Towards an Educator-Centred Digital Teaching Platform: the Ground Conditions for a Data-driven Approach

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Abstract— **We introduce innovations in a Digital Teaching Platform (DTP) through tools centred on supporting the teacher. We focus on the utilisation of data about the students and the class in order to recommend actions and content for the teacher. For this, we need a platform with novel capabilities. First, we augment the content delivery application with data collecting capabilities. Second, we create a cloud-based analytics engine that infers student profiles and context parameters from multi-modal sources. Third, we provide a web-based platform for content composition that makes use of the inferred student and context profiles to support teachers in lesson planning. Our solution implements the complete cycle from content composition to delivery and adjustment, allowing for the research and development of new features and intelligences in Digital Education.**

I. Introduction

There is a challenge around technology intake in classrooms. Whereas mobile computing has become almost ubiquitous, the same process is lagging behind in education, especially in classroom scenarios [1]. We advocate the use of a Digital Teaching Platform (DTP) that focuses on educator demands for affordability, intelligence, decision support, and easy to implement. The DTP provides support for: : (i) preparing structured pedagogical plans; (ii) helping with common activities such as maintaining a presence list and correcting exams; (iii) understanding the social elements in the classroom environment, such as student profiles, context parameters, others, and; (iv) relating these parameters with teaching activity and material components to promote adjustments towards continuous improvement.

We argue that while heavily personalised content is useful for online and other forms of distance learning, it will create problems in a regular classroom: it will almost certainly create confusion, because the teacher will not know what content any particular student is looking at; and moreover, it can amplify differences in learning pace in a classroom. In our opinion, the way to personalise the learning experience in a classroom is by providing teachers with topical information in order to better connect with the students.

What is missing is a DTP that can collect, store, inference and deliver smart materials and feedback to support educators during their classroom lessons. We aim to address this shortcoming with an innovative DTP, that also serves as a springboard for further research and development in the area.

II. Proposal

We propose a holistic DTP including: (i) an Android application for delivering content to the student, collecting as many events about student-material interaction as feasible, such as page turns, clicks, entering or leaving content, eye tracking, and so on; (ii) a web service for the teacher to compose a lesson plan, and students to have access to material and videos produced during the classes, and; (iii) a multi-modal learning analytics service to analyse the generated data through data mining algorithms. The intelligence infers student profiles, context parameter, material, and other factors that relate learning performance with variation of elements, which can be used to provide recommendations to the teacher.

The underlying assumption for our DTP is that each student has access to a tablet in the class room. The content itself is defined by the teacher. This content delivery app is designed to not stray too far in its presentation from the conventional textbook for a number of reasons. Firstly, because the further we stray from conventional teaching methods, the harder it becomes to adapt existing learning material to the new format. This is already one of the largest hurdles in adopting digital teaching platforms. Secondly, while novel pedagogic methods are being promoted world wide, the vast majority of teachers and classrooms are used to the traditional “chalk and talk” method of teaching, in which students work with a traditional text book. Nevertheless, there are a number of innovations in the content delivery app. The first is that, being a digital medium, it does support additional content, such as audio material, video, and interactive content. It also allows for the automatic evaluation of quizzes, and similar functionality that one would expect from a digital content delivery system. In addition, students have the ability to annotate material, both for themselves and for the teacher. They also have the ability to notify that they like a piece of content, or that they need further instruction about it. Finally, students have the ability to share content with each other within a class. The teacher also has this ability. This is particularly useful for personalised content. The teacher can mark material as supplementary and share with certain, or all, students during the class.

However, the main difference with a traditional text book is that the app is instrumented to record every interaction the student has with the material. This includes viewing any content, scrolling, zooming, highlighting, sharing content, rating it and answering test questions. Moreover, we have rudimentary eye tracking and are planning on incorporating sentiment analysis. These signals are used to infer the various aspects of a student profile, which in turn informs the personalised learning and content recommendation modules.

Before the start of a lesson, the teacher plans his class

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through the use of a web-based tool. Its main component is a method for aiding in the composition of class materials. This component allows the teacher to quickly and easily compose the lesson's material by following a lesson plan.Within this lesson plan, the teacher has the option of simply importing a bundle of material (for instance, a digital book from a publisher), or customising the content to better suit his needs. In the latter case, we allow for various recommender systems that help the teacher in composing the material, based on the students' profiles and the learning plan. Once the material has been selected, the system automatically composes this in a layout that is best suited to the lesson plan.

A. *Recommenders Based on Teacher Needs*

At the moment, the platform uses an item-based collaborative filtering mechanism [2] to find learning objects that are often used in combination with those that the teacher has already included in a lesson. However, this is not the end goal. Far more interesting is to create recommender systems that personalise the content to a teacher's situation. For instance, by finding content that treats the same material, but with examples that are *more relevant* to the teacher and the class. In order to do this, context-aware user-based collaborative filtering mechanisms are more appropriate: we would need to find content that was used by similar teachers in similar situations.

B. *Recommenders using Class Profiles*

Another function of the recommender systems is to recommend content that is specific to the class, rather than the teacher. In a way, the class profile could be seen as part of the context for the teacher, but we choose to treat this separately, because the kind of recommendations are different. In particular we wish to recommend material that is likely to engage and challenge the class. This has a number of challenging aspects. The first is that it can be seen as a group recommender system with its associated problems. The second is that it is not just the content that such recommendations should focus on, but rather the entire structure of the class; in other words, the lesson plan. An obvious example of this is that a quiz completely changes in its pedagogical function if it is given before explaining the material or after. In the former, it can be used as an exercise to explore the subject and the intuitions behind it before going into detail. In the latter it is mostly used as an assessment, both to practice the material and to assess how well it is understood. To extrapolate further, the former use of a quiz is more likely to engage students who learn from active experimentation, whereas it may very well frustrate students whose learning method tends more towards reflective observation. Thus recommendations for the lesson plan should be considered in combination with recommendations for content. As above, recommender systems capable of such sophistication are an active area of research.

C. *Multi-modal Learning Analytics*

The recommendations of Sections II-A and II-B rely on detailed profiles of the students. In the current version we only capture the signals and are busy curating a data set for analysis. This is an ongoing research project, and the next step is to define both the profile attributes and the method for automatically extracting these attributes from the usage data. This falls in the area of educational data mining [3], and we expect to adapt many of these approaches and learn to recognise levels of various parameters such as attention and activity [4] . By correlating such signals over time with the content, we can further learn students' learning style (active experimentation, abstract conceptualisation, reflective observation, etc.) and what type of content (video, textual, interactive, etc.) best suits them. Such inference can complement the direct feedback from the students, who can indicate what content they like, and what content is difficult. This type of information is essential for being able to personalise educational content.

In addition to individual profiles, we aim to extract class profiles. There are various different methods. Firstly, information fusion techniques can be used to aggregate the signals for individual students into an "average" signal for a whole class. For instance, we can average the class' attention level. This type of information can serve two purposes: firstly, a signal can be sent to the teacher during the class, in order to adjust his teaching style in order to better engage the students. Secondly, it can serve as an input to a recommender system that recommends content for future classes, in order to avoid content that does not connect well with students. This aggregation of a group profile is what we see as a promising approach to solving some of the challenges with group recommendations.

III. Conclusion

In this paper we presented an ongoing research project to develop a DTP aimed at fulfilling the range of benefits that technology-enhanced learning can bring to the classroom. So far, we have developed the content composition and delivery platform, and some basic AI components to enable us to test its usage. We are on the door step of deploying the platform in a number of field trials, in order to (i) test and receive feedback on the existing components, and (ii) to collect data for the development of further profiling algorithms and recommender systems. The main focus, and what sets this platform apart from existing systems, is its focus on the teacher as the main vector for education.

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