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Ontology Supported Domain Knowledge Module for E-Tutoring System*

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Abstract

E-tutoring Systems are computer applications that provide direct customized education to learners. This paper introduces a domain knowledge module for an E-tutoring system that allows knowledge stored in a well defined form to support reusability, shareability, flexibility, and standardability and to assists the storage of transfer and prerequisite knowledge relationships. The introduced knowledge domain module is designed in two ways the general concepts domain knowledge module and a specific domain knowledge module ontology. This innovative technique is helpful for students in enhancing their learning progress. Combining the proposed ontology domain knowledge module with an E-tutoring system can enhance the quality of intelligent problem solving. Also, it will be possible to reuse the knowledge domains. As a result, the proposal of the domain knowledge module for the E-tutoring system can enhance the teaching and learning process, support recommendations, generate hints. In the future the suggested module can be improved by adding some functionalities and automatically support the generation of problems and their solutions.

Keywords: E-tutoring system, domain knowledge module, ontology, SPARQL

1 Introduction

E-learning environments are increasingly getting popular in different contexts in academies, universities, and vocational training [1]. Therefore, suitable support of learners is also getting great significance. Besides, collaborative learning is also growing, which puts greater demands on learners, especially when the collaboration is implemented and tailored to enhance learning and teaching process [1].

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In the earlier decades, learning platforms such as e-learning have been controlled by a technology called Learning Management Systems (LMS) [11]. such as Moodle, ATutor, or Blackboard, these LMS present integrated systems that allow and support a wide range of academic activities. Thus, instructors can use LMS to create courses and test suites, communicate with monitor learners, and evaluate their work. In addition, learners can learn, share, and collaborate through LMS. The problem is that LMS cannot offer only limited personalized learning services [12]. All learners are given access to the same learning resources and implements without considering the differences in knowledge level, interests, and goals.

Regarding this problem, a new learning platform is coming to provide learning facilities for customizing the education as one-to-one learning. This technology is an E-tutoring system. An E-tutoring system is defined by [7], as computerbased software that provides immediate personalized learning or feedback to learners without the involvement of humans while conducting a task. According to [14]. E-tutoring systems commonly involve four modules: the Knowledge Module, which incorporates content related to the rules and facts for a specific domain of interest to be given to the learner; the Tutoring Module, which creates and controls instructional interactions with the learners; the Learner Module, which is a dynamic representation of the current state of student knowledge; and the Learner Interface, which governs the interaction between the learner and the system [20].

The creation of an E-tutoring system can concentrate on different issues, including the tutoring decisions which will take place in the tutoring module as well as the rules and facts represented in the knowledge module. The goal of E-tutoring systems is to allow students to gain knowledge and develop skills in a particular field of study. However, delivering such tutoring services effectively, these systems must provide an explicit representation of the domain knowledge module that the topic of the education activity [21]. It must also be prepared with the tools by which the representation can be employed on the E-tutoring system for reasoning to solve problems in given domain of interest. E-tutoring systems must also include a domain specific knowledge module capable of generating and resolving domain problems as well as providing access to such knowledge to promote the dissemination and acquisition of this knowledge by students [2].

Developing and describing a domain knowledge module is a challenging problem that has been the issue of many investigations in the disciplines of both artificial intelligence and artificial intelligence in the educational domain (AIED) [4]. Scholars offered many approaches to expressing the knowledge base explicitly for domain knowledge modules [17]. The approaches presented have been drawn from several fields such as artificial intelligence, education science, knowledge engineering, knowledge management, knowledge representation, and software engineering. These techniques are semantic networks, frames, knowledge graphs, ontologies, rulebased, casebased, logicbased and belief networks. In this work, the authors focus on developing the domain knowledge module using ontology as acknowledge representation techniques.

Investigation into an ontology is evolving and increasingly becoming widespread in the computer science community. Its importance is recognized in many research and application areas, including knowledge engineering, database design and integration, information retrieval and extraction, and educational systems [21]. Ontology is a standard structure that offers a shared understanding of a specific area [2]. It represents the domain semantically explicitly, allowing intelligent access to the knowledge module. Ontology is a building block of semantic technologies. It is a formal description of the relevant knowledge concepts and their relations. The formal definition of ontology given by Gruber [10] "ontology is an explicit specification of a conceptualization". Ontologies determine or model the domain using concepts, attributes, and relationships, and this explicit formal representation provides meaning for the vocabulary. In computer and information science, ontology is a formal concept describing an artifact designed for a purpose, enabling the modeling of the domain knowledge module [21].

Most of the current E-tutoring systems solutions are developed for a particular domain, meaning the provided solution of a given knowledge domain will not be suitable for other knowledge domain [17]. Therefore, these systems developed for isolated knowledge bases have some limitations and drawbacks to using local knowledge bases. These limitations are limited knowledge base shareability and lack of standardability, flexibility, reusability, and manual control. Due to this problem, the solution in this work of the ontology domain knowledge module proposed to avoid the limitations and drawbacks of using local knowledge bases.

This paper constructs an ontology supported domain knowledge module for an E-tutoring system that provides help for enhancing the teaching and learning process. The applications of this modules are implemented in Python, which can be used to support the problem solving process. Accordingly, to improve and increase the learning quality and their processes, a novel ontology domain knowledge module develops by defining a set of relationships that would be adequate and clear to represent all possible relationships for developing and building the ontology domain knowledge model. In the proposed ontology domain knowledge module, two domain ontologies were introduced: a) general concepts for domain knowledge module ontology and b) specific domain knowledge module ontology. The general concepts for the domain knowledge module deal with the domain knowledge model concepts and define the relationship related to these concepts. The ontology of a selected domain knowledge module deals with the selected subject area that can relate the selected subject domain to the general concepts for the domain knowledge module. It seems like individuals or instances for the general concepts of the domain knowledge module.

This article is organized as follows: the introduction in the first section. The second section displays the related work, the third section illustrates the proposed the domain knowledge module and explains the proposal module in detail, the fourth section presents the implementation of the proposed module using Python and Owlready2 module, the fifth section demonstrates the result and discussion, and the conclusion in the sixth section.

2 Related Work

Researchers have followed a modern technology known as an E-tutoring system in different disciplines such as teaching, psychology, and artificial intelligence. The aim is to support the benefits of one-to-one education and allow learners to train their skills by conducting exercises on many interactive learning platforms. E-tutoring System is a software system developed to support students with immediate and personalized instruction or feedback, usually without human teacher intrusion. Several researchers, designers, and developers define E-tutor systems in different ways according to their interests. According to authors in [14], E-tutoring systems are intelligent instruction techniques using computer software and communication technologies their capabilities, practices to improve a human tutor who is an expert in the subject matter to enhance personalized learning in the form of one-to-one learning. Scholars have struggled since the early invention of computer applications to create intelligent learning systems that are more successful than human instructors [20], The fundamental role of using an E-tutoring system is to facilitate and customize student learning and achieve their activities effectively [20].

Nowadays, ontologies have become a proper representation scheme, and several application domains are considering adopting it. Recently, scholars found that the benefits of using ontologies in the learning field have greater support for designing and developing the coming E-learning platform [18]. However, concentrating on this technique is reusing domain knowledge resources for developing domain ontologies. Ontologies have been discussed in the context of E-Learning since early 2004 [21]. Ontologies are employed in different ways in E-Learning systems, depending on the E-Learning tasks they perform. Every part of E-learning activities can represent by a collection of welldefined associated entities that can have the same semantic representation, especially when dealing with concepts in particular domain knowledge module.

Ontology is the mostly used approach in the evolution of AI applications to model concepts in a particular domain of knowledge. In different terms, ontology is used to represent classes, concepts, and properties that usually exist in a specific domain and their relations. Ontology is a building block of semantic technologies. It is a formal description of the relevant knowledge concepts and their relations [2]. Ideally, ontologies should describe these welldefined meanings that can be formalized in languages such as Ontology Web Language (OWL) [4], Resource Description Framework (RDF) [17], or Resource Description Framework Scheme (RDFS) [17]. The formal nature of ontologies allows intelligent machines to interpret the meaning of concepts. In computer technology and information science areas, Ontology is the formal description of a specific domain by representing the concepts of a specific domain their properties and relationships among these concepts [2]. Concepts are usually classified regarding a hierarchical relationship of specialization, generalization, and containment among these concepts.

Data Model (DM) is a commonly used notion in many disciplines to deliver an abstract representation of its structure, function, behavior, or others [9]. DM expresses as a conceptual model that organizes knowledge structure, relationship, semantics, and consistency constraints [9]. According to authors [12]. Domain Model deals with a collection of knowledge concerning a specific topic, concept, or domain. Artificial intelligence is a tool that can extract and work with this data. The data represented in this case relates to the form of knowledge in a given domain. As an additional point, this model is not designed to replace the role of the instructor.

Domain knowledge module (DKM) introduces as a knowledge base for courses, topics, fundamental concepts, teaching units, or knowledge units in the E-tutoring system. In other terms, the DKM represents the knowledge base structure of a particular domain in a specific discipline which used as a component in E-tutoring systems. DKM is essential and valuable to educational communities because it is usually a targeted skill for developers to build a knowledge base [5]. DKM within the E-tutoring system describes the course, topics, knowledge domains, key concepts, teaching units, including the knowledge contents and competencies. However, the primary role of developing a DKM is to promote and reuse this knowledge on different E-tutoring frameworks. Domain module is the most significant part of E-tutoring systems providing a base for operational components such as learning material, content recommenders, or collaboration tools.

Scholars have investigated practices of knowledge representation such as semantic-based, rule-based, case-based, frame-based, Bayesian network, logic-based, and ontology-based. Rule-based models are also called Cognitive tutors. The rulebased models are built from cognitive task analysis, producing problem spaces or task models. These problem spaces or task models are constructed by observing the expert and novice users. Task models represent a set of production rules in which each rule represents an action corresponding to a task [16]. When a user tries to solve a given task, the user's reasoning ability is analyzed based on the rules applied by the user, i.e., the user's solution is compared step-by-step to the solution given by the expert.

Case-based is an artificial intelligence problem solving method that records experience into cases and associates the current problem with an experience [15]. The Case-based approach is operated in several domains, including pattern recognition, diagnosis, troubleshooting and planning, and intelligent e-learning.

A logical representation language has some definite rules for dealing with propositions and reasoning for knowledge and representation. Logical representation entails deducing a conclusion from many circumstances. This representation establishes many fundamental communication principles. It is composed of well-defined syntax and semantics that facilitate sound inference. Each phrase can transform into a logical form through syntax and semantics.

Frame-Based is one of the artificial intelligence techniques to structure the data, and it is used to separate information into substructures via the representation of stereotyped scenarios [3]. Frame-Based seems like a record form build-up of many characteristics and values used to describe an object in the real world. In addition, this object contains a collection of slots and their associated values. However, these slots come in a combination of shapes and sizes. Facets are the names and values assigned to slots.

A Bayesian network is also referred to as a belief network or Bayes net. Bayesian network is probabilistic and graphical in a form of graph with directed acyclic devoid of loops and self-connections used for knowledge representation for an uncertain domain, with each node indicating a random variable [22]. Each edge denotes a conditional probability associated with the associated random variables.

Semantic-based is a knowledge representation method that enables visualization of the knowledge via graphical networks [19]. This network incorporates nodes representing entities and arcs that reflect their relationships. Moreover, semantic-based classify concepts in different ways and can also connect them in a form of a graph. Ontologies, as semantic-based representation, have gained vital significance as one of the most commonly used techniques to describe and share knowledge in several disciplines such as E-learning systems, business modeling, software engineering, knowledge engineering [6].

Regarding the continuous development of new technology, it can change the way of teaching and learning. According to Fensel [23], the primary reason for the popularity of ontologies is due to providing "a shared and common understanding of a domain that can be communicated between people and application systems. Ontology can be constructed as a representation required for scale and variety in the design of educational frameworks. In the e-learning field, ontologies are employed in various applications extending from domain knowledge modules representation to automate generation and assessment of personalized learning materials. The concept of ontology is a useful technology that incorporates related resources, shares knowledge, and eliminates unnecessary data. Ontology is a fundamental description of the information in the world [13]. The ontology in computing refers to knowledge representation applying a collection of concepts and connections among them [8]. In the context of a targeted discipline, ontology is used to rationally reason and validate concepts in the semantic knowledge model. In theory, ontology is a "formal, explicit specification of a shared conceptualization [10]. It offers a shared vocabulary that can be employed to construct the domain knowledge model, involving objects, concepts, properties, and relationships.

A comparison was made using selected criteria according to the representation schemas used in the current works for representing the domain knowledge module as a part of E-tutoring systems. The criteria used to compare the proposed model with others in the literature covered the terms: standardbility, shareability, reusability, flexibility, simplicity, and reasoning engine, which are indicated in Table 1. In the columns, the following properties are represented: C1: standardability, C2: shareability, C3: reusability, C4: flexibility,C5: simplicity and C6: reasoning engine.

3 Proposed Domain Knowledge Module

Based on the properties of the learning content, two kinds of ontologies were introduced: a) general concepts for domain knowledge module ontology and b) specific domain knowledge module ontology. The general concepts of the proposed ontology

Table 1: Comparison of the models

Representation schema	C1	C2	C3	C4	C5	C6
knowledge graph	+	+	+	-	-	+
semantic network	+	+	+	-	-	+
rule-based	-	-	-	-	-	+
case-based	-	-	-	-	-	+
belief network	-	-	-	-	-	-
DITA architecture	+	+	+	-	-	-
ontology-based	+	+	+	+	+	+

domain knowledge module deal with the domain knowledge module's concepts and define the relationship related to these concepts. The ontology of a specific domain knowledge module deals with the selected subject area that can relate the selected subject domain to the general concepts for the domain knowledge module. It seems like individuals or instances for the general concepts of the domain knowledge module. These modules describe the topic to be learned, provide input to the domain module, provide specific feedback, select problem topic, generate suggestions, and support the learner module. The key structure of our proposed domain knowledge module is shown in Figure 1.

The proposed model is based on topics, attributes, task assessments, material forms, learning levels, learning rules and relations. To share and reuse the knowledge module in E-tutoring systems, ontology is utilized to manage and represent the domain knowledge module. The benefit of this model is to personalize the material forms, make suggestions, and automatic assessments for students.

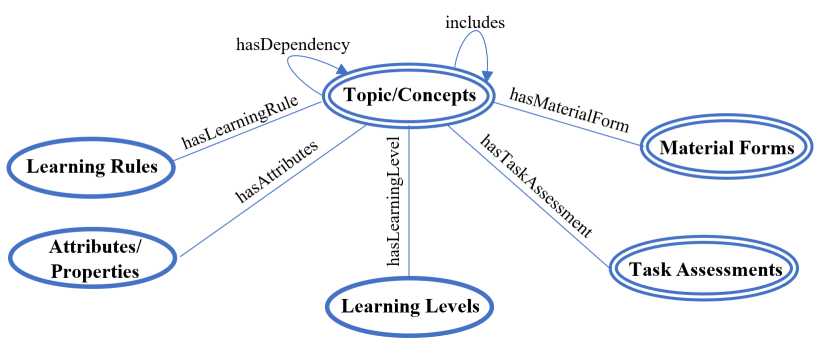

Figure 1: The proposed domain knowledge module

Based on the general concepts of the proposed domain knowledge module ontology displayed in Figure 1, topics, attributes, task assessments, learning levels, learning riles, and material forms terms refer to the following: Topic refers to knowledge modules as a unit of instruction representing domains, key concepts, or education units of the learning materials. Attributes refer to slots as an atomic property of the topics. Every slot has a value domain and concept type. Learning rule refers to rules or constraints defined on the topics and the attributes. A learning rule is a group of explicit or implicit ontology constraints or principles managing behavior or procedure in a particular activity area. Task assessment refers to the task as an activity related to the topics and attributes/properties. Task assessment describes an activity to be performed by learners. Material forms refers to teaching material for the topic. Material forms are teaching materials used to learn the topic. Material forms contain any parts of the academic institution or education material. Regarding the primary relationships, the ontology model contains the following elements: Topics taxonomy relationship: it defines the specialization among the topics. Topics component relationship: one topic consists of other topics. Topics and competency relationship among the topics. Figure 2. Indicates the case study structure of a specific domain knowledge module ontology for the world history domain in the E-tutoring system. We use various kinds of relationships in the case study, such as specialization or generalization, association, and containment. Containment denotes that a specific topic within a domain includes different concepts (has-a). The specialization or generalization indicates that topic has specific topics (is-a). Finally, association means a specific topic associated with attributes/properties, material forms, and task assessments. Based on Figure 1 and Figure 2, the following shows a brief description of a subject:

- *Topic Concepts*: Loop, Condition, Iterative Loop.
- *Dependency*: Logical Operator, Relational Operator.
- *Task Assessments*: program output, code review.
- *Attributes*: syntax, operators.
- *Material Forms*: Web, Textbook, Media.

4 Implementation of the Proposed Module

The proposed module is implemented as a prototype system includes the back-end, which is the ontology domain knowledge of the selected module, and the front-end, which is the interface design of the prototype system that allows the learner to use the functionality of the proposed module that can integrate the ontology domain knowledge module with the E-tutoring framework using Python. Python is the most commonly used language for implementing the ontology domain knowledge module, which can apply to the E-tutoring system. It is an object-oriented and extensible programming language [10]. It offers different modules, frameworks, and packages for handling and implementing ontology. Python can be integrated with

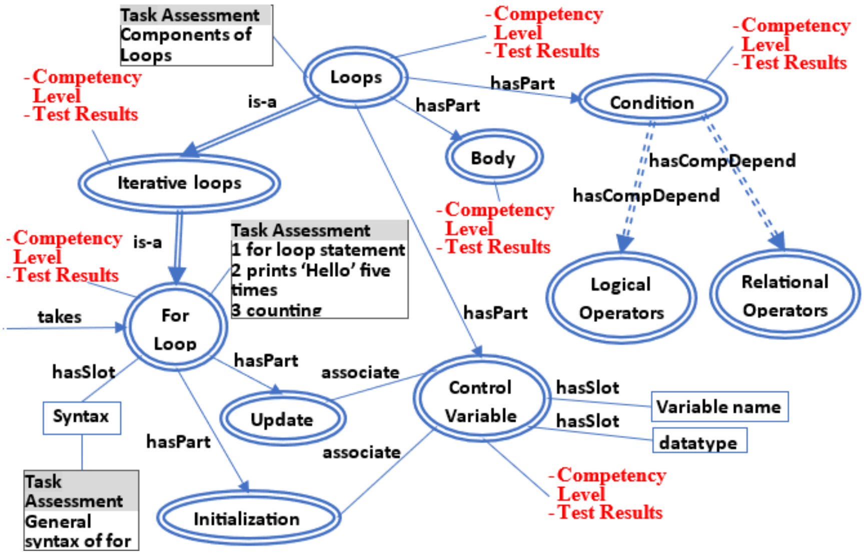

Figure 2: Domain knowledge module sample

an OWL ontology using Owlready2 and Flask. Owlready2 was employed to get transparent access to ontologies, manipulating the classes, object and data properties, individuals, property domains, ranges, annotations, constrained datatypes, disjoints, and class expressions. Flask is a Python Web framework that allows the rapid design of web applications [10]. The domain knowledge module considered here is "History," The ontology created consisted of the "World History." Figures 3, 4, 5, 6, 7, and 8 show the implementation of the proposed module. In Figure 3 a snippet shows topic components construction while. Figure 4 displays a snippet of the object property of the topic module. Figure 7 presents a topic instance. Checking the consistency of the ontology is shown in Figure 5. Rule construction and adding new knowledge are indicated in Figure 6. Figure 8 represents the topics and their task assessments.

```
# Domain Knowledge Module Components
with History:
    class Topics(Thing): pass
    class Attributes(Thing):pass
    class TaskAssessments(Thing):pass
    class MaterialForms(Thing): pass
    class LearningLevels(Thing): pass
    class LearningRules(Thing): pass
```

Figure 3: Domain knowledge model components

```
#Object Property of the Domain Knowledge Module
class hasParts(Topics >> Topics): pass
class partsOf(Topics >> Topics):
    inverse = hasParts
class hasDependencies(Topics >> Topics): pass
class dependencyOf(Topics >> Topics):
    inverse = hasDependencies
class hasParents(Topics >> Topics): pass
class parentsOF(Topics >> Topics):
    inverse = hasParents
```

Figure 4: Object property of the domain knowledge

```
try:
    sync_reasoner()
    print("Ok, the ontology is consistent.")
except OwlReadyInconsistentOntologyError:
    print("The ontology is inconsistent!")
```

```
* Owlready2 * Running HermiT...
    java -Xmx2000M -cp C:\Users\Hussein Ghanim\anaconda3\lib\site-packages\owl
ib\site-packages\owlready2\hermit\HermiT.jar org.semanticweb.HermiT.cli.Comman
ta/Local/Temp/tmp1m9xrqtt
```

Figure 5: Checking the consistency of the ontology

```
with History:
    imp = Imp()
    imp.set_as_rule("""
    Topics(?to), hasAttributes(?to, ?a),
    hasDependencies(?to, ?d), taskScore(?t, 2),
    tasksOf(?to, task1)-> hasLevels(?t, ?bl)""")
```

Figure 6: Rule construction for adding new knowledge

```
PREFIX topic: <http://test.org/history.owl#>
SELECT DISTINCT ?topic ?description
WHERE {?t a topic:Topics.
       ?t topic:topicName ?topic.
       ?t topic:topicDescription ?description.}
```

```
Topic Concept: Initialization Description: Initialization of For loop in C++ Programming
____________________________________________________________________________
Topic Concept: Update Description: Update of For loop in C++ Programming.
____________________________________________________________________________
Topic Concept: Set Description: Set of Foreach loop in C++ Programming.
```

Figure 7: A SPARQL query to retrieve the topics

```
PREFIX topic: <http://test.org/history.owl#>
SELECT DISTINCT ?topic ?task
WHERE {?t topic:topicName ?topic; topic:hasTasks ?ta.
       ?ta topic:taskName ?task.}
Topic Concept: Loops: Task Assessment: Entry control loop
________________________________________________________________
Topic Concept: Loops: Task Assessment: number of iterations in the loop
________________________________________________________________
Topic Concept: Loops: Task Assessment: Loop structures in C++ Programming
```

Figure 8: A SPARQL query to retrieve the task assessments

5 Functionality tests of the e-tutor module

In the functionality test of the proposed module, a specific field in IT, namely the loop structure in programming was selected as target domain. The main Topic Concepts in the corresponding knowledge model are the following elements: iterative loops, conditional loops, while loops, do-while loops, for loops, foreach loops, conditions, body, loop variable, logical operators (see Figure 9).

The domain knowledge module was extended with a set of task elements, too. Task assessments (T-assessments) refer to activities related to the T-concepts and attributes. T-assessments describes an activity to be performed by a student. It contains a task type followed by a list of arguments. It also can be given as a question-answer pair. In addition, the T-assessments can be represented in the form of activities performed by the learners. Syntactically, a T-assessment contains a task type followed by an argument list. The T-assessments may be either primitive or compound. A primitive T-assessments was considered to be performed by a planning operator: the task type is the planning operator's name to apply. The task arguments are the parameters for the operator. A compound task requires separating into smaller tasks using a method; any method whose title unifies the task type, and its arguments may probably be suitable for satisfying the task unit. A Task is aimed at a procedure that defines how to accomplish it. A Task is a combination of steps users follow to produce an expected outcome.

The task can be represented as a pair of questions Q and answer A. The set of all T-assessments is denoted by T=t where t is a T-assessment, the T-assessment is given as a question-answer applying as a function form as shown below: Q(S, Student): list the S of ST ¡S is a field, ST is a table¿ A(S, Student): select S from Student Another key element in the domain knowledge module is the competency relationship which is used to link the Topic concepts. Topic T1 is linked to topic T2 if T1 is a foundation to understand the concept T2. Based on this relationship, if a user fails a test on T2, the engine will suggest studying T1 to the user before retaking the test. The E-tutoring framework also involves a student model database, beside the domain models. It will register in this database the progress and the current knowledge level of the students. The knowledge level indicator is

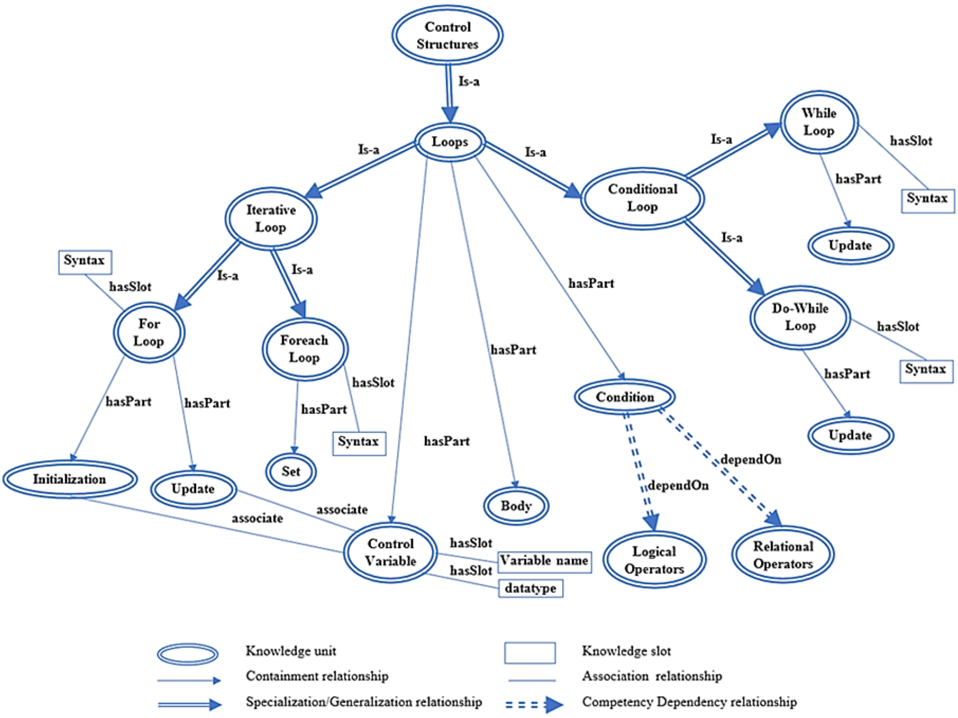

Figure 9: Topic Concepts in Loop Structures domain

given with a pair describing separately the grade of correct and incorrect answers similar to the intuitionistic logic approach (see Figure 10).

A functional test was done to evaluate the student knowledge level in the prototype system, which is integrated with the ontology domain knowledge module. Several task assessments with MCQ were performed. According to that, the result gives feedback according to the student's answer showing if the answer is correct or incorrect. The student status will update and offer suggestions. The suggestion related to task questions, student correct and wrong answers, the student result, knowledge level progress, and suggested reading materials. Figures 11, 12 display a test evaluation of the task assessments for different practices that allow the student to answer the task questions related to the topic concept, and then the student chooses the correct answer and moves to the next task question. After that, the prototype system checks whether the answer is correct or not and provides feedback according to the student's answer.

Figures 13, 14, 15 shows the generated result in detail for the task assessments, the selected task question related to the topic concept, and the learner's answer, and suggests related material if the learner wants to learn more about the chosen topic concept.

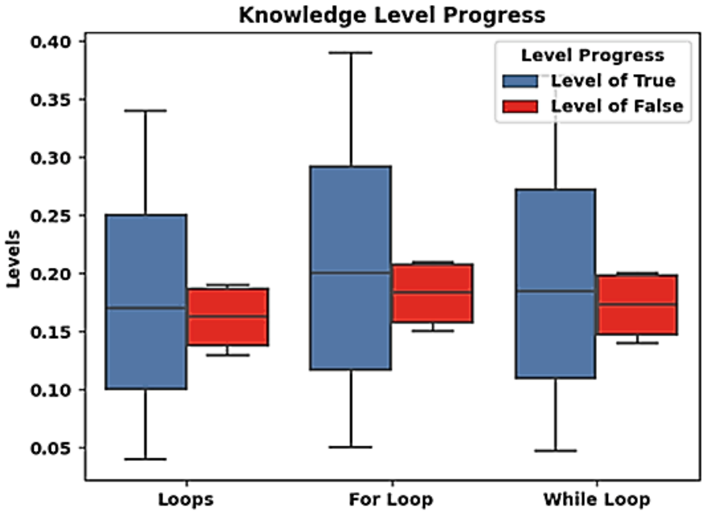

Figure 10: Knowledge level progress

6 Results and Discussions

A proposed model for an ontology domain knowledge module is given in this work. In Section 3, a theoretical module was described based on two kinds of ontologies. First, a general domain knowledge module ontology based on topics, attributes, task assessments, learning rules, learning levels, material forms, and their relations is indicated in Figure 1. Second, a specific domain knowledge module is designed as a case study for the History domain using different relationships such as specialization, generalizations, association, and containment, as shown in Figure 2. In Section 4, an implementation of the domain ontology using Python and Owlready2.

The current work deals with a knowledge module that helps learners understand all the key concepts in a specific topic. The future work recommended is coping with problem solving to support learners in understanding how to use knowledge modules in solving a practical problem. The majority of the domain knowledge module uses a separate knowledge base, which can satisfy the features of reusability, standardability, open knowledge, and flexibility. By employing ontology in constructing the domain knowledge module, we can avoid the problem of isolating knowledge bases, which is the problem of the most current solutions. The domain ontology can be involved in managing adaptive intelligent E-learning frameworks, supporting personalized learning, generating tasks, suggesting materials, and giving hints automatically.

The domain ontology considered in this work has diverse pedagogical goals. These goals include understanding specific domain facts and solving standard problems, obtaining a conceptual and intuitive understanding of the material in the

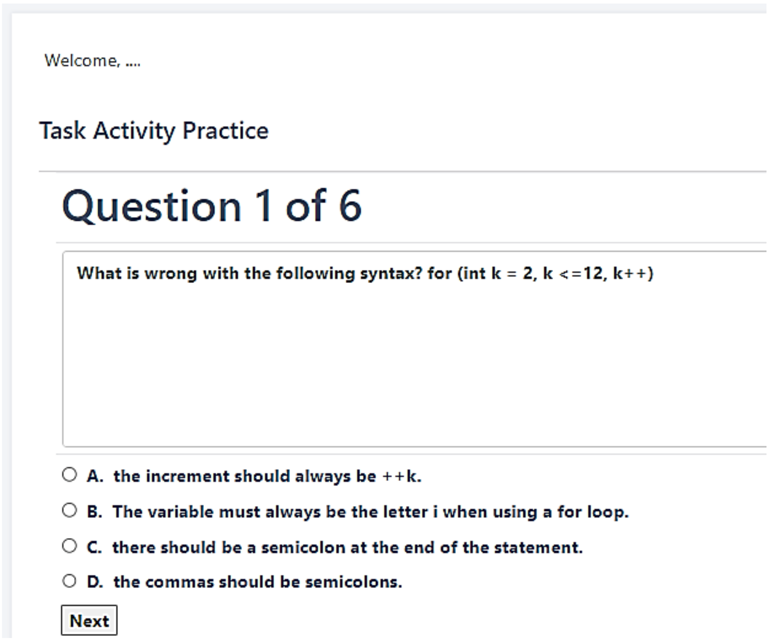

Figure 11: Task assessment interface

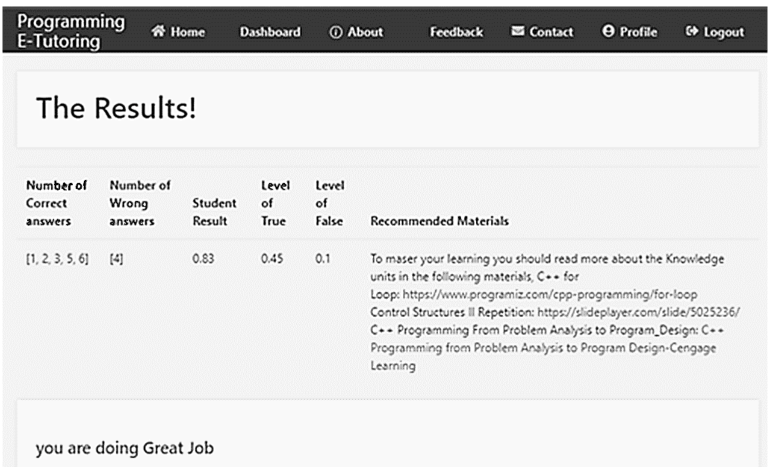

Figure 12: Task assessment result interface

The Results

User Name	Unit Name	Level of True	Level of False	Competency Level
None	For Loop	0.0	0.0	Unknown
None	While Loop	0.0	0.0	Unknown
Test	For Loop	0.21	0.04	weak
Test	While Loop	0.22	0.05	weak
Test	For Loop	0.36	0.07	good
Test	While Loop	0.37	0.08	good
Test	For Loop	0.48	0.09	good
Test	While Loop	0.45	0.1	good
Test	For Loop	0.32	0.31	average
Test	While Loop	0.3	0.32	average

Figure 13: Task results interface

Assessment Ranking

ID	Unit Name	weight	Assessment ID
1	For Loop	None	None
2	While Loop	None	None
3	For Loop	0.75	Loop Assessment
4	While Loop	0.8	While Loop Assessment
5	For Loop	0.8	Loop Assessment
6	While Loop	0.8	While Loop Assessment
7	For Loop	0.85	For Loop Assessment

Figure 14: Assessment Ranking

Study Aid Ranking

ID	Unit Name	weight	Material ID
1	For Loop	None	None
2	While Loop	None	None
3	For Loop	0.75	https://www.programiz.com/cpp-programming/for-loop
4	While Loop	0.8	https://www.programiz.com/cpp-programming/do-while-loop
5	For Loop	0.8	https://www.programiz.com/cpp-programming/for-loop
6	While Loop	0.8	https://www.programiz.com/cpp-programming/do-while-loop
7	For Loop	0.85	https://www.programiz.com/cpp-programming/for-loop
8	While Loop	0.75	https://www.programiz.com/cpp-programming/do-while-loop

Figure 15: Study Ranking

selected domain, and learning general problem solving and metacognitive skills. A major feature of our model is that the knowledge representation techniques used have a standard structure. This standard structure allows general representational inference tools and control mechanisms, facilitating the pedagogical analysis of knowledge.

Several task assessments were tested with correct and incorrect answers using list of questions for evaluating the prototype system, which is integrated with the proposed ontology domain knowledge model. The prototype system generates feedback for the result according to the student answers, it suggests materials for learning more about the knowledge units if the answer is correct and it provide links to related materials if the answer is incorrect. The developed ontology domain knowledge module integrated with the prototype system can be used in managing adaptive intelligent e-learning frameworks in the future. Furthermore, the domain ontology knowledge model can meet various pedagogical goals. These goals include understanding specific domain facts and solving standard problems, obtaining a conceptual and intuitive understanding of the material in the selected domain, and learning general problem solving and metacognitive skills. A significant feature of the selected module is that the knowledge representation techniques have a standard structure. However, the standard structure of the proposed model can allow for general representational inference tools, control mechanisms, and facilitating pedagogical analysis of knowledge. In addition, combining the proposed ontology domain knowledge module with an E-tutoring system can enhance the quality of intelligent problem solving. Also, it will be possible to reuse the knowledge domains. Finally, a proposal of the domain knowledge module for the E-tutoring system can enhance the teaching and learning process, support recommendations, generate hints, and automatically support the generation of problems and solutions.

7 Conclusion

An E-tutoring requires content-specific knowledge and pedagogical, social, and technical factors to manage the complicated procedure affected in an E-learning platform. We first developed general concepts for domain knowledge module ontology which deals with the general concepts of the domain knowledge module and defines the relationship related to these concepts. Secondly, we design a specific domain knowledge module ontology that deals with the selected subject area that can link the selected subject domain to the general concepts for the domain knowledge module. It seems like an individual or instances for the general concepts of the domain knowledge module. Therefore, we created domain ontology for the Knowledge Module, especially in History Domain, to integrate with E-tutoring System. Using ontologies is concerned as a knowledge representation for describing the domain knowledge module, which can provide solutions to fundamental problems in this subject—also, an approach for organizing the ontology domain knowledge module presented and discussed. Furthermore, a proposed method explains how the ontology domain knowledge module can be combined with an E-tutoring system to enhance the quality of intelligent problem solving. Also, it will be possible to reuse the knowledge domains and design E-tutoring frameworks. Finally, a proposal of the domain knowledge module for the E-tutoring system can enhance teaching and learning, support recommendations, generate hints, and support the generation of problems and solutions automatically.

The developed ontology domain knowledge module can be used in managing adaptive intelligent e-learning frameworks in the future. Furthermore, the domain ontology knowledge module can meet various pedagogical goals. These goals include understanding specific domain facts and solving standard problems, obtaining a conceptual and intuitive understanding of the material in the selected domain, and learning general problem solving and metacognitive skills. A significant feature of the selected module is that the knowledge representation techniques have a standard structure. However, the standard form of the proposed module can allow for general representational inference tools, control mechanisms, and facilitating pedagogical analysis of knowledge. In addition, combining the proposed ontology domain knowledge module with an E-tutoring system can enhance the quality of intelligent problem solving. Also, it will be possible to reuse the knowledge domains. Finally, a proposal of the domain knowledge module for the E-tutoring system can enhance the teaching and learning process, support recommendations, generate hints. In the future the suggested module can be improved by adding some functionalities and automatically support the generation of problems and solutions.

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