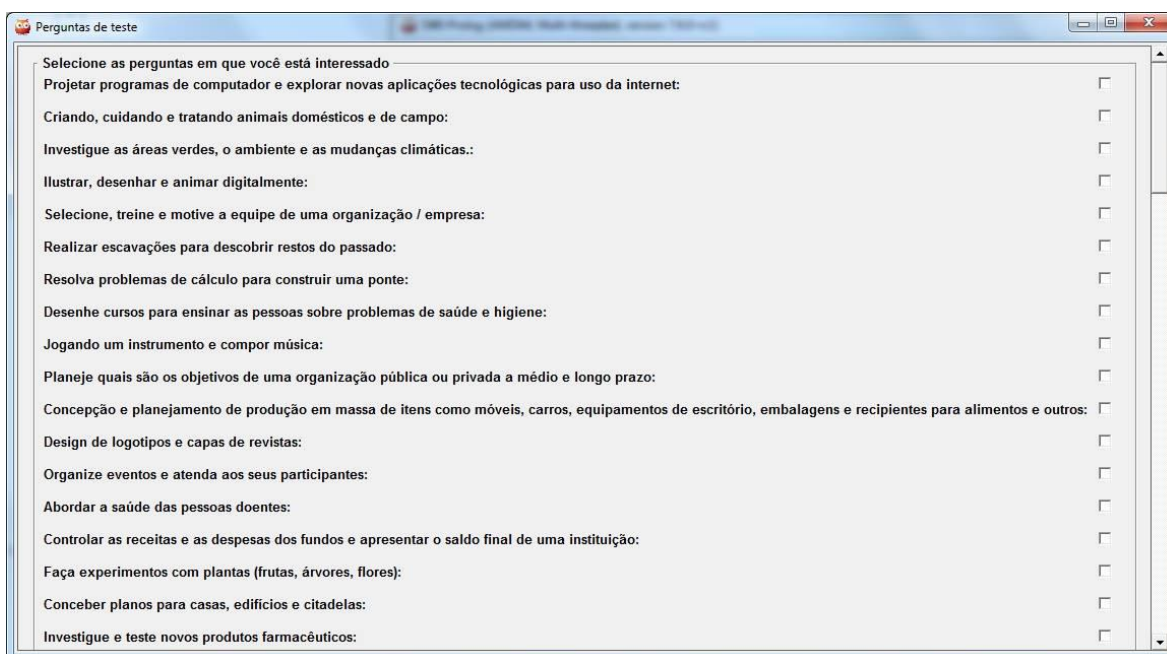


Figure 2 Teste vocational guidance screen

Source: self- elaboration

The proposal is justified in the following aspects:

- The existence of specialists linked to the area of vocational guidance with published works on the subject that were taken as a reference.
- The methods used by specialists to make the diagnosis and determine the vocational interest are not extremely difficult.

- The task belongs to a domain in which the existing knowledge to solve it is precise and well structured.
- The system has the necessary information to provide a diagnosis accurately and quickly.
- In the school where the research is going to be applied, there is no specialist and the cost of hiring is very high, making it an effective way to deal with the problem.

In order to obtain the requirements of the system, the interviews carried out with the pedagogical director and students of the institution, and the instrument proposed by the psychologists mentioned above were taken into account.

RF1 Login

RF2 Manage expert knowledge

RF3 Perform vocational guidance test

RF4 Generate explanations

RF5 Manage User

RF6 Manage universities

RF7 Manage University Careers

RF8 Manage area of interest

RF9 Show report

In addition, the following non-functional requirements are met.

RNF1 - Appearance or external interface: the software provides a friendly interface, conforms to the established standards for the development of a good design, preponderant to the light blue color. It is designed so that the user can navigate the various actions of the system with great ease, all available options are visible.

RNF2 - Usability: the system will guarantee easy and fast access to users so that they do not have difficulty interacting with it, it can be used by anyone who has elementary knowledge in computer operation.

RNF3 - Performance: as the application is designed for a client / server environment, it must be ensured that response times are generally fast or equal to the speed of information processing, as dynamic screens must be generated, implying that access to the database will be fast enough.

RNF4 - Portabilidad: el producto se construye utilizando SWI-Prolog, es una implementación en código abierto del lenguaje de programación Prolog el cual funciona en las plataformas Unix, Windows y Macintosh.

RNF5 - Support: a compiler is required to work with the system for the SWI-Prolog development environment and the MySQL 5 or higher database engine. In addition, a preparation is given to the end users with the explanation of how to use the software.

RNF6 - Hardware: at least one Pentium III processor, at 1.53GHz with 128 Mb of RAM and free 30Mb memory on the hard disk is required to the server.

- RNF7 - Security: the information is protected against unauthorized access using validation mechanisms that can guarantee compliance with this (account, passwords and access level), so that each one can only have available the options related to their activity and have own access data, thus guaranteeing confidentiality. The specialist system is deployed in the vocational guidance support cabinet where students can make inquiries in the sense that they pursue a career at the University. The system is used by two types of user.
- The student user can enter to answer the test, additionally receives information about the universities and careers that exist.
- The expert user has system administrator privileges and will obtain as a result the student's record with the test results, which will facilitate the orientation work to be

performed. As an administrator, he performs the function of enrolling student, university, areas of knowledge and university career.

The system consists of the following modules:

- Knowledge acquisition module: corresponds to the knowledge acquisition stage, the bases of facts and rules will be updated with the information provided by the specialist user
- Vocational guidance test module the student user will answer the psychological test that forms the vocational guidance battery. Your response will be stored in the database for later consultation and preparation of reports that will support the specialist.
- Inference engine analysis module: at this stage the inference engine using the techniques of the computerized model obtains the appropriate solution regarding the area of vocational interest related to the user.
- Explanation generator module: the student showed the result of the test. The file indicates the area of vocational interest where you obtained the most value and the list of professions for that area with your information. For the design of the graphical interface figure 1 the following criteria were taken into account:
 - Visibility: each of the screens must be pleasing to the user's view, it is for this reason that a combination of color family in shades of blue was chosen, obtaining together a user-friendly image.
 - Grouping: the information within the screen is well grouped so that the user can quickly access the information he needs.
 - Symmetry: the screen elements are aligned both horizontally and vertically to maintain harmony in the drawing.
 - Clarity: the functionalities presented to the user are easy to sense and understand in such a way that they are not confused with all the information they are accessing or with the functionality of each section.

- Sequence: the sequence in which the displayed information is arranged allows you to reach to the required option quickly.
- From a functional point of view, the system is defined with a Client / Server architecture in two layers. A first layer with the interface, the knowledge base and the inference engine, and a second layer with the complementary data stored in a database.

Expert System Validation

The system was implemented as an experiment at the Maravilla de Benguela school. It was applied to 12th grade students ranging between 17 and 20 years of age, led by the pedagogical director and the researcher.

The following table shows the information on the characteristics of the students who were part of the experiment.

	Population	Age (years)	Groups	No. of students	
				Beginning	Ending
Vocational orientation	12th grade students of Maravilla de Benguela school	17-20	Control group	25	25
			Experimental group	25	25

Table 1: sample characterization

Source: self-elaboration

To verify whether the application of the test battery in the expert system was correct, a sample of 25 students was evaluated.

Degree of reliability according to the specialist (%)	
Code	Test
002022393BA034	97.6

00365444BA031	97.6
001843382BA034	97.4
005928281BA044	97.6
006368527HO048	97.6
006634081BA046	97.4
007424849HA040	97.6
009254489BA043	97.6
002080306LN039	97.6
005644862LA045	97.4
000052839HO032	97.4
000340398HO033	97.6
003302514KN038	97.4
004621697CA041	97.6
002565048BE030	97.6
006493188LA040	97.6
000140017KN015	97.4
004980028BO044	97.6
000210570HA036	97.6
000495527ME035	97.4
003711254UE032	97.6
00375576KS037	97.6
001124669BA038	97.6
003074169BE036	97.4
002567006HA036	97.4

Apreciación psicóloga	97.51%
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Table 2: Degree of reliability according to specialists

Source: self-elaboration

The results obtained indicate that the degree of reliability of the system's test battery complies with 97.51% reliability, which will allow career options to be more accurate.

The time of delivery of the test and the time of revision by the pedagogical director were also verified.

Indicator	O1(Manual time-seconds)	O2(Expert system seconds time)	Difference-seconds
Test delivery time.	1200	20	1180

Table 3: test delivery time

Source: self-elaboration

Indicator	No. of students	Minutes per test	Total time
Manual Test	25	56	1400
Expert System	25	1	25
Time Earned			1375

Table 4: review time of the test battery manager

Source: self- elaboration

Conclusions

The study of the vocational guidance process for 12th grade students of the Maravilla de Benguela College allowed us to corroborate the existence of inefficiency in this process, and the conditions that justify the implementation of an expert system that supports this process.

The results obtained in the validation of the system showed that the reliability of the developed expert system is 97.51%, based on the average reliability that the pedagogical director attributed according to his experience and affirmed with the sample of 25 students, concluding that the system allows an orientation correct vocational.

The computerization of the psychological test battery manages to reduce the delivery time and evaluation of the diagnosis, the difference in times obtained reveals that the solution allowed reducing the delivery time of the clinical diagnosis from 1400 minutes to 25min by reviewing the psychological test battery. As for the evaluation, there is a time economy of 1375 minutes, equivalent to 23 hours.

The implementation of an expert model-based system that allows students to suggest a specific area of training to enter the university according to their interests, contributes to perfecting the vocational guidance process at the Maravilla de Benguela College.

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