Learner Modelling: Optimizing Training, Assessment and Testing

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Abstract

The authors are experimenting an innovative procedure to profile learners using an e-learning platform to predict if they will successfully end their training (or education activities) and to help tutors organize their tasks from the very beginning. Predictive learner modelling is proposed as an instrument for planning individual-oriented tutoring strategies to increase not only the probability of completion but also the return on investments of the training activities. In fact, by modelling learners' profiles it is possible to know in advance who of them will successfully complete their courses, who will leave the training anyway and who needs more help to complete their courses, according to their profiles. Knowing where learners are more likely to succeed will also help optimizing the assessment and training phases.

1 The Context

The understanding of learners' behaviour and the foreseeing of actions and reactions on the basis of their characteristics is the key factor for managing the learning system and for organizing tutorial, assessment and testing activities. This would be a great opportunity not only for educational institutions, but also for companies offering continuous education and training activities, e.g. in the framework of a structured career planning.

Today, the business environment is changing rapidly and every day companies face new challenges which require new competences and updated information. This scenario is made more complex by the fact that the effectiveness of training activities varies a lot for each single learner, due to different personal attitudes, background, behaviour, etc. Motivation is also a crucial factor for achieving the expected outcome: an evaluation on an aggregate level can be misleading due to the lack of information related to the learners. The advantage of planning training, tutorial and assessment strategies based on the characteristics and needs of each single learner means the optimisation of the learning process, while maximising the effectiveness of the whole human resource (HR) career planning process.

In fact, the success of a HR development strategy is proportional to the knowledge of learners. Accurately foreseeing behaviours will enhance the return on investment as it will increase personal success rates and it would help organizing the tutorial effort how and where it is effectively needed.

The whole training process may thus be optimized.

The proposed instrument is a profiler, called iClip, aimed at optimizing the use of resources (like documents, courses or training materials, different types of tests,…) and investments (in terms of time and money) in order to achieve the expected results, both at a training/competency and at an economical level. The instrument is able to detect implicit characteristics and patterns of learners, to identify useful indicators and to foresee the return of the courses for each individual. On the basis of the reached predictive knowledge of learners, the manager of the learning system will be able to plan the most appropriate strategy for each trainee.

2 The Approach

Data mining is the process of discovering meaningful correlations, patterns, and trends between large amounts of data collected in a dataset.

The iClip system relies on the availability of a large set of data of past interactions between users and the learning system to infer predictive models of learner behaviour.

iClip represents models as sets of fuzzy rules (Zadeh, 1992). A rule consists of one or more antecedent clauses ("If…") and a consequent clause ("Then…"). Fuzzy decision rules are useful in approximating non-linear functions because they have a good interpolative power and are intuitive and easily intelligible at the same time. Their characteristics allow the model to give an effective representation of reality and, simultaneously, avoid the "black-box" effect of, e.g., neural networks. Therefore, this approach provides the manager with information that is more transparent for the stakeholders and can be easily shared with them. Furthermore, the intelligibility of the models and the high explanatory power of the obtained rules allow an expert to understand and evaluate them.

iClip uses evolutionary algorithms to effectively search the space of fuzzy rule-based models. Evolutionary algorithms (DeJong, 2002; Bäck, 1996; Bäck *et al.*, 2000, Yao & Xu, 2006) are a broad class of optimization methods inspired by the evolutionary theory of natural selection.

While analysing historical data, a population of candidate models is maintained. The models reproduce by recombination and undergo random mutation and selection. The models that best capture the relations between data survive and reproduce. The population is divided in several "islands", which take different evolutionary paths and exchange individuals from time to time, on the basis of the established migration rate, thus preserving diversity and reducing the risk of premature convergence.

As new data become available, they can be added to the dataset and the model can be recomputed and updated. iCLIP thus gives a dynamic picture of the situation and is never obsolete.

3 Learner Modelling

Matching different competences' gaps of trainees with a homogeneous objective and schedule for a training is not trivial: different pedagogical approaches and several possible training methodologies should be considered with respect to single individuals and to the group as a whole, making the preparation very expensive. Also, once the aim is defined, how should "general" lessons or focusing on the wrong aspects be avoided?

This whole organizational difficulty is even increased if one thinks about coordinating tutorial services. These would be mostly effective if a tutor knew from scratch the peculiarities and special needs of each single learner.

Trying to overcome these difficulties, the authors are applying the approach described in Section 2 to the training and assessment scenario.

The project will first analyse log-files coming from e-learning platforms via the described approach. In particular for each trainee, data will be analysed, e.g.: age, sex, previous experience with online training, role if company

training; duration and frequency of platform use; time and frequency of use of communication tools, virtual library and supporting materials; result of course pre-, intermediate, final test; type of tests; type of course; total planned duration of the course.

This analysis will allow to classify analysed tracks into different profiles:

- Under-stimulated (very smart, can easily be motivated to help some groups of colleagues like Weak or maybe Emotional helping the tutor)
- Smart (no problem, can succeed without support, works as individual)
- Lazy (needs some pressure from tutor to succeed)
- Emotional (needs some encouragement from tutor to succeed)
- Weak (needs more support and must constantly be helped to understand in order to have chances to succeed, but is trying hard)
- Not interested (this is the group where tutorial energies would be mostly wasted because these trainees do not want to learn!)

Starting from a classification of Training Methodologies and Approaches (e.g. simulation, business game, case study, coaching, group discussion, in-basket, out-door, project, (field) research, role-playing, training on the job) which are weighted according to their potential application to meet pedagogical and psychological objectives, the system will suggest the best mix of different approaches for each single trainee profile.

4 Conclusion

It is extremely difficult for education to respond effectively to the ever changing challenges and requirements of society. In order to guarantee competitiveness knowledge-intensive enterprises require increased productivity and specialization; this means a quick and sharp competence development of knowledge workers based on an efficient career development process. At the same time universities need to enhance the way they approach working students and distant people with online courses.

Both the profiling of trainees and the personalized selection of methodologies together with the focussed support of tutors should help increase the motivation and the result of each single trainee, the cooperation among a virtual group, and globally the success rate of an online training for the students and the return on investments for a company.

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