Opportunities for the Use of Recommendation and Personalization Algorithms in meLearning Environments

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Abstract- One major challenge of most current eLearning and mLearning environments is that course activities are generally ‘one-size-fits-all’ and hence not able to respond to the unique needs, motivation and interests of all learners. Learning environments will have to become more and more learner-centered and personalized in order to overcome this challenge. meLearning approaches have shown some promising results in this area. meLearning refers to personalized or individualized learning environments in mLearning and eLearning where learners’ profiles, preferences, learning styles and optimal learning paths are continuously being monitored and evaluated with the aim of making the learning experience more effective and efficient to the learner. This paper describes a desk review which explored the potential and opportunities of recommendation and personalization algorithms for improving meLearning environments. An ever-increasing number of e-commerce websites and personalized search engines are using advanced algorithms to individualize their search results or online stores for each user or customer. A wide variety of algorithms and technologies is now available – including traditional collaborative filtering, cluster models, item-to-item collaborative filtering, people-to-people correlation, and aggregated rating. Though not always well documented or shared, these algorithms are already providing very effective forms of targeted marketing by creating personalized search and shopping experiences for each customer. On the other hand, the algorithms have not been fully exploited yet for improving meLearning environments. Against this background, this paper provides some innovative ideas for new applications of recommender and personalization systems in meLearning. This is expected to lead to useful suggestions and practical recommendations for the further advancement, implementation and up-scaling of effective meLearning systems.

Keywords- meLearning, recommendation systems, individualization, personalization, learning styles, learning paths, eLearning, mLearning

I. INTRODUCTION

Many types of eLearning environments have been trying to emulate a classroom environment online, very much like an ‘afterthought’ of traditional teaching and learning environments. Face-to-face classrooms are converted to virtual classrooms with no or little modification and without taking full advantage of the new features of technology.

Fortunately, the traditional instructor-centric model of eLearning is now being replaced by a learner-centric view, realizing that each learner has a personal style or set of preferences and learns at his/her own pace.

With the development of more sophisticated learning environments, the need for them to take into account the learner’s traits and learner’s devices on which the training is executed, and to place
them within the context of the training activities, has become an important issue in the domain of building novel learning environments [1].

meLearning is a new form of eLearning referring to personalized learning experiences for each and every learner. meLearning is just for the learner and just right (in terms of time, place, amount, device, medium, way); it is on demand and adaptive (when the learner is ready, the “teacher” will appear). It can provide learning in all forms (formal and informal; not just online, on computer, on mobile devices, but everywhere). meLearning also combines mLearning and eLearning and emphasizes continuous monitoring and evaluation (M&E) of the learner.

This paper describes the concept of meLearning and explores the potential and opportunities of recommendation and personalization algorithms from e-commerce and Internet search tools for improving meLearning environments. The study is largely based on a literature review and discussions with key informants.

II. THE CONCEPT OF ME-LEARNING

A. Background

The motivation and continued interest of a diverse group of learners is a challenge in many current eLearning environments. eLearning will have to become more and more learner-centered and personalized in order to overcome this challenge.

Hodgins [2] calls this idea meLearning and describes a very active role for the learner in which he or she activates, customizes and controls his or her own Personalized Learning Environment (PLE). Broad arrays of learning resources can be accessed as desired, rather than a particular sequence. PLEs recognize the role of the individual in organizing his or her own learning: learning is made “just right” for each learner by having maximum context, relevance and fit for the individual and his or her future directions, aptitudes, and personalities. Effective meLearning environments should ensure that the right content is delivered to the right person, with the right partners, at the right time, on the right device, in the right context, and in the right way.

From a technical point of view meta-information of learning objects is matched against meta-information of learners stored in the learner profile. Learning objects for an individual are selected or filtered by using information about the individual (his or her learner profile) and the information presented through the Learning Management System (LMS) is specifically tailored for the learner and the context.

B. Evolving Educational Paradigms

1) Knowledge Transfer: Traditionally, teaching and learning focused on the learner’s mastery of particular identified content. Teachers and lecturers were seen as the most significant source of knowledge and their role was to transfer their knowledge to the learners. This learning paradigm envisions the primary aim of learning as the acquisition of information. Its major auxiliary learning technology is the textbook. This system was suitable for the industrial age, when manufacturing processes were performed in a routine way. But the knowledge age demands higher skilled jobs based on critical thinking, creativity, collaboration, and interpretation abilities.

2) Constructivism: In contrast, teaching and learning during the past few decades were not focused on the mastery of content per se, but rather on the production of new knowledge – a constructivist approach. Teachers and lecturers form only one part of the sources of knowledge and their role is to facilitate learning and to assist learners in producing new knowledge.

The knowledge-based economy and accompanying mass-creation of knowledge and available information brought along a further dimension in this process. Therefore contemporary educational paradigms do not only focus on the production of knowledge, but are focusing more and more on the effective application, integration and
manipulation of existing information and knowledge.

3) Social Constructivism: Constructivist approaches are now also making way for social constructivism [3], which refers to learning as the result of active participation in a community where new meanings are co-constructed by the learner and his/her community and knowledge is the result of consensus.

Social media are evolving rapidly and beginning to play a very significant role in social constructivist learning environments. The focus is on the effective and productive use of existing and emerging resources for learning. The real expert is not the teacher or lecturer, or any other person for that matter, but the community.

4) Knowledge Navigation: New and emerging learning paradigms emphasize knowledge navigation [3]: learning is seen as the activity of exploring, evaluating, manipulating and navigating. Successful learning takes place when learners solve contextual real life problems through active engagement in problem solving activities and extensive communication and collaboration. In this paradigm, the role of the teacher is to coach the learners in how to navigate and to be their mentor in the skills and competencies required in the knowledge era.

5) Tutorial Learning: Bork [4] predicts a similar future paradigm: tutorial learning. It sees learning as fully active, focusing on the student as learner rather than on authority figures giving information. Tutorial learning refers to the type of learning that takes place between a highly skilled tutor and the student, or a small group of students.

The main problem related to this form of learning was that there were few good tutors, and it is a very expensive way of learning.

But what makes the difference now is the available technology to rebuild learning and make it more interactive, individualized, and adaptive: “For the first time we have the possibility of educating everyone on earth to each person’s full potential.”

C. Implications for meLearning

The implications of these new developments in educational paradigms are that educational institutions should not focus on providing content per se to learners but rather on how to enable learners to find, identify, manipulate and evaluate existing knowledge, to integrate this knowledge in their world of work and life, to solve problems and to communicate this knowledge to others.

The role that communication and interaction plays in the learning process becomes a critical success factor. It is within this context that meLearning can contribute to the quality of education because of the rich communication and interaction environment it provides. meLearning environments are ideal for contemporary social constructivist approaches where interaction and communication between lecturers and learners, between the learning management system (LMS) and learners, and among learners is paramount.

Educational software packages and learning management systems (LMS) either enhance or restrain certain pedagogic approaches to learning. There is no such thing as pedagogically neutral software.

A Personalized Learning Environment (PLE) for meLearning would allow the learner to configure and develop a learning environment to suit and enable their own style of learning, or alternatively the system adapts (semi-)automatically to the characteristics of the learner.

D. Different Learning Needs and Different Learning Styles

If meLearning has to become more individualized, it will have to take into account these new educational paradigms, as well as the different learning needs and learning styles of students.

1) Different Learning Needs: Learners all have different and specific learning needs and preferences, and they can have different educational background and knowledge levels.
2) Different Learning Styles: Each person also learns differently and needs to develop his/her own learning skills in his/her own way. Learners have different backgrounds, strengths and weaknesses, interests, ambitions, senses of responsibility, levels of motivation, and approaches to studying and learning.

For example, different learners prefer different presentation forms: some prefer multimedia contents (graphical material and hypertext documents, simulations, presentations); while others prefer traditional web pages (questionnaires, exercises, research study).

E. Personal Learning Paths

meLearning is a form of eLearning where these different learning needs and different learning styles of learners are taken into account to adapt and tailor the learning environment. Personal learning paths can contribute to this.

In meLearning environments, learners can reach the same learning outcomes using different learning paths. Chew [5] has shown that an international eLearning specification such as SCORM 2004 can be used to provide learners with different learning paths.

An existing example of personal learning paths for meLearning is IMARK [6], a partnership-based e-learning initiative spearheaded by the Food and Agriculture Organization of the United Nations (FAO) to train individuals and support institutions and networks worldwide in the effective management of agricultural information. Learners with various levels of experience, or having specific needs, can create tailored courses by designing their own personal learning path, often making learning more relevant to the situation of the learner and saving significant study time. To build the personal learning path, users are asked to respond to a series of "yes" or "no" queries that are formulated to assess their level of understanding. Upon completion, users are presented with a tailored list of lessons that will support their understanding of the subject matter. Currently 59% of learners make use of the personal learning path feature to create their own customized course.

III. LEARNING FROM TECHNOLOGICAL DEVELOPMENTS IN E-COMMERCE

Solid educational paradigms need to drive technology and application development in meLearning. But where possible and appropriate, innovations from other disciplines could be used. New technological developments in Internet search and e-commerce – particularly recommendation and personalization algorithms – look very promising and could be of significant importance for the development of Personal Learning Environments (PLEs) for meLearning.

A. Personalized Search Tools

Personalized search tools gather information about the user’s web searches and clickstream in order to improve the relevance of search results [7].

Personalized search tools support the information search stage of a user’s decision-making process by fine-tuning search results and advertising based on an individual’s preferences, demographic information and other factors. From a marketing perspective, the information search stage involves a consumer who is interested in a product or service and is actively looking for information on the Internet.

Personalized search tools attempt to reduce information overload and retain customers by offering more relevant results while taking less time to find information.

In personalized search, every search result you click, every link you bookmark, every RSS feed you subscribe to can be used to improve your personal search results.

Similarly, meLearning environments should also be personalized for different users and learning objects should be adaptable to individual needs and preferences.
B. Recommender Systems

Recommender systems have gained increasing popularity on the web, both in research systems and e-commerce sites, which offer recommender systems as one way for consumers to find products they may want to purchase.

1) The Recommendation Process: Recommender systems act as personalized decision guides for users, aiding them in decision making about matters related to personal taste. Typically, a recommender system compares the user's profile to some reference characteristics, and seeks to predict the 'rating' that a user would give to an item he/she had not yet considered. These characteristics may be from the information item (the content-based approach) or the user's social environment (the collaborative filtering approach).

In everyday life, people often rely on incomplete information when deciding which books to read, movies to watch or music to purchase. When presented with a number of unfamiliar alternatives, people tend to seek out recommendations from friends or expert reviews in newspapers and magazines to aid them in decision-making.

2) Algorithms: In recent years, online recommender systems have begun providing a technological proxy for this social recommendation process. A wide variety of algorithms and technologies is now available – including traditional collaborative filtering, cluster models, item-to-item collaborative filtering, people-to-people correlation, and aggregated rating.

Most recommender systems work by asking users to rate some sample items. Collaborative filtering algorithms – which often form the backbone of such systems – use this input to match the current user with others who share similar tastes.

3) Accuracy and Transparency: Satisfaction with a recommender system is only partly determined by the accuracy of the algorithm behind it. Recent studies [8] have highlighted the role of transparency (understanding of system logic), familiar recommendations, and information about recommended items in the user’s interaction with the recommender system.

This could mean that personalization systems for meLearning environments would also have to be accurate and transparent.

3) User Profile: When building a user profile for recommender systems a distinction is made between explicit and implicit forms of data collection.

Examples of explicit data collection include the following:
- Asking a user to rate an item on numerical scale
- Asking a user to rank a collection of items from favorite to least favorite
- Presenting two items to a user and asking him/her to choose the best one
- Asking a user to create a list of items that he/she likes
- Demographic data, which refer to information such as the age, the gender and the education of the user.

Examples of implicit data collection include the following:
- Observing the items that a user views in an online store
- Analyzing item/user viewing times
- Keeping a record of the items that a user purchases online
- Obtaining a list of items that a user has listened to or watched on his/her computer
- Analyzing the user's social network and discovering similar likes and dislikes

The recommender system compares the collected data to similar data collected from others and calculates a list of recommended items for the user.

Similarly, in meLearning, a Learning Management System (LMS) could use the profile of a learner and appropriate algorithms to tailor the learning environment to the specific needs and preferences of the learner. meLearning environments could use a combination of explicit and implicit data collection for determining these learner profiles.
VI. CONCLUSIONS

The future of eLearning will be in best serving the learner according to his or her current needs and personal learning style. This paper therefore introduced the concept of meLearning, which is learner-centered and personalized and context-specific.

The role of meLearning in the improvement of eLearning environments should not be underestimated. meLearning can increase the chances of successful learning outcomes by providing multiple paths for learning and alternative learning methods.

meLearning is now a reality and will continue to develop and will grow in importance. Researchers and educators should embrace the rich learning enhancing possibilities that meLearning already provides and will provide even more so in future. Students and lecturers will soon be able to take more advantage of the opportunities to further customize individual learner experiences.

The design and development of relevant, adaptive, personalized and optimized meLearning environments based on sound didactical principles remains a challenge. But recent developments in Internet search and e-commerce can provide some valuable insights.

More research is still needed to develop reliable mechanisms to model student’s learning styles and adapt and present the matching content to the individual student. Different recommendation and personalization algorithms should also be examined further for

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