AUVA - Augmented Reality Empowers Visual Analytics to explore Medical Curriculum Data

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Abstract. Medical curriculum data play a key role in the structure and the organization of medical programs in Universities around the world. The effective processing and usage of these data may improve the educational environment of medical students. As a consequence, the new generation of health professionals would have improved skills from the previous ones. This study introduces the process of enhancing curriculum data by the use of augmented reality technology as a management and presentation tool. The final goal is to enrich the information presented from a visual analytics approach applied on medical curriculum data and to sustain low levels of complexity of understanding these data.

Keywords. Augmented Reality, Visual Analytics, Medical Education, Curriculum Data

Introduction

Healthcare education is being transformed and improved recently with the use of technology. One recent study analysed and represented big educational data from an undergraduate medical curriculum using visual analytics (VA) [1] By using VA, different representations of intended competencies and learning outcomes the medical students should succeed to achieve after graduating from the medical program could be linked to curriculum content and teaching strategies [2]. In a similar study, [3] VA were applied at the level of a pilot course from the medical program going deeper to analyse and represent the course through its teaching methods and assessment towards the intended learning outcomes and all the relationships between them creating a structured network of the examined course. The VA approaches in these two studies appeared to improve significantly the perception of patterns and relationships within the curriculum data. However, they offer no interaction and a low level of meta-visual analysis to the end users who were limited to relating the depicted information to genuine curriculum data without being able to add more information from other structured curriculum data sources.

In this study, we explored how the problem of non-interactivity can be addressed using Augmented Reality (AR) technology. AR provides the opportunity for computer-
generated virtual imagery information to be overlaid onto a live directly or in-directly?? real world environment in real time [4]. The potentials offered by applying the AR in healthcare education has been explored in the past leading to promising results [5]. The potentials offered by AR could act in this particular case as a top-level layer that broadens the dynamics of VA while it is powered with complex information from a structured data source to create a mechanism capable to amplify and promote high levels of visual analysis and interaction. Our approach uses AR technology as a data management and presentation tool, pooling information from two different sources: the first source is the curriculum data database, where curriculum-based information is saved and analysed. The second source is the visual analytics exported data, where the information from the curriculum database has been presented in a human understandable format. The AR tool combines these two sources of information, allowing the user to explore more information according to different topics.

The aim of this study is to structure a research base for using AR technology as a data management-presentation tool for medical curriculum data: Augmented Reality Visual Analytics (AUVA) aiming to (i) change the presentation of big educational data for the end users aiming to increase interactivity; and (ii) to enrich the presented visualizations with information from different sources.

1. Methods

For the design of this research we adopted one of the produced representations created in the previous study [3] following the model methodology [6], in order to explore and determine how we could use static data in the depicted information and enrich them with additional information from the database containing the mapped curriculum data.

1.1 Technical implementation-Merging Databases-Data Consolidation

We used two separate databases (SQL): one was used to derive the medical curriculum data and the second one to derive the representation produced by visual analytics. We created a master worksheet [6] which merges the data from the two different sources to connect it with the AR tool. The data consolidation assembles data in a format that could also easily update and aggregate data ad hoc or regular. This technique allows us to connect the AR tool with the master worksheet and inform the prototype with information from these two different sources.

1.2 Data Collection

The data used in this study were derived from the undergraduate medical program at Karolinska Institutet. Specifically, this data represent one course in the medical program, built from the identification of major entities that play important roles in healthcare education delivery and quality improvement. The entities comprising the representation include the teaching methods and the written examination (assessment) of the course towards the learning outcomes of the medical program and all the connections between them [3].
1.3 Augmented Reality and Visual Analytics

We used Artoolkit in order to develop the AR prototype. The interface is similar with every AR application scanner. The user uses the device camera in order to scan the objects. The zoom in/out feature as well as screenshot and video was enabled. We used the data exported after the visual analysis process from the previous study [3] in paper format as can be show in the figure below (Figure 1):

![Figure 1: Constructive alignment](image)

Three points of the visualization were used as markers in order to present more information about them with AR technology. These markers are in the bold ring shape showing the learning outcomes.

2. Results

2.1 Conceptual model

The system structure model consists of four layers. First is the physical layer where the data coming from different University’s processes are saved in different formats. These data can be, for instance, educational and administrative data, electronic documents (docs, pdfs), worksheets, programs/courses web pages, higher education web pages and paper formats. The second layer is curriculum mapping. At this layer the data from the first layer are processed then exported as educational administrative topics (learning outcomes, assessment methods). The third layer is the visual analysis of the curriculum mapping data in order to present them in different views? and with different ways (paper, projector). The final layer employs AR technology and the data from layer two and layer three are presenting to the final users as additional information.
2.2 Interaction with curriculum data

In figure 3 we illustrate the curriculum data information presented with a visual analysis technique in a paper: the user has scanned the paper with a tablet device and the system presents a button with more information about the learning outcomes.
2.3 Additional information from curriculum data

In figure 4 we present the interface when the user clicks the button and additional information according to the selected learning outcome appears in the tablet screen. This information has been stored in the curriculum database.

Figure 4: Additional information from VA and CM databases.

3. Discussion

This research paper described the management and presentation of complex data printed in a paper for remote presentation in different sides and the usage of AR technology as a tool for presenting information from different sources. Our system architecture outlines a novel way of presenting curriculum data with mobile devices and the management of information exported from different tools. In our future studies we will explore the users’ experience from the usage of this tool.

Moreover, new tools could be possibly used for the augmentation of data such as google glasses and explore the dynamics of presenting augmented data of medical curriculum in meeting rooms and classes.

References