Online-Journals.org

iJOE International Journal of Online and Biomedical Engineering

iJOE | eISSN: 2626-8493 | Vol. 21 No. 8 (2025) | OPEN ACCESS

https://doi.org/10.3991/ijoe.v21i08.54911

PAPER

A New Ontology-Based Recommender System for Academic Guidance in Paramedical Studies

Samira Reguragui[1](✉), Ahmed Bendahmane[1], Abdellatif El Aidi[2], Essaid El Haji[3]

[1]Higher Normal School (ENS), Abdelmalek Essaadi University, Tetuan, Morocco

[2]FLHS Sais-Fez, Sidi Mohamed Ben Abdellah University, Fes, Morocco

[3]Multidisciplinary Faculty of Larache, Abdelmalek Essaadi University, Tetuan, Morocco

samira.reguragui@etu.uae.ac.ma

ABSTRACT

This paper presents NurSHT-RS (Nursing Sciences and Health Techniques-Recommender System). The purpose is to help students choose study options within the paramedical education sector in Morocco. Recognizing the challenges students face due to insufficient knowledge about study specialties and the reliance on subjective advice, NurSHT-RS aims to address the risks of uninformed career decisions. The system leverages machine learning (ML) and ontology techniques to personalize recommendations based on students' academic profiles, demographic data, and physical conditions, including disabilities. The system also incorporates NSHTOri-Onto (Nursing Sciences and Health Techniques Orientation-Ontology), a comprehensive ontology that semantically represents student profiles, paramedical specialties, and training institutions. This ontology not only supports accurate recommendations but also provides reusable and extensible knowledge frameworks for similar applications. NurSHT-RS stands out by offering students detailed and up-to-date information, including study modules, admission criteria, and career opportunities, to ensure informed decision-making. In addition, it could be used by educational advisors, Moroccan students, or foreign students wishing to continue their studies in Morocco.

KEYWORDS

recommender systems (RS), paramedical education, academic guidance, NurSHT-RS, ontology, NSHTOri-Onto

1 INTRODUCTION

The selection of a university major or career field is a difficult task that is laden with anxiety, causing students to become disoriented [1], [2]. The choice of study specialties is a crucial step that has a significant impact on the academic and professional career of students. Indeed, after completing their secondary education, students begin to choose the fields of study and establishments in which they will pursue their higher education. In most cases, students base their decisions on the personal experiences of family and friends. In addition to these subjective decisions,

Reguragui, S., Bendahmane, A., El Aidi, A., El Haji, E. (2025). A New Ontology-Based Recommender System for Academic Guidance in Paramedical Studies. *International Journal of Online and Biomedical Engineering (iJOE)*, 21(8), pp. 104–119. https://doi.org/10.3991/ijoe.v21i08.54911

Article submitted 2025-02-16. Revision uploaded 2025-04-13. Final acceptance 2025-04-13.

which do not take into account the personal and academic profile of the student, the lack of personalized guidance increases the risk that students choose the wrong professional path. The career decision is often difficult to reverse for a variety of reasons, including financial, familial, and personal constraints [3], [2]. This can lead to a sense of regret and dissatisfaction with one's life [3], [2]. They therefore need personalized advice and precise information to make an informed decision regarding their higher education.

This study focuses specifically on paramedical education in Morocco, which is one of the fields of study most chosen by baccalaureate graduates. They have the choice between twenty-four study options offered by the higher education institutions, such as radiology technician, multi-skilled nurse, physiotherapy, occupational therapy, orthoptics, operating room nurse, etc. The number of these options increases every year, and students often have insufficient knowledge about these specialties and their differences, making it increasingly difficult for them to make a good decision regarding which specialty they would like to pursue. It is therefore essential to have personalized guidance allowing you to make informed and realistic choices.

Although some systems have been developed for the academic and professional guidance of Moroccan students [4], [5], [6], [7] they are not specifically designed to direct Moroccan and foreign high schools towards paramedical studies. To our knowledge, these systems do not provide useful and precise information on the different specialties in this field of study.

To solve these aforementioned problems, this paper proposes a system to recommend suitable study options based on students' personal, academic, and demographic information. Recommender systems (RS) have the potential to personalize student guidance and enable them to make good career choices.

The main contributions of this study can therefore be summarized as follows:

1. The proposed system helps students choose study options that best match their personal and academic profiles and, therefore, choose their future careers in the paramedical sector. Additionally, it provides accurate and up-to-date information on these recommended options so that students can easily make informed decisions instead of relying on system predictions.
2. We propose a recommender system based on machine learning (ML) and ontology techniques. These artificial intelligence (AI) techniques are integrated in order to improve the accuracy of recommendations [8], [9], [10] and overcome the limitations of traditional recommendation systems, such as handling heterogeneous data types and the problem of cold start. In our system, ML techniques are used to generate personalized recommendations by analyzing the profiles of graduates or students admitted to paramedical training establishments in Morocco. The ontology is also applied to model student profiles, study options (specialties), study courses, and training institutions.
3. Our proposed system integrates a holistic approach by involving different aspects of students, such as their academic data, sociodemographic data, and body condition (normal or disabled). The integration of these aspects makes it possible to improve the efficiency and quality of our recommender system.
4. We construct an ontology to semantically describe knowledge relating to the field of student guidance in paramedical education. This ontology can be reused by other systems for academic and professional student guidance. It can also be reused or merged with other existing ontologies to create new ontologies in education.

The rest of the paper is organized as follows. Section 2 presents a brief overview of RS, the concept of ontologies, their components, principles, and methodologies for their construction, as well as related work. The architecture of our proposed recommender system and the developed ontology are described in Section 3. Section 4 discusses the main challenges and limitations of the system. Section 5 presents the conclusion and future work.

2 BACKGROUND AND RELATED WORK

2.1 Recommender systems

Recommender systems are intelligent systems that can automatically detect user preferences and interests based on their experiences with the system. They use feedback to make individualized recommendations to users [11], [12]. These systems leverage user interactions to collect information about users and the items in order to create user profiles.

Recommender systems use filtering methods to recommend relevant articles to users. Based on the sorts of information collected and the similarity calculation methodology utilized, these methods can be categorized into the following three broad categories [13], [12].

1. *Content-based (CB) filtering* makes recommendations based on item descriptions. This strategy proposes things to active users that are comparable to those they have previously favored, without regard for the preferences of others.
2. *Collaborative filtering (CF)* makes recommendations based on comparable user preferences. Items that have not yet been evaluated by a user but have received positive feedback from users with similar preferences can be recommended to that user.
3. *Hybrid filtering* combines multiple ways to maximize benefits while minimizing drawbacks. This third type of RS enables the improvement of recommendations while also overcoming some of the limitations of prior approaches.

2.2 Ontologies

Definition of ontology: In the literature, several definitions of ontology have been proposed in different fields. In AI, the most cited and accepted definition is that of Gruber [14]. This author defined the concept of ontology as "*an explicit specification of a conceptualization*" [14]. This definition was modified by Borst [15] by introducing an aspect of sharing. He defined ontology as *"a formal specification of a shared conceptualization*".

The definitions of Gruber [14] and Borst [15] were merged by Studer et al. [16], who stated that "*An ontology is a formal, explicit specification of a shared conceptualization*". These authors explained the three aspects of this definition as follows:

A *conceptualization* is an abstract representation of a real-world occurrence based on the identification of key ideas. *Explicit* denotes that the concepts employed and the limits on their use are expressly defined. *Formal* refers to the requirement that the ontology be machine readable, which excludes natural language. *Shared* refers to the idea that an ontology captures consensual knowledge, which is not private to any individual but is accepted by a group.

Components of an ontology: Knowledge in an ontology is represented using five types of components [14], [17]:

1. ***Concepts:*** Also called terms or classes, these represent all relevant knowledge describing a part of a problem domain. They can be abstract or concrete, elementary or composite, real or fictitious. In short, a concept can be an object or a description of a task, function, action, strategy, reasoning process, etc. [17].
2. ***Relations:*** These are used to represent the types of associations between the concepts in the ontology. They can be of the following types: specialization-generalization (subclass-of), aggregation or composition (part-of), disjunction, etc. These relations allow the structuring and interrelation of concepts to be seen.
3. ***Functions:*** A special case of relations in which the n-th element of the relation is unique for the n-1 previous elements [17].
4. ***Axioms or rules:*** These are assertions, always considered true, that define the semantics of concepts and their property restrictions, verify the logical consistency of an ontology, and infer new knowledge. These axioms are the primary elements for setting the semantic interpretation of concepts and relations.
5. ***Instances:*** Also called individuals, these constitute the extensional definition of the ontology [18]. They are used to represent particular elements of the concepts.

Principles of ontology construction: A set of criteria and principles has proven effective in the development of ontologies. Among these are the criteria proposed by Gruber [14] to guide the ontology design process. These criteria are summarized as follows:

- ***Clarity:*** the ontology must provide the meaning of the defined terms. Definitions should be objective and documented in natural language. A complete definition, expressed by necessary and sufficient conditions, is preferred over a partial definition (defined only by necessary or sufficient conditions).
- ***Coherence:*** an ontology must be coherent, meaning the inferences must be logically consistent with the definitions. Coherence should apply to both the axioms of definition and the concepts defined informally.
- ***Extendibility:*** an ontology must be easily extendable in a monotonic manner, meaning that new general and specialized terms can be defined in the ontology without requiring revision of existing definitions. An ontology must be designed to be easily extended in a monotonic manner.
- ***Minimal encoding Bias:*** the conceptualization must be specified at the knowledge level, independent of any notation or implementation. The reason for this principle lies in the possibility of implementing knowledge-sharing agents in different representation systems and styles.
- ***Minimal ontological commitment:*** an ontology should require a minimal ontological commitment sufficient to support knowledge sharing. It should define only its essential terms and specify them as little as possible to allow parties involved in the ontology to specialize and instantiate it according to their needs.

Methodologies for ontology construction: Various methodologies have been suggested to facilitate the construction of ontologies, each offering a structured approach adapted to specific contexts. This section provides a concise overview of four principal methodologies that served as the foundation for the development of our ontology.

The *Uschold and King methodology* [19], developed during the Enterprise Ontology project, was among the first systematic approaches to ontology creation. It consists of four main stages: defining the ontology's purpose and scope, building it (through ontology capture, programming, and integration), evaluating its coherence, and documenting the process. One of its strengths lies in its use of bottom-up, top-down and middle-out strategies for concept identification [18].

The *Grüninger and Fox methodology* [20], introduced through the TOVE (Toronto Virtual Enterprise) project, emphasizes formal logic and the use of competency questions. It begins with motivating scenarios, followed by both informal and formal formulations of questions the ontology must address, specification of terminology and axioms in first-order logic, and the definition of completeness conditions. This approach is especially valuable for ensuring that the ontology responds to specific informational needs [18].

The *METHONTOLOGY methodology* [21], developed by Fernández-López et al., provides a comprehensive framework for building ontologies at the knowledge level. It follows seven phases: specification, knowledge acquisition, conceptualization, integration, implementation, evaluation, and documentation. Its methodological rigor and alignment with IEEE software engineering standards make it suitable for large-scale and interdisciplinary domains [18].

The *MI20 methodology*, proposed by Valéry Psyché [18], integrates elements from several previous approaches to offer a flexible and complete framework. It includes five phases: 1) feasibility study and environmental analysis, 2) ontology modeling (comprising conceptualization and formalization), 3) implementation, 4) evaluation, and 5) documentation. It draws upon methods such as On-To-Knowledge [22], Swartout et al. [23], Mizoguchi [24], making it particularly suitable for domains requiring both theoretical rigor and practical adaptability.

2.3 Related work

In recent years, AI technologies have been widely used in RS. The use of these technologies has proven to be a promising solution when designing RS in the era of Big Data [25], [26].

Machine learning techniques have shown their potential to overcome the limitations of traditional recommendation systems and to improve the accuracy and performance of recommendations. Indeed, many systems exploiting these techniques have been designed for student academic and professional orientation [4], [5], [6], [7], [27], [28], [29], [30], [31], [32]. For example, Moukhliss et al. [7] proposed a school orientation model based on ML and data analysis technologies. It provides personalized recommendations to secondary school graduates by taking into account student profiles and data on Moroccan higher education institutions and labor market needs. Another guidance model based on ML and big data was presented by Badrani et al. [32], which allows students to make informed decisions based on their academic performance. However, while this hybrid model shows accurate results, it was specifically developed to help Moroccan students choose their secondary education specialization.

Majjate et al. [4] developed a hybrid recommender system that uses ML algorithms to predict a student's chances of admission to the university they have chosen, based on the student's academic background and preferences. The system also recommends other similar universities, relying on a CB filtering approach and a popularity-based approach. Similarly, the systems proposed in [6] and [29] are designed to connect students with academic and career paths that align with their personalities, skills, interests, and other socio-demographic data. However, while these and the other systems described above offer personalized and useful guidance, they are often too general. In specialized fields, such as paramedical studies, what we really need is personalized, in-depth support.

Regarding the application of ontologies in RS, research has shown that using ontologies to represent user characteristics can mitigate the cold start problem [33], [34], [35], [36], [26]. It can also improve career guidance by providing a structured approach to representing and organizing career-related knowledge [37]. However, ontologies have not been widely used in the field of career guidance [37]. Some ontology-based RS have been proposed for student orientation. For example, Ibrahim et al. [33] built a hybrid recommender system based on ontology and CF, knowledge-based (KB), and CB techniques to suggest a higher education course at the university based on the learner's profile and course content. In addition, Obeid et al. [38] presented a hybrid recommender system, called COHRS, which combines KB recommendation techniques and CF based on ontology and case-based reasoning. This system generates personalized recommendations for high school students based on their interests.

Like Obeid et al. [38], we propose a RS that combines ML algorithms and ontologies, but it aims to help Moroccan high school graduates and graduates from other countries who wish to pursue their studies in paramedical training institutions in Morocco. Our system uses ML algorithms to determine the most appropriate association between paramedical sciences study specialties and the personal and academic profiles of students. Ontologies are used to model student profiles and semantically describe study options and training institutions. Unlike systems that have made recommendations based solely on academic results, our orientation system integrates a holistic approach that takes into account the student's academic profile, socio-demographic data, physical condition (normal or disabled), and the requirements of nursing and health technology training institutions. It recommends study options appropriate for each student and provides accurate and up-to-date information on these recommended options so that students can make informed decisions instead of relying on predictions, such as the modules taught, the opportunities offered by each option, and the subjects of the written entrance exam.

3 PROPOSED RECOMMENDER SYSTEM

Our proposed recommender system, called NurSHT-RS (Nursing Sciences and Health Techniques-Recommender System), aims to help Moroccan and foreign students make good decisions when choosing a study option in the field of paramedical sciences. It is based on ML techniques and ontologies, and its design is adapted to the Moroccan educational system.

In this section, we present the architecture of this proposed system and the ontology developed.

3.1 NurSHT-RS architecture

We have chosen the layered architecture, which ensures better scalability and easy maintenance of our recommender system and separates the different responsibilities [39]. The general architecture of our system is presented in Figure 1. It is structured into three layers that interact with each other: (1) presentation layer, (2) modules layer, and (3) knowledge layer.

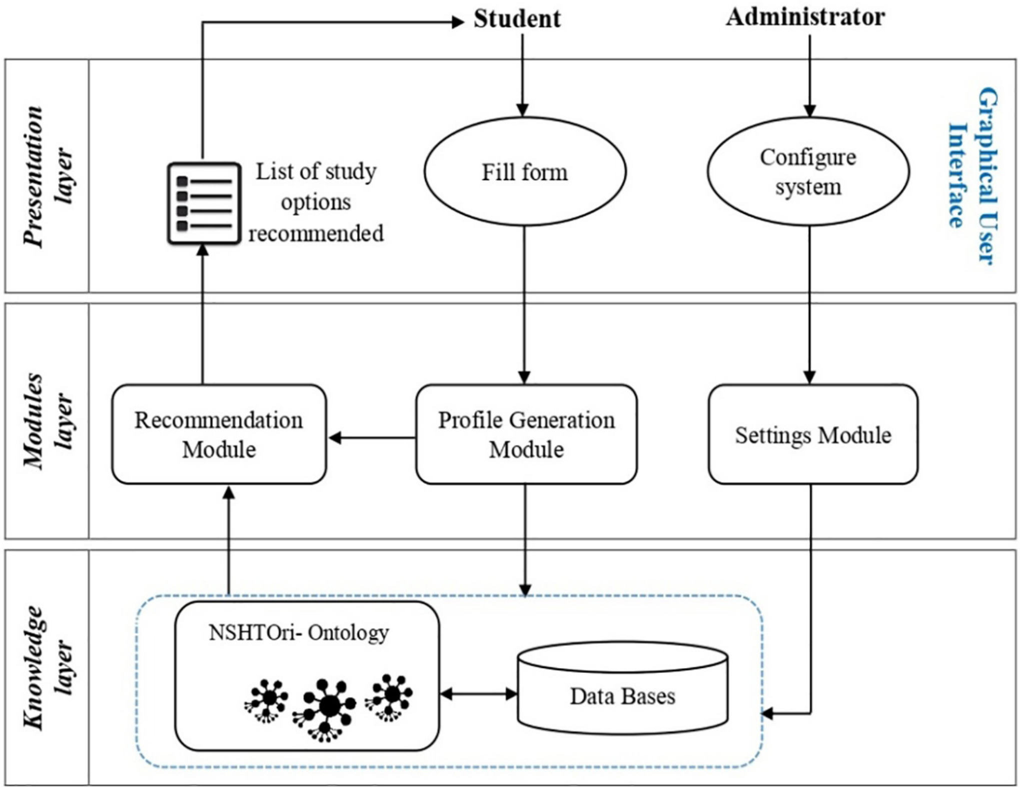

Fig. 1. General architecture of the proposed guidance system – NurSHT-RS

1. Presentation layer: This layer provides a graphical user interface (GUI), allowing users to communicate easily with the system. It has two interfaces: an administrative interface and a student interface.

The administrative interface allows administrators to log in and modify the operating parameters of the system. The student interface enables Moroccan and foreign students holding a baccalaureate to enter their data, which are as follows:

- ***Personal information:*** Gender, nationality, area (urban or rural), type of disability (in the case of students with disabilities).
- ***Academic information:*** Includes the baccalaureate series (Physics-Chemistry, Life and Earth Sciences (SVT), Humanities, etc.), the year and location of obtaining the baccalaureate, type of candidacy (official candidate or free baccalaureate candidate), the average score of the national exam and the average score of the regional exam for official candidates, or the overall average of the baccalaureate for free candidates.

Recommendations are displayed in this layer in the form of a list with details on each recommended study option (modules, establishment, and subjects for the admission exam).

2. Modules layer: This layer consists of three main modules: the Settings Module, the Profile Generation Module, and the Recommendation Module. These modules function in an interconnected manner to provide personalized and relevant recommendations. The functions of each module are presented in the following subsections.

a) **Settings module:** This module is responsible for initializing and maintaining all operating parameters of the proposed recommender system. It allows, in particular, to:
   - Define and modify the list of fields and study options available for the current academic year.
   - Define the institution's requirements for each study option.
   - Define the student characteristics used in the recommendation process.
   - Configure the types of data collected about students.
   - Define and modify the basic criteria for recommendations (e.g., personal characteristics of students, academic results, and preferred subjects).
   - Create and update ontologies.

b) **Profile generation module:** This module uses the personal and academic data provided by students in the presentation layer to create a profile for each student. This profile is generated based on the ontology model of the student. This ontology used by our recommender system will be described in detail in Section 3.2.

c) **Recommendation module:** This module is based on ML techniques. It recommends appropriate study options for the profile of the target student, using their generated profile, ontologies, and data on the various study options stored in the system's databases.

In addition, the recommendation module also provides additional information about each proposed option.

3. Knowledge layer: This layer consists of databases and ontologies and also ensures the storage and management of the data necessary to make precise and adapted recommendations for student profiles.

In this layer, student profiles, study options, and accessibility data are stored in different databases to facilitate their management. Furthermore, it also allows other layers of the proposed system to quickly and securely access these data.

3.2 NSHTOri-Onto ontology

To model and semantically represent student profiles, study options and training establishments, we have developed an ontology named NSHTOri-Onto (Nursing Sciences and Health Techniques Orientation-Ontology).

Based on the MI20 methodology and the principles of ontology construction, the development of our ontology is carried out in two phases: (1) the conceptualization phase and (2) the formalization and implementation phase. The main activities of each of these phases are described in this section.

1. Conceptualization phase: The first phase focuses on the identification and structuring of domain knowledge using semi-formal representations (tables).

At the beginning of this phase, activities of analysis of existing information resources (the circulars and technical sheets of the access competition, the descriptions of modules, and the official websites of the paramedical training establishments in Morocco) were carried out to extract the most important and widely used terms in this field. The extraction of concepts and the relationships between them is done based on the intermediary approach.

After this analysis, natural language definitions were attributed to the extracted concepts to avoid any semantic ambiguities related to these concepts. Table 1 presents the concepts identified in the ontology, along with their hierarchical structure (super-concepts) and corresponding definitions.

Table 1. Glossary of the concepts in our ontology

Concepts	Super-Concepts	Definitions
Candidate		A student holding a baccalaureate who wishes to pursue his/her higher education in the field of paramedical sciences in Morocco.
Moroccan_Student	Candidate	A Moroccan student.
Foreign_Student	Candidate	A non-Moroccan student who wishes to continue his/her studies in Morocco.
Program		A program contains one or more study options.
Study_Option	Program	An option is a specialty of study in the fields of nursing sciences and health techniques.
Establishment		This is an institution of higher education that provides training in paramedical sciences.
Bac_Diploma		The baccalaureate diploma
Moroccan_Bac	Bac Diploma	Represents the national Moroccan baccalaureate diploma.
Foreign_Bac	Bac Diploma	Represents all diplomas equivalent to the Moroccan baccalaureate, issued by foreign educational systems.

After defining the concepts and their hierarchy, the complete description of the properties of these concepts (attributes and relationships) was made. Common properties are placed in general concepts (super-concepts). The attributes defined for each concept and the various relationships identified between the concepts of our ontology are summarized in Tables 2 and 3, respectively.

Table 2. Glossary of attributes of the concepts of our ontology

Concept	Attributes	Comments
Candidate	Gender	
	Nationality	
	Area	Area designates the geographic area to which the student's residence belongs (urban or rural).
Disability	Type of disability	It could be a disability affecting hearing, vision, movement, or a combination of these.
Study option	Name	
	Description	
	Modules	
	Subjects for a written exam	Indicates the subjects to be assessed in the written admission exam.
Admission criteria	Baccalaureate series	Indicates the required baccalaureate series for enrollment in the chosen option.
	Type of disability	Types of disabilities that do not prevent the student from pursuing training with this option.
Bac Diploma	Bac Series	Designates the baccalaureate series.
	Year of obtaining	Year of obtaining the baccalaureate.
	Overall average	Overall baccalaureate average.

(Continued)

Table 2. Glossary of attributes of the concepts of our ontology *(Continued)*

Concept	Attributes	Comments
MoroccanBac	Provincial Directorate	The provincial directorate where the student obtained their baccalaureate diploma.
	Type of application	Indicates the type of baccalaureate application. It can be either "an official candidate" or "a free candidate".
Official Candidate	Average score of the national exam,	The average score of the national baccalaureate exam.
	Average score of the regional exam	The average score of the regional baccalaureate exam.
Foreign Bac	Place where the baccalaureate was obtained	The country where the student obtained their baccalaureate diploma.
Establishment	Establishment Name	The official name of the institution.
	City	The city where the institution is located.
	Website	The website address of the institution.
	Phone number	The phone number of the institution.

Table 3. The relationships between concepts and their cardinalities

Relation Name	Principal Concept	Target Concept	Principal Cardinality	Target Cardinality
Obtained	Candidate	BacDiploma	1.1	0.n
Is_admitted	Moroccan_Student	Study_Option	0.1	1.n
Has	Candidate	Disability	0.n	0.n
Requires	Study_Option	BacDiploma	1.1	1.n
Included	BacDiploma	Bac_Series	1.1	1.1
Necessitates	Study_Option	Bac_Series	1.n	1.n
Taken_in	BacDiploma	Province	1.1	1.n
Contains	Program	Study_Option	1.n	1.1
Offered by	Program	Establishment	1,n	1,n
Adapted to	Study_Option	Disability	1,n	1,n

The results of the activities of extracting concepts and relationships as well as the results of the activities of describing these concepts and their properties were validated and refined with people having extensive knowledge and experience in this training domain.

2. Formalization and implementation phase: This step allows the formal representation of the conceptual model obtained in the first phase by a formal ontology language. Then, operationalize the ontology using an ontology editor to make it exploitable by a machine. To do this, we chose to use the OWL language and the Protégé tool (version 5.6.4) for the formalization and implementation of our ontology. OWL language is richer and more semantic, providing mechanisms to create all components of an ontology (classes, instances, properties, and axioms). Protégé is a free and open-source ontology editor, which perfectly meets our needs in terms of inference capability and simplicity of use.

During this phase, activities of creating classes, subclasses, instances, and properties of the classes (object property and datatype property), as well as creating restrictions on classes and properties, were carried out. For each class, we specify the data types of its attributes (integer, string, decimal, boolean, etc.). Similarly, for each relationship (object property) created, we specify the domain and range, i.e., the classes concerned by this relationship.

Figure 2 presents our ontology implemented under the Protégé 5.6.4 editor.

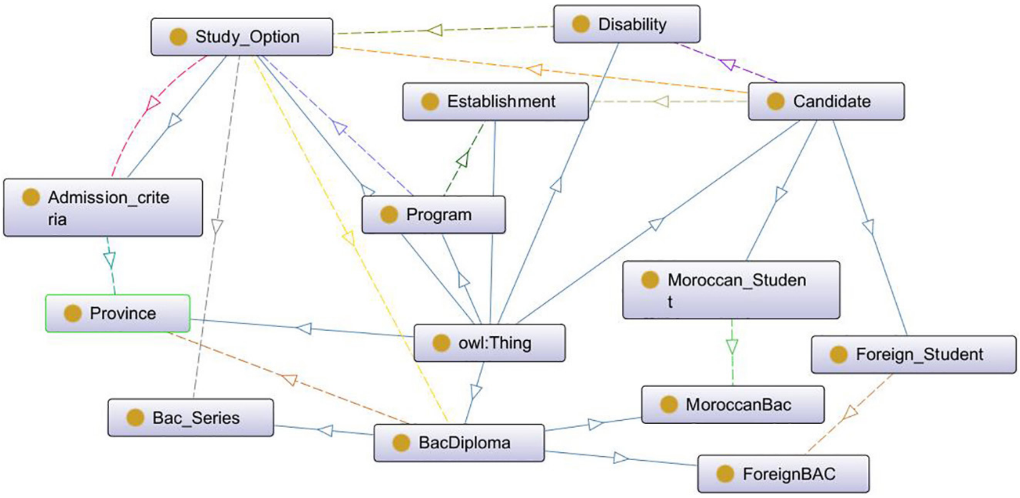

Fig. 2. The developed NSHTOri-Onto ontology

4 CHALLENGES AND LIMITATIONS

Although the proposed NurSHT-RS system offers a promising solution for academic guidance in the paramedical field, its development and implementation face a number of limitations and challenges that must be taken into account in order to improve its efficiency and ensure its applicability in real contexts.

The first challenge concerns the lack of structured and digitized data relating to student profiles and paramedical training programs in Morocco. The ML techniques used in our system require high-quality and representative datasets to provide accurate and relevant recommendations. However, in the Moroccan context, this type of data remains difficult to access, fragmented, or not available in digital format. This situation limits the ability to train the models and reduce errors in recommendations. The collection, digitization, and regular updating of this data therefore represent a major challenge that must be addressed in collaboration with educational institutions.

The second limitation is related to the protection of personal data. The personalization of recommendations in NurSHT-RS is based on the analysis of several types of information, including academic data, sociodemographic characteristics, and physical condition. Although this holistic approach improves the precision of the recommendations, it also raises ethical and legal concerns related to the confidentiality and security of the collected data. The implementation of appropriate protection mechanisms is essential to ensure responsible and secure use of this information.

The third challenge lies in the presence of potential biases in the ML algorithms. If the training data are unbalanced or underrepresent certain categories of students—such as students from rural areas or students with disabilities—the system may generate inappropriate or non-inclusive recommendations. Moreover, the overfitting problem may appear when the model becomes too specific to the training data and fails to generalize to new profiles. To mitigate these risks, it is necessary to apply balancing techniques, such as oversampling, and to conduct regular evaluations of the system.

Finally, the scalability and adaptability of the system remain important challenges.

Although the layered architecture of NurSHT-RS allows for modularity and maintenance, expanding the system to other academic fields or adapting it to new contexts requires additional development work. Similarly, updating the ontology to reflect changes in training offers and institutional requirements depends on close and continuous collaboration with experts in the field.

These limitations do not question the relevance of our system but rather highlight the importance of future work aimed at improving its different components, evaluating its performance in real academic settings, and ensuring its long-term sustainability.

5 CONCLUSION

This paper presents a proposed new recommender system, called NurSHT-RS, which aims to help students choose study options that best match their personal and academic profiles and, therefore, choose their future careers in the paramedical sector. This system could be a promising solution to the problem of professional orientation towards paramedical studies in Morocco because it provides Moroccan and foreign high school graduates with precise and up-to-date information on the different study options offered in order to facilitate their informed decision-making and save them time.

The design of the proposed system adopts a layered architecture to ensure optimal scalability and easy maintenance. It is also based on ML and ontology techniques. ML techniques are used to analyze the profiles of graduates or students admitted to paramedical studies in order to generate personalized recommendations appropriate to the profiles of high school students. The ontology is also used to represent student profiles, study options, and training institutions.

In addition to the combination of these AI techniques that overcomes the limitations of traditional recommendation systems, the integration of the holistic approach that takes into account the academic profile of the student, their demographic data, and their body condition (normal or disabled) to provide more precise and effective recommendations is one of the main contributions of this study. Furthermore, the constructed ontology could be integrated into other academic guidance systems or used as a base ontology to develop other ontologies in the field of education.

In future work, we plan to conduct a user study involving students and academic advisors from Moroccan paramedical institutions. This study will assess the usability and effectiveness of the proposed system in real-world settings, using a combination of standard evaluation metrics and qualitative feedback. The results will help refine the system's recommendations and ensure their relevance to users' actual needs. Overall, this system could serve educational advisors, Moroccan students, and foreign students wishing to pursue paramedical studies in Morocco. This work lays the groundwork for future research focused on comparing ML models to identify the most accurate algorithm for our guidance system, along with implementation experiments to assess its performance and practical utility.

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7 AUTHORS

Samira Reguragui is a Ph.D. student at Abdelmalek Essaadi University in Morocco. Her areas of expertise include artificial intelligence in education, ICT, and instructional engineering. With a keen focus on the integration of technology in pedagogy, she has contributed significantly to the field. Her work has been presented at national and international conferences and published in reputable journals (E-mail: samira.reguragui@etu.uae.ac.ma).

Ahmed Bendahmane is a Professor of Computer Science at the Higher Normal School (ENS), Abdelmalek Essaadi University. He earned his doctorate in Computer Science from the same university in 2013. His main research interests include distributed systems, security of grid and cloud computing systems, intrusion detection and tolerance, blockchain, and smart systems. He is the author and co-author of several papers covering these and other topics, which have appeared in refereed specialized journals and international conferences. He is a member of the IEEE (E-mail: abendahman@uae.ac.ma).

Abdellatif El Aidi is an Associate Professor of English at the Faculty of Letters and Human Sciences Sais-Fez (FLHS), Sidi Mohamed Ben Abdellah University in Morocco, and a researcher at the AMERLA-DCCS Research Laboratory. His research interests include postcolonial studies, cultural theory, Francophone literary representations of Morocco, and education. He is the founder and chair of the annual International Conference on Language, Literature, and Culture, hosted by FLHS. His research, which critically addresses sociocultural issues and challenges prevailing views of representation and identity, has been published in peer-reviewed journals and presented at various national and international conferences (E-mail: abdellatif.elaidi@usmba.ac.ma).

Essaid El Haji is a dedicated researcher and faculty member at the Multidisciplinary Faculty of Larache, Abdelmalek Essaadi University, where he serves in the Department of Computer Science. He also leads the university's FabLab, a creative hub for technological innovation and student-driven projects. He earned his Ph.D. in 2018 from the Faculty of Sciences and Techniques in Tangier, specializing in Computer Science and Artificial Intelligence. He is the author of several scientific publications in international journals and conferences. Beyond his research, he actively contributes to the academic community as a reviewer for various peer-reviewed journals and international conferences (E-mail: e.elhaji@uae.ac.ma).