Paper Interfaces for Learning Geometry

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Abstract. Paper interfaces offer tremendous possibilities for geometry education in primary schools. Existing computer interfaces designed to learn geometry do not consider the integration of conventional school tools, which form the part of the curriculum. Moreover, most of computer tools are designed specifically for individual learning, some propose group activities, but most disregard classroom-level learning, thus impeding their adoption. We present an augmented reality based tabletop system with interface elements made of paper that addresses these issues. It integrates conventional geometry tools seamlessly into the activity and it enables group and classroom-level learning. In order to evaluate our system, we conducted an exploratory user study based on three learning activities: classifying quadrilaterals, discovering the protractor and describing angles. We observed how paper interfaces can be easily adopted into the traditional classroom practices.

Keywords: Paper interfaces, Sheets, Cards, Geometry learning, Tabletop

1 Introduction

Geometry education in primary schools is a domain ripe for exploiting the possibilities of computers, as they allow for an easy exploration of the problem space. However, there are some constraints which make it difficult to effectively utilize computers in a classroom scenario. Particularly, they do not cover the entire curriculum, which is based on pen and paper. For example, the only way for children to learn how to draw an arc is by using a physical compass.

Paper interfaces can prove to be an effective solution to this dilemma, as paper is already situated and integrated in the classroom environment and its practices. In addition, paper is cheap to produce, yet persistent and malleable to adapt to the dynamics of the classroom. As a computer interface it can transform into a dynamic display capable of computing and processing data. Besides these benefits of paper interfaces, paper has different properties and affordances depending upon its material, shape and size. Also, many interface metaphors such as cut-copy-paste, files and folders, check-boxes etc. are actually inspired by practices involving paper. Effective identification of these properties followed by a proper utilization, might render the paper interface intuitive for the users to interact. We hypothesize that geometry education in primary schools can greatly

Unsupervised Auto-tagging for Learning Object Enrichment

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Abstract. An online presence is gradually becoming an essential part of every learning institute. As such, a large portion of learning material is becoming available online. Incongruently, it is still a challenge for authors and publishers to guarantee accessibility, support effective retrieval and the consumption of learning objects. One reason for this is that non-annotated learning objects pose a major problem with respect to their accessibility. Non-annotated objects not only prevent learners from finding new information; but also hinder a system's ability to recommend useful resources. To address this problem, commonly known as the cold-start problem, we automatically annotate specific learning resources using a state-of-the-art automatic tag annotation method: α-*TaggingLDA*, which is based on the Latent Dirichlet Allocation probabilistic topic model. We performed a user evaluation with 115 participants to measure the usability and effectiveness of α-*TaggingLDA* in a collaborative learning environment. The results show that automatically generated tags were preferred 35% more than the original authors' annotations. Further, they were 17.7% more relevant in terms of recall for users. The implications of these results is that automatic tagging can facilitate effective information access to relevant learning objects.

Keywords: Metadata Generation, User Study, LDA, Cold-Start, Recommender Systems.

1 Introduction

Learning strategies have shifted from a solitary activity to a collaborative web-based one [2]. In collaborative learning systems, digital collections of educational materials or Learning Objects (LOs), such as, lecture videos, notes and presentations, are made available in online repositories. Online learners are not only able to browse or search for LOs, but also enrich this content with value-added metadata.

Learning object enrichment is crucial within a collaborative setting. For example, consider a scenario in a collaborative environment where a user wants to retrieve specific documents related to their interests and uses tags to navigate to the associated resources. Ideally, if the system can effectively provide good tag coverage over the resources, the user can better navigate through document objects and be steered to the relevant resources in the system. On the contrary, if tags are either unclear, not specific for the resource, noisy, or ambiguous, then users cannot retrieve or easily locate resources. Unfortunately, the latter situation is all too common. Since users typically only

C. Delgado Kloos et al. (Eds.): EC-TEL 2011, LNCS 6964, pp. 83–96, 2011.