Classification Based on Learner’s Ability and Emotionality For Selecting a Suitable Teaching Method

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Abstract
Most important teacher’s duty is making learners interested. We know that it is more important than content representation. But E-Learning systems are not regarding enough to this reality. In the other words, they represent content in a same way to different learners. Although adapting content to learners is good but it is not effective enough. For more effectiveness, system could be able to adapt its tutoring method with different learners. Thus, system could select proper method from existing teaching methods. We have a restricted number of teaching methods in our system. Therefore, each teaching method must be selected for a class of learners. So, each learner, based on his/her characteristics should be placed in a correct class. System should tutor to each class with a suitable teaching method. This method should be designed by a psychologist team and a teacher whom is expert in educating that content. System should be able to estimate learner classes by a little or no mistake. Then, it should be able to adapt teaching method with different classes. In the other words, system should behave with different classes of learners in different ways, according to their common characteristics. In this paper we will propose an approach for classification of learners. In our proposed method, classification is down based on two metrics: Learner’s Rate of doing exercises and his/her emotionality. Using these two metrics we will analyze how the system could classify learners and how it could select appropriate teaching method for each class. We have assigned a numeric value to each class. With our proposed method, system can estimate classes of learners with a good probability.

Keywords: E-Learning System, Learners Classification, Teaching Method.

1. Introduction
E-learning systems and educational hypermedia systems are generally consist of three parts: learning content, learner model, and adaptation model (De Bra and Calvi, 1998; Brusilovsky, 2003). These systems are attempting to adapt educational content to individual learners using information that is stored in learner model (De Bra, 1996; Brusilovsky and Millán, 2007). But they don't consider enough to representing method of this content. In the other words, their focus is on selecting an appropriate content for each
learner, but they don't consider to selecting an appropriate teaching method (Brusilovsky et al., 1996; Cheung, 2003; Brusilovsky and Henze, 2007; Sonwalkar, 2007; Roy et al, 2008). It means that an effective e-learning system must represent the same content for different learners differently. Although, there are some researches in the context of learners classification (Daniłowicz and Kukla, 2003), but they are not consider to important differences of learners such as learning ability and emotional affectability for classifying them.

Different learners are differently affected by emotional motivators. In the other words, their cognition ability is differently changeable by amending their emotional states. Furthermore, learning ability in individual learners in the same emotional state is not alike. We propose that e-learning system should select different teaching method for different learners regarding to their characteristics. Characteristics that we are focused on them are: Learning Rate and Emotional Affectability.

System can use a restricted number of teaching methods. Thus, it is essential for e-learning system to classify the learners. Each class of learners should be related to one teaching method. Classification is done based on three metrics that have been mentioned above.

The structure of this paper is as follow: after introduction in the second section different classes of learners will be investigated. In the third section our proposed methods for detecting classes of learners will be explained. Selecting an appropriate method for representing content to each class will be discussed in the section four. Finally in the section five evaluation results of our proposed method will be represented.

2. Learners Classes

We can classify learners in different classes for teaching them according to their common characteristics. Learners are different in learning rate and emotionality. We can utilize these differences for more effective representation of educational content. Each of these two metrics has three levels: high, medium, and low (Table 1).

<table>
<thead>
<tr>
<th>Learning Rate</th>
<th>Emotional Affectability</th>
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<tbody>
<tr>
<td>Low</td>
<td>Medium</td>
</tr>
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<td>*</td>
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</tbody>
</table>

According to table 1 we can distinguish 9 classes of learners. We can assign a numeric value (between 0 and 8) to each class. This class number must be saved in the learner model.
3. Learner class number computation method

System utilizes implicit parameters and asking some questions for class number detection. We will explain our proposed method in the 2 next subsections.

3.1. Learner class computation according to learning rate

For learners classification based on learning rate we have focused on number of mistakes and time of doing exercises. Our proposed system maintains probability of doing mistake in each exercise in the meta-data of it. Also, predicted time of doing each exercise should be stored in the meta-data of each exercise. This probability and time are recommended by teacher of the course. We have utilized equation [1] for computing learner's rate class.

\[ VV = V - V_p = N - N_f \cdot \frac{1 - \overline{F}_{ps}}{\overline{T}_{ps}} \]

That \( VV \) is difference between learner's rate and predicted rate. \( V_p \) is the predicted rate and \( V \) is learner's rate. \( N \) is the number of exercises in this session, \( N_f \) is the number of mistakes in this session, \( T \) is time of this session, \( \overline{F}_{ps} \) is average of predicted mistake probability for exercises of this session, and \( \overline{T}_{ps} \) is mean of predicted time to doing exercises in this session. If \( VV > a \), learner's rate is high. If \( a \leq VV \leq b \), learner's rate is normal and if \( V > b \), he/she belongs to low rate learners class. The values of \( a \) and \( b \) are determined by teacher of course regarding to educational content. Increasing the number of sessions will lead to more precise result in learner's class detection.

3.2. Learner class computation according to learner emotionality

For detecting that how much learner is effectible according to his/her emotions, system must estimate learner's current emotional state at first. For detecting emotions some researchers have utilized facial or vocal recognition (Ekman, 1999; Pantic and Rothkrantz, 2000; Gunes and Picardi, 2006). Some others have utilized some special sensors for movement recognition (Osano, et al., 2006). Also, there are some researches about emotion recognizing by the other means. In this work, we request the learner to determine his/her emotional states at the start of the session, 10 minutes later and 20 minutes later. We have assigned a numeric value for each emotional state. Positive emotional state has positive value (+1) and negative one has negative value (−1). After
each request sum of values is computed and after the session, average of this value is computed as overall emotional state.

As it mentioned in previous section, mean time of doing exercises and number of mistakes is computed for each session. System should find two sessions that learner's emotional state value of them has most difference. Then system can use equation [2] for detecting class of learner based on his/her emotional affectability.

\[ EF = \frac{\sum_{i=1}^{3} CN_{1i} \left( \frac{T_1 - T_{p1}}{T_2 - T_{p2}} \right) \left( \frac{F_1 - F_{p1}}{F_2 - F_{p2}} \right)}{\sum_{i=1}^{3} CN_{2i} \left( \frac{T_1 - T_{p1}}{T_2 - T_{p2}} \right) \left( \frac{F_1 - F_{p1}}{F_2 - F_{p2}} \right)} \]

In the above equation, EF is learner's Emotional Factor. \( \sum_{i=1}^{3} CN_{1i} \) is overall emotional value for session by most overall emotional value. \( \sum_{i=1}^{3} CN_{2i} \) is overall emotional value for session by least overall emotional value. \( T_1 \) and \( T_2 \) are average times of doing exercises by learner, \( T_{p1} \) and \( T_{p2} \) are average of predicted time, \( F_1 \) and \( F_2 \) are average of mistakes for learner, \( F_{p1} \) and \( F_{p2} \) are average of predicted mistake probability related to session 1 and 2.

If \( EF > 3/4 \), learner's affectability is low, if \( l \leq EF < 3/4 \), learner's affectability is medium, and if \( EF < l \), he/she belongs to high effectible class. Determining exact values for \( d \) and \( l \) depends on educational content and is done by the teacher and a psychologist team.

4. Designing a teaching method for each class

In (Mayer and Allen, 1995) it has suggested that system induces learner emotions to a suitable state. But for a learner by a little emotional affectability it could be useless. In this case more regarding to emotional states of learner may be damage the learning process. We propose that system behave by different classes of learners differently. We have represented a method for dividing learners in 9 classes by means of two metrics: learning rate and emotional affectability. We have focused on detecting classes of learners. Designing of teaching methods is out of our discussion. For designing of teaching methods according to each class we recommend that a psychologist team assist the development team.

Using our proposed method we can estimate learner class by a high preciseness. Behaving by learners according to their classes will lead to more satisfaction and thus it can cause to more effective learning process.
5. Evaluation of our proposed method

As it mentioned above, our aim is detecting of learner's class. We have assigned a numeric value between 0 and 8 to each class. In fact, each class number is a topple for example (High, Low). If we consider High as 2, Medium as 1, and Low as 0 then previous topple will be (2, 0). We can represent it as 20 in ternary, and it is 6 in decimal. In the other words, the classes are illustrated by toples (0,0), (0,1), ..., (2,2) that are correspondent by numbers 0, 1, ..., 8. It means that if classes of learners are approximately same in characteristics, their decimal values are near as well.

We will study a large number of learners to discover that how much their rate of doing exercises are variable by occurring emotional changes. It can lead to more precise values for \(d\), \(l\). Furthermore these values could be variable for different contents.

6. Conclusion

In this paper we have proposed that system should behave differently by different classes of learners. We have classified the learners based on two metrics: learning rate and emotional affectability. Because of emotions play an important role in the cognition process, system should behave more carefully by emotional learners.

Moreover, we have proposed a method for detecting the class of each learner based on our recommended metrics. We have proposed that teaching method should be adapted by learners' characteristics for each class. Also, a teaching method should be utilized for more than one class. Finally, we have explained the evaluation method.

Future works could be in these contexts: obtaining more precise values for \(a\), \(b\), \(d\), \(l\) and designing a suitable teaching method for each class.

REFERENCES


