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Performance of Ontology classification for Self-Assessment in Educational Data Mining

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Abstract

Students, through all phases of training, handle new information with regards to learning remembered all through their past instruction. To self-foresee individual capability in training, self-appraisal goes about as an essential learning input. The in-house created Studio suit for instructive self-appraisal empowers to show the instructive space as a metaphysics based information structure, associating evaluation inquiries and learning material to every component in the cosmology. Self-appraisal tests are then made by using a sub-metaphysics, which outlines a customized testing environment fitting to the focused on instructive field. In this paper we give an outline of how the instructive information is demonstrated as space metaphysics and present the ideas of various relations utilized as a part of the Studio framework. We will deduct how the introduced self-evaluation makes utilization of the information structure for web testing and how it adjusts the test to the execution of the understudy. Further we highlight where possibilities are for the following phases of improvement.

Keywords: Education, Adaptive Test, Self-Assessment, Educational Ontology

1. Introduction

Students investigating new fields of training are constantly gone up against with inquiries in regards to their individual advancement: what amount do they know after cycles of learning, in which bearings would it be advisable for them to advance to fill the field most viably, how to get a handle on the blueprint and subtle elements of the field and what amount of their time would it be advisable for them to put resources into learning? Particularly in advanced education, where learning turns into a self-directed, customized process, Students need persistent self-evaluation to catch their present condition of capability. In the meantime, the unframed, casual self-expectation of Students in regards to their own abilities is regularly substantive and methodicallly defective [1]. Here a deliberate and target answer for self-appraisal is generous to keep a wrong or one-sided self-assessment and to bolster the self-forecast of the individual capability.

Taking after Jonassen, learning in training could be part into nine sorts crosswise over three classifications to catch the human's subjective conduct. In his talk, eight out of nine information sorts underline that learning in the extent of learning is interrelated and unequivocally connected with past encounters [2]. All things considered, a supporting answer for self-appraisal ought to get a handle on and formalize the learning to survey with regards to related information.

The Studio suit for instructive self-evaluation, displayed in this paper, gives here a product answer for testing the individual capability with regards to related learning. It empowers to model zones of instruction as a significant hotspot for evaluation and river the hole between a possibly imperfect self-expectation and the genuine capability, by offering a target and versatile online information test. To take after the common learning process and empower a simple augmentation, the product inserts the evaluated information into a system of logical learning, which empowers to adjust the appraisal to the reactions of the Students.

This paper will give an outline of the Studio instructive area philosophy and the parts of the framework supporting customized self-appraisal. Further it will highlight possibilities for information mining on the accumulated instructive information with a point of view toward the following phases of assessment.

2. The Studio Approach For Self-Assessment

The fundamental idea of Studio is to demonstrate the engaged instruction as an interrelated information structure, which separates the training into sub-territories and learning things to know. The oversaw structure formalizes the connection between information ranges as a learning setting and models the necessities to ace particular parts of the instruction. This structure is utilized to make and bolster information tests for Students. Through this mix of appraisal and learning structure, the understudy picks up the flexibility to investigate single information things as well as the training with regards to related information regions, while the implanted necessities are utilized to outline displayed information against the normal instructive result. The evaluation framework is intended to be joined by periods of learning inside the framework, where the understudy accesses learning material, taking into account and upheld by the test input. This consolidated methodology offers a special self-evaluation to the Students, where the support information setting is utilized to adjust the appraisal in reliance of the test execution of the understudy. Prior to any normal examination Students may utilize Studio to evaluate their insight all alone. It is the guide's obligation to set the course of self-evaluation test in Studio framework by selecting learning territories and sub-information regions which are pertinent for the objective instruction from the area philosophy. At that point the edge will be naturally finished with components from the philosophy which detail the chose learning zones and are demonstrated as required for this a player in the instruction. As the framework stores appraisal questions for every information component, Studio will then consequently set up an evaluation test, taking into account the characterized choice and the area philosophy. The subsequent information test is then available as a self-evaluation test for the understudy, who investigates the supported information structure, which pictures the normal learning result, in cycles of testing, reflection and learning. The procedure of test definition and evaluation is appeared in Figure 1, while the outcome planning for reflection and learning is talked about in area 2.5.

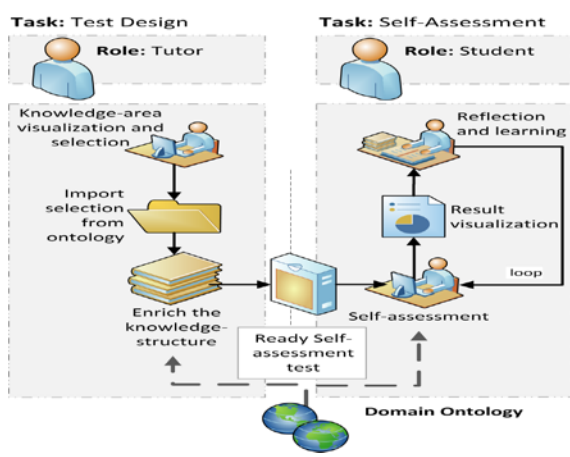

Figure 1: The overall design, assess and reflection cycle of the system.

2.1. The Educational Domain Ontology

The Studio framework depends on a predesigned instructive philosophy, clarified in subtle element by Vas in [3]. Area philosophy is a habitually utilized term as a part of the field of semantic advancements and underlines the capacity and conceptualization of space learning and is regularly utilized as a part of various activities and arrangements [4][5][6] and could address an assortment of areas with various qualities in their creation, structure and granularity, contingent upon the point and the displaying individual [7]. A specialization as far as the field is the instructive space cosmology which is an area metaphysics adjusted to the region and ideas of training. They could focus to show distinctive parts of instruction as the educational programs or viewpoints important for the assignment of learning and course creation [8][9][10] or portray the configuration, use and recovery of learning materials till making courses [11], and in addition straightforwardly the learner inside the training [12]. Inside the territory of instructive ontologies, area ontologies tend to show excessively particular points of interest of the training, trying to demonstrate the particular field as complete as could be expected under the circumstances. This empowers a complete perspective on the field yet it comes at the expense of sweeping statement, with the possibility to be resolute to handle changes. Different ideas show the training crosswise over various ontologies, coordinating ideas like the learner, the instruction and the course portrayal, presenting an expansive skyline yet with extra overhead to consolidate demonstrated bits of knowledge and reason on new occurrences. The claim of the Studio instructive cosmology is the size and center of the principle classes and their connections between each other. The information to learn is the primary interfacing idea in the center of training. It empowers an incredible adaptability to be clever for various training related inquiries. An illustration is here the business procedure administration expansion PROKEX, which maps process necessities against information zones to make evaluation test, mirroring the prerequisites of appended procedures [13]. A critical variable in learning is the separation between the desire of the coach and the learning execution of the understudy. Here a short cycle of rehashed appraisal and learning is a main consideration for a superior individual learning execution [14]. This perspective straightforwardly profits by the engaged fixation on information territories as the principle trade idea amongst Students and guides. As much further the nearby associations amongst learners and instructors by means of direct coaching is one noteworthy empowering influence for PC helped frameworks [15], every progression towards a more straightforward cooperation through centered ideas is an extra supporter. The class structure melds interrelated information with a model of the fundamental sorts of instructive ideas, required in circumstances of individual learning. Figure 2 pictures the class ideas as information components, together with the connection sorts, used to display the conditions between various parts of information and learning inside the instructive metaphysics.

The Knowledge Area is the super-class and center idea of the metaphysics. The metaphysics characterizes two characteristics of principle relations between learning territories: Knowledge regions could be a sub-information range of other learning regions with the "has_sub-knowledge_area" connection or be required for another learning territory with the "requires_knowledge_of" connection. A learning range may have different associated information regions, connected as a prerequisite or sub-region. The "requires_knowledge_of" connection characterizes that a hub is required to finish the learning of a guardian information zone. This strict idea models necessity reliance between fields of information in instruction and yields the possibility to survey perquisites of learning, simple to the fundamental thought of perquisites inside learning spaces, created by Falmagne [16]. Instruction is an organized procedure which parts the information to learn into various sub-parts of learning. Learning zones in the cosmology are stretched out by an extra sub-layer of information components keeping in mind the end goal to adequately bolster instructive and testing necessities. Figure 2 envisions the sub-components also, their relations. By part the surveyed information into sub concepts, the cognizance and relationship of self-appraisal inquiries could be communicated all the more productively and with the capability of a more definite instructive criticism.

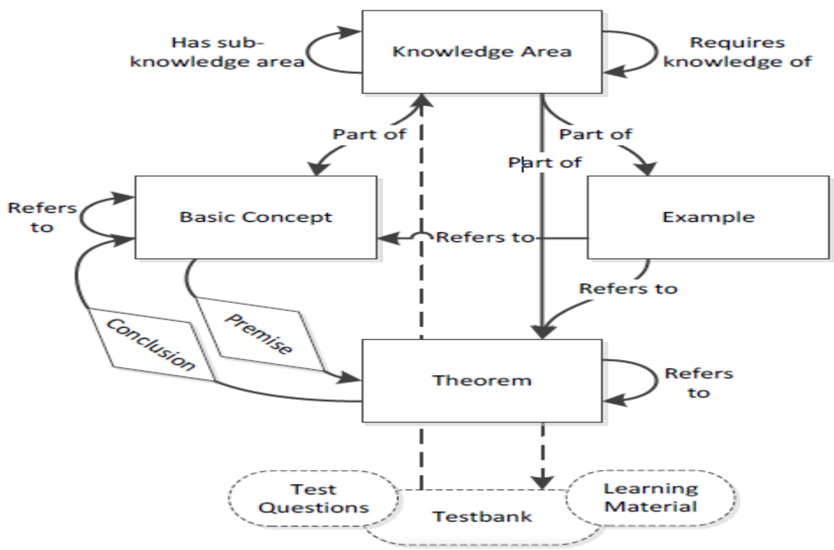

Figure 2: Model of the Educational Ontology

Hypotheses express in a consolidated and organized way the crucial experiences inside learning regions. They intertwine and clarify the essential ideas of the delineated learning and set them in connection to the earth of learning with illustrations. Various hypotheses could be "part_of" an information zone. Each hypothesis may characterize various Basic Concepts as a "reason" or "conclusion", to structure how the parts of the information region are connected. Cases improve this parts as a solid grapple for self-appraisal questions and "refer_to" the hypotheses and essential ideas as a "part_of" one or more learning ranges.

2.2 The Test bank

Keeping in mind the end goal to associate the assignment of self-appraisal with the model of the instructive area, the framework coordinates a store of evaluation questions. Every inquiry addresses one component of the general learning and is straightforwardly connected with one learning territory or information component occurrence inside the metaphysics. The area cosmology gives here the structure to the online self-evaluation while the archive of inquiries supplements the territories as a test bank.

The objective of the self assessment is to persistently enhance the individual learning inside the evaluated instructive zones, by giving input on the execution after every period of testing. To do as such, the Studio framework incorporates

Learning Material associated with the test bank and the learning zones, simple to the test questions. The learning material is sorted out into segments as an organized content with blended media, as pictures and recordings, and depends on a wiki engine to keep up the substance, including outside connections.

2.3 Creating and Maintaining Tests

The creation and proceeds with upkeep of the area philosophy is an assignment of philosophy building. The philosophy design (the cosmologist), makes, utilizes and assesses the cosmology [17], with a solid spotlight on keeping up the structure and substance. Inside Studio, this procedure is guided and upheld by a particular organization work process and parts in three back to back errand territories, in accordance with diminishing access rights:

- **Ontology engineering (instance level):** The creation and linking of instances of the existing knowledge-area classes into the overall domain ontology.
- **Test definition:** Knowledge areas, which are relevant to a target self-assessment test, are selected and grouped into specialized containers called Concept Groups (CG). These concept groups are organized into a tree of groups, in line with the target of the assessment. The final tree in this regards captures a sub-ontology. Concept groups are internally organized based on the overall ontology and include all relations between knowledge elements, as defined within the domain ontology.
- **Question and learning material creation:** Questions and learning materials alike are directly connected to single knowledge areas within the designed test frame and get imported, if already existing, from the domain ontology. More questions and learning materials are defined now, in line with the additional need of the targeted education and are available for future tests.

3. System Evaluation

The system has been used, extended and evaluated in a number of European and nationally funded research projects, including applications in business process management and innovation-transfer [20], medical education [21] and job market competency matching [22].

Currently the system is being evaluated based on a running study with 200 university students in the field of business informatics. The study will conclude on two current research streams which are improving the systems testing and analysis capability. The first direction looks into potentials for the integration of learning styles into adaptive learning systems to offer valuable advice and instructions to teachers and students [23]. Within the second direction the question is challenged on how to adapt the presented self-assessment further towards the performance of the students, based on extracting assessment paths from the knowledge structure [24].

For each running test, Studio collects basic quantitative data about the number of assigned questions, how often tests are taken and how many students open which test and when. This is completed by qualitative measures, collecting which questions and knowledge elements the students passed or failed. To conclude further on the mechanisms and impacts of Studio within the current study, a new logging system was developed, collecting the interaction with the system and detailed information about the feedback as detailed events.

Each event stores information about the system in 7 dimensions, as described in Table 1 below:

Table 1: Event blueprint to store events concerning system interaction.

Attribute	Description
Event description code	Which type of event and what factors are relevant.
Location code	On which part of the assessment-process or interface the event has occurred.
Session identifier	Each access of the system is one session for one user.
Numerical value storage	Multi-purpose field, filled depending on the event type.
String value storage	Multi-purpose field, filled depending on the event type.
Event-time	The time of the start of the event.
Item reference	A unique reference code, identifying the correlated item within the ontology. E.g. a question or a knowledge-element ID.

All events are stored in order of their occurrence, so if no explicit end event is defined, the next event for the same session and user is acting as the implicit end date. Extending the existing storage of information within Studio, the new logging system stores the additional events, as shown in Table 2 below:

Table 2: Assessment events and descriptions.

Event type	Description
START_TEST	Marks the start of a test.
END_TEST	Marks the end of a test.
OPEN_WELCOME_LM	The user opened the welcome page.
OPEN_LM_BLOCK	The student opened a learning material block on the test interface.
OPEN_LM	The student opened the learning material tab on the test interface.
RATE_LM	The student rated the learning material.
CHECK_RESULT	The student opened a result page.
CONTINUE_TEST	The student submitted an answer.
FINISH_TEST	The test has been finished.
SUSPEND_TEST	The user suspended the test.
RESUME_TEST	The user has restarted a previously suspended test.
SELECT_TEST_ALGO-RITHM	The algorithm used to actually test the student is selected.
TEST_ALGORITHM_-EVENT	The behavior of the current test algorithm changes, e.g. entering another stage of testing.
ASK_TESTQUESTION	Sends out a test question to the user to answer.
STUDIO_LOGOUT	The user logs out of the Studio system.

4. Next Steps

The domain ontology offers a functional and semantically rich core for supporting learning and education. Yet not all the semantic potentials are fully leveraged to support and test the learner's progress. The "requires_knowledge_of" relation-requirement is a potential start-concept to model sub-areas as groups which together compose the dependency. This could act as an additional input for the assessment, where the system derives more complex decision how to further explore the related parts of the structure [25]. This could also be visualized, enabling the learner to grasp the personal knowledge as a visible group of concepts. Besides giving colors to the different types of relations, the visualizing of edges between knowledge areas is yet unfiltered, offering no further support for navigation. A next stage of implementation could be the introduction of a visual ordering and grouping of knowledge areas and relations. Underlying relations of sub-nodes could be interpreted visually through the thickness of relations between nodes, easing the perception of complex parts of the domain ontology, especially within administration and maintenance tasks. The feedback of the current evaluation study of Studio will provide additional insights into the usage of the system by the students. Based on this new data it is possible to mine profiles over time on the knowledge structure. One major application is here the creation of behavior profiles, as proposed in [23].

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