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Research paper

How To Motivate Students Through mining Educational Data

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Abstract

Despite having educational data mining as a new research area, it has already made contributions to the learning theories and their teaching practices. The aims of this article are to present a way of improving both the student and the teacher performance, and to empower educational institutions through exploring data and through examining them with the purpose of motivating students in different aspects of their performance.

Keywords: *educational data mining, the learning theories, performance, motivating students*

1. Introduction

As a human teacher can adapt to an individual student, the same teacher can also learn more about how students learn, reflect and improve his/her practice by studying a group of students. Here, Educational Data Mining comes to help teachers to make an appropriate action that will motivate students in a wide variety of educational systems. In order to building a picture of the learners, of learning, of their interests, data is only one part of that picture used for translating their interest into appropriate actions. Hence, Educational Data Mining allows policymakers, administrators and teachers to improve the students' conditions in the context of higher education; more precisely, it focuses mainly on the enhancement of teaching and learning processes, and the students and teacher performance as a model of continuous school evaluation and improvement. Educational data can actually generate a framework for students and teachers to choose when, where, and how the self-evaluation and improvement occur. Furthermore, data analytics encourages predicting the performance at the end of the semester. Through discerning the pattern in the data and making sense of what is happening, one can predict what should come next and take the suitable decision.

2. Definition of Educational Data Mining

Educational data mining (EDM), as a research field with a suite of computational and psychological methods, has been referred to as "an emerging discipline, concerned with developing methods for exploring the unique types of data that come from educational settings, and using those methods to better understand students, and the settings which they learn in(IEDMS)[1]. In addition, educational data mining is also defined as "the process of converting raw data from educational systems to useful information that can be used to inform - and to - design decisions and answer research questions [2].

However, The EDM definition provided by Lai and Schildkamp [3] goes further to be defined as "information that is collected and organized to represent some aspect of schools[;]This can include any relevant information about students, parents, schools, and teachers derived from qualitative and quantitative methods of analysis. This definition suggests the idea that EDM is not limited on the students' grades in the final exam, but it is generally operated in a wide variety of educational institutions.

3. The relationship between EDM and school autonomy

The use of Educational Data Mining to identify, to collect, combine, analyse, interpret and act upon data from different sources is increasingly required to achieve better educational outcomes, as well as more efficient and productive school operations. This can be undertaken through applying the concept "School Autonomy, which has been seen as the centre of educational system reform policies in terms of teaching professional practices and school quality outcomes. Clearly, university autonomy was original derived from the fact that policies are reformed due to the critical decisions of school leaders. This view leads to talking about data-driven decision-making in schools. For the support of School Autonomy, data-driven decision-making is a continuous process of exploring, gathering and examining educational data from different sources to evaluate and to improve the process and outcomes of school. In this sense, Arcia et al. [4]consider data-driven-decision making as "a form of … management in which [universities] are given decision-making authority over their operations. This form of management encourages to using DM as well as to provide particular objectives to the DM users.

4. Using Data Mining to Motivate Teaching and Learning Processes

The objectives of data mining are to improve the teaching and learning processes, and to have each user do whatever to evaluate and increase the effectiveness of their performance in terms of learning material and educational web-based courses; e-learning. For all these reasons above, our study will use Intelligent Tutoring Systems (ITSs) to explore and gather student learning data for better understanding how a student learns. Intelligent Tutoring Systems (ITSs), which can track and record information about when each learner uses, how many times they access particular courses, and how many minutes a particular course is being shown on each user's computer screen.

In general, the systems above are applied to develop predictive modelling of four main stakeholders. As Romero and Ventura [5] suggest, the following table helps each user/ stakeholder to receive their interests and objectives through using EDM:

Table 1: EDM users/ stakeholders.

Users/Actors	Objectives for using data mining
Learner/ Students/ Pupils	To personalize e-learning; to recommend activities to learners resources and learning tasks that could further improve their learning; to suggest interesting learning experiences to the students, to suggest path pruning and shortening or simply links to follow, to generate adaptive hints, to recommend courses, relevant discussions, etc.
Educators/ Teachers/ Instructors/ Tutors	To get objective feedback about instruction; to analyse students' learning and behaviour; to detect which students require support; to predict student performance; to classify learners into groups; to find an learner's regular as well as irregular patterns; to find the lost frequently made mistakes; to determine more effective activities; to improve the adaptation and customization of courses, etc.
Course Developers/ Educational Researchers	To evaluate and maintain courseware; to improve student learning; to evaluate the structure of course content and its effectiveness in the learning process; to automatically construct student models and tutor models; to compare data mining techniques in order to be able to recommend the most useful one for each task; to develop specific data mining tools for educational purpose; etc.
Organizations/ Learning Providers/ Universities/ Private Training Companies	To enhance the decision processes in higher learning institutions; to streamline efficiency in the decision-making process; to achieve specific objectives; to suggest certain courses that might be valuable for each class of learners; to find the most cost-effective way of improving retention and grades; to select the most qualified applicants for graduation; to help to admit students who will do well in university, etc
Administrators/ School District Administrators/ Network Administrators/ System Administrators	To develop the best way to organize institutional resources(Human and material) and their educational offer; to utilize available resources more effectively; to enhance educational program offers and determine the effectiveness of distance learning approach; to evaluate teacher and curricula; to set parameters for improving web-site efficiency and adapting it to users (optimal server size, network traffic distribution, etc.)

All the objectives above provide an overall view of educational instructions that enable users, especially teachers, to classify students into different groups based on their needs in guidance and support, to evaluate the structures of course content, to organize the contents efficiently to the progress of the learner and adaptively constructing instructional plans, and so on. The educators may also identify the students' interests and adapt the most effective activities to successfully integrate their desires into the given courses as well as to discover as more information about their learning process as possible.

To end up with critical decisions such those mentioned above mainly needs a continuous process of motivating students' behaviours and their needs. All in all, we can say that the only way to make students truly satisfied is to incorporate their interest in learning processes, and to incorporate their interest is to apply the educational data mining.

5. Educational Data Mining Applied in Building an Overview of A Learner

Educators and academics are responsible for organizing teaching designing, understanding the effectiveness of their instructional courses, and motivating students to break through different psychological barriers. To successfully make use of these elements, we should carefully take a look at the following diagram:

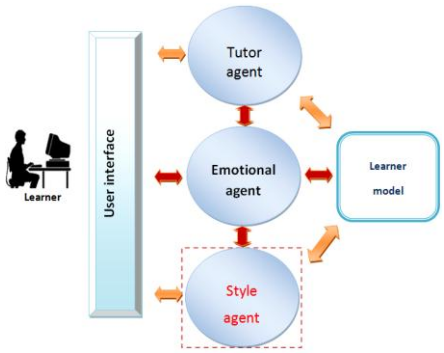

Fig. 1: Global System Architecture

The diagram is from a previous study [6]represents a system based on the concept of agents in an emotionally intelligent Tutorial System called ASTEMOI.

- Tutor agent: Is the agent in charge of managing the courses and cognitive status of the e-learner [7]
- Style agent: Using the Felder Questionnaire[8] we can determine the suitable learning style of the e-learner.
- Emotional agent: The role of this agent is to determine the emotional status of the e-learner using the results of the voice analysis and the feedback.

Since every learning situation's central objective is to provide the learners with good-quality training, the ASTEMOI system highly considers the learners' needs and also their strengths and weaknesses, because they are the main factors to boosting e-learners performance and improving the quality of e-learning applications.

In a learning environment envisioned, the student will take the time to answer the questionnaire of Felder [9], something essential to determine his/her appropriate learning style, even give them a personal profile where their strengths and weaknesses in a specific discipline/ course will be taken into account. The style agent of ASTEMOI system has a predictive model that tries to achieve this goal.

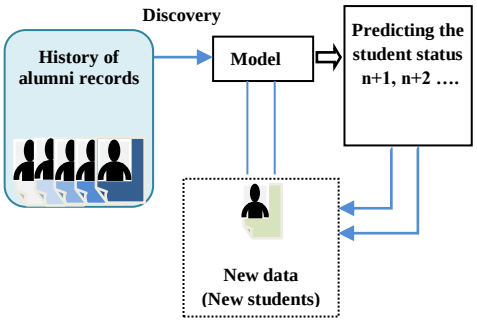

Fig.2: Predictive model in the system ASTEMOI

This model in the system ASTEMOI has been recording any historical information about old learner's progresses, interests, and motivation; therefore, it tries to apply the old data to the new one.

6. The role of ASTEMOI in Boosting Learners' Motivation

Motivation, as one of the fundamental factors in the learning process, plays an incentive dimension of the learner's profile, which is reflected through his motivational abilities directly associated to his emotional and cognitive states. By using ASTEMOI, we can establish some mechanisms that support the motivational state and that endorse the applications of learning process.

In this stage, AlaouiHarouni et al. suggest in their study that there are many theories that help in better understanding the learners' motivation; however, we are going to choose only one, which is known as the self-determination. Self-determination [10]is a famous modern theory among psychologists. According to this theory, the human motivation is based on three psychological needs: the need for autonomy, competences, and the need for social relatedness. The possession of these three needs leads to a feeling of satisfaction and well-being for the individual [11].

Every student possesses a particular kind of motivation that helps him/her complete an interesting mission of his or hers. Our study will be focused mainly on two types of motivation:

- Intrinsic motivation is thought to be as the highest level of self-determination and motivation that an individual can ever reach [12]. It is usually self-applied, which comes from a direct relationship between an individual and a certain situation. It plays a very important factor in the successful learning processes.
- Extrinsic motivation is related to a behaviour driven from external rewards or punishment such as money, fame, grades, praise, reprimand or rebuke [12]. This type of motivation comes from outside the individual, which is opposed to the intrinsic motivation. By going from the highest degree of self-determined motivation to the lowest, we find three different types of regulation: identified regulation, introjected regulation and external regulation.

•The identified regulation, According to Charms(1968), is the least autonomous; it is performed because of external demand or possible reward. Such actions can be seen to have an externally perceived locus of causality.

•The introjected regulation is when an individual performs an activity only to avoid possible feelings of guiltiness, nervousness, or to satisfy his ego [13].

•The external regulation is when an individual is driven by outside factors such as material rewards or punishments.

7. Improving the Motivation Through ASTEMOI

The main objective behind our work is to establish a suitable learning environment in which educational data analysis will help us understand the learners' behaviours and predict profiles that are going to fit in the improvement of motivation according to the results that we have found. Therefore, the learner will be extrinsically motivated so as to satisfy his/her three self-determination theory psychological needs:

- Helping learners to acquire the freedom of decision making in order to encourage their needs for independence and autonomy in the sense that they have the ability to decide and choose whatever they see is appropriate for them.
- Guiding the learners by providing them with a pedagogical support, and praising the learners when they accomplish an achievement or successfully complete a task or an activity to boost their self-confidence. We can also assist the learner when he/she fails to perform well and not to make them feel unable and powerless.
- To give the learners the opportunity to share a common learning experience and give them the chance to interact with each other by utilizing competitive activities [14].

All these needs have been supporting the fact that the learning style we assign to the learners during the training is proportional with their degree of motivation.

8. The Impact of Using EDM on the Quality of Teaching and Learning

It is worth noting that the use of the Internet in educational environment has created a new context such as e-learning or web-based education in which large amounts of data about learning-teaching interaction are endlessly generated by the users and clearly available to them. In other words, "[w]hen learners interact with a digital device, data about that interaction can be easily captured or logged and made available for subsequent analysis" [15]. Such data, therefore, are applied to EDM as a means of better understanding students and their learning processes, and developing computational approaches that combine data and theory to transform practices to benefit learners. In general, Romero and Ventura [16]provide a cycle of using Data mining, which illustrates the whole processes of learning and teaching.

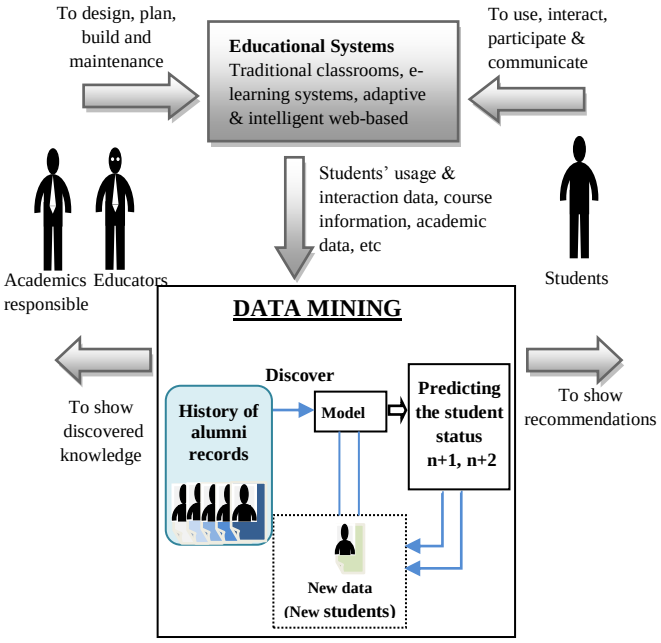

Fig.3: The cycle of applying data mining in educational systems.

For example, administrators would like to know which students will excel in particular courses and which students will need assistance in order to graduate. Policymakers may hope to know the students requirements and to predict the most effective instructional materials. Learners may also like to know how best to select courses based on prediction of how well they will perform in the courses selected. Teachers may wish to find out what the learning experiences are most sufficient and why one class surpasses the other. Hence, they would like to know which subjects their learners excel and which struggles they would have. To make decision of classroom processes requires administrators to examine learners' behaviour, analysing data, to determine the effective pedagogical strategies in a formative manner, and to improve the educational materials [17].

In this sense, data are not only presented to particular administrators so as to make strategic decisions about the institutional policies, but also aims to help any user to receive their interests and objectives.

9. Application of EDM on Motivating Students' Achievement and Performance

The aim of this study is to present a course which approaches the learner's attempts and which reduces the irrelevant proposition (Which is not appropriate to the need of the learner adult) goes through the modelling algorithms of the subjects. In our website, we will create a search engine that is capable of suggesting links selected by theme and the historical record of each learner. Our content-based filtering system recommends documents similar to those that the user has already appreciated in the proposed links. This is calculated by approximating the interests of users (implicitly introduced through the monitoring of their behaviour).
The filtering system suggests complements concerning the following axis:

- Knowing the importance of this science.
- The definition of this science its subdivisions.
- Representation of each course section
- General rules.
- Some applications of this science.
- The ability to derive these provisions.
- Questions about the chapter, and so on.

During a learning session, every action taken by a learner will be automatically saved and stored in the form of a structured journal, written in a text file, and delimited by tabs. Each entry in the log file contains general information about the types of action performed, specific information on the exact parameters of the action and relevant contextual information.

10. Conclusion

Thanks to educational data mining, the present article tries to satisfy the learners' desires through proposing many topics selected similarly to the chosen ones written in their search engine. This historical background is recorded intentionally to provide each learner with his/her interests as a kind of motivating him or her individually. His/her learning process will be addressed independently. This article offers different opportunity for teachers to evaluate and integrate different courses into teaching design in accordance to the learners' interests and motivations.

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