LiftUpp: Support to Develop Learner Performance

Frans A. Oliehoek[3], Rahul Savani[3], Elliot Adderton[2], Xia Cui[3], David Jackson[3], Phil Jimmieson[3], John Christopher Jones[1], Keith Kennedy[4], Ben Mason[1], Adam Plumbley[3], and Luke Dawson[2]

[1] LiftUpp Limited
[2] School of Dentistry, University of Liverpool
[3] Department of Computer Science, University of Liverpool
[4] Clinical Trials Research Centre, University of Liverpool

1 Introduction

The last two decades have seen enormous progress in both theories and technology to support learner progress. However, many of the Artificial Intelligence in Education (AIED) techniques are difficult to apply in workplace-based educational settings, such as dentistry. Such settings put high demands on e-infrastructure, because they require intelligent systems that can be used in the workplace every day, and can also fuse many different forms of assessment data together. In addition, such systems should be able to enhance student development through personalised real time feedback (in dentistry education, for example, from both staff and patients) to drive learner self-reflection. Moreover, the information these systems provide must be reliable to facilitate defensible decisions over individual student progress to protect the public [2].

In this paper, we describe LiftUpp, a system developed at the School of Dentistry at the University of Liverpool, which has been specifically designed to meet these demanding requirements.

2 An Overview LiftUpp

LiftUpp is a digital educational platform designed to support quality-assured assessment, feedback, curriculum design and mapping. Its design is grounded in pedagogy and directly addresses the issues of complex data collection, clearing the way for applying AI and data-driven improvements to workplace-based education. It is th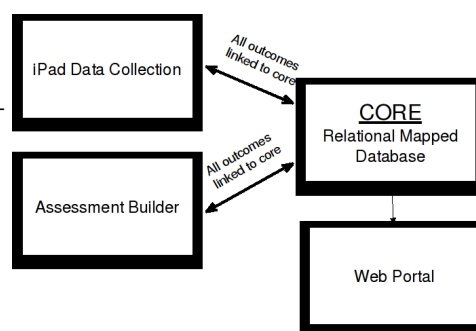e most sophisticated digital educational platform for workplace-based assessment available in dentistry, and is currently deployed in 70% (10 out of 14) of UK dental schools, as well as in veterinary medicine, physiotherapy, nursing and other healthcare sectors.

Fig. 1: A graphical overview of LiftUpp.

An overview of the LiftUpp platform is given in Fig. 1. The figure shows how the 'core', which contains the learning outcomes of the entire program (both internal as well as those of external stakeholders such as accreditation bodies) interacts with several modules, which currently comprise: an assessment building module (with support for exam setting, QA, blueprinting, psychometrics, reviewing, results, feedback); an iPad-based data collection module; and a web portal (system administration, data analysis, collation and display).

3 Data Collection for Workplace-based Education

A salient feature of LiftUpp is the level of detail with which assessment data are recorded, and its ability to connect these results to learning outcomes, making it the first platform capable of fully programmatic assessment: all assessments are deliberately designed to develop and demonstrate learning outcomes. In the extreme, the importance of individual assessments vanishes: they just supply data on learner performance with respect to learning outcomes. In this paradigm, progression is based on *performance stability* and not on passing single tests, which is much better aligned to the needs of the real-world workplace [2].

However, to realise this, one significant challenge lies in effectively managing data components from multiple sources. For dentistry, this required the collection of daily observational data from 300 students in the workplace in 20 different sites, from 100 different staff, spanning 149 learning outcomes, along with data from other forms of assessment. While this is challenging by itself, it is further complicated by the inherent difficulty of objectively assessing the quality of treatments performed by students while in the work place.

To overcome this, LiftUpp uses the combination of a 6-point grading scale and a 'work flow model' of data collection [1], in which assessors only have to record what they see (rather than being pressurised into 'ticking all the boxes'). This approach was initially rolled out using paper forms that were replaced by an iPad app in 2010. The app, shown in Fig. 2a, is tailored to make sure data collection is a straight forward as possible: it is designed for easy navigation during observations, it deals with all possible work flows and uses location information to automatically select the relevant work flows, and it provides a convenient interface for attendance monitoring of students as well as staff sign in, enabling staff to cover for a colleague.

4 Data Fusion, Visualization & Use

While advanced AI techniques have the potential to radically improve the development of student performance, the current system already benefits from the collected data in various ways. Here, we briefly itemise these ways, for more information please see [3]:

– Quality Assurance for Curriculum and Assessment Design. Due to all exam questions and work-based observations being coupled to learning outcomes, it is possible to automatically verify if the requirements of accreditation bodies are satisfied.
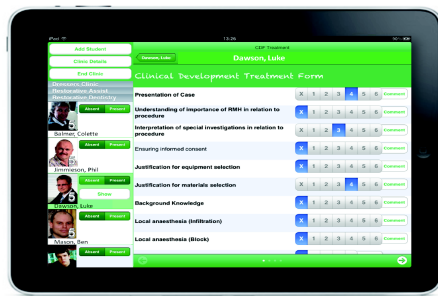
(a) iPad interface for judging clinical independence.
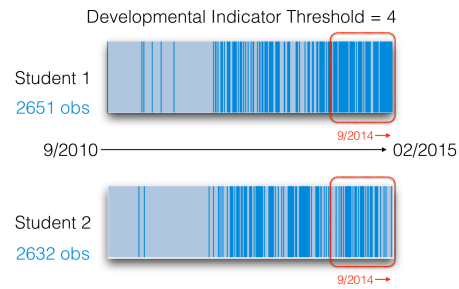
(b) *Barcodes* visualise consistency. (grey indicates sessions with an below-expectation observation.)

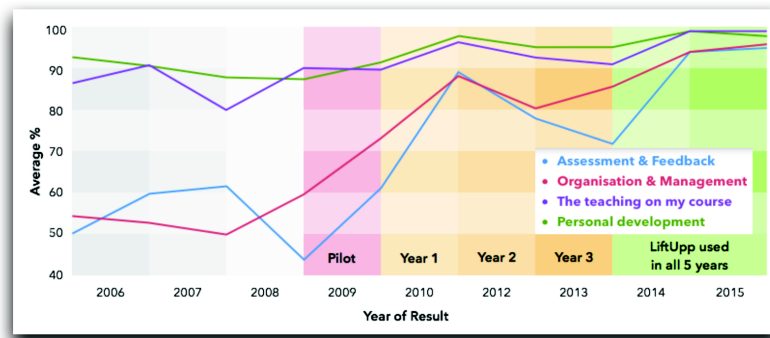Fig. 2: Collection and visualization of data.

Fig. 3: Student satisfaction ratings since the introduction of LiftUpp.

- Progress Monitoring. Displaying data in a manner that is simple for both the learner and the staff to understand is challenging. A major step forwards was the definition of what we have termed 'sessional consistency': the fraction of a student's sessions that meets a desired performance threshold level. To represent this sessional consistency visually we developed the 'barcode' view. Fig. 2b shows two examples of barcodes.

- Adaptive Instructional Planning. The insight that LiftUpp provides about the students performance is used to decide which students will benefit most from additional practice opportunities, while other students are put in 'holding patterns', which means that the frequency of their workplace-based assessment is reduced or shifted towards less resource-limited treatments.

- Feedback for Students and Observers. Liftupp provides feedback to both students and observers about their performance.

5 Deployment and Effectiveness

LiftUpp has been in use in the School of Dentistry at the University of Liverpool since 2009, and has made an unprecedented impact on the student experience. This is perhaps most clearly expressed by the student satisfaction ratings (as measured by the national student satisfaction (NSS) survey), shown in Fig. 3. The figure clearly shows improvements over all four categories, especially satisfaction with respect to 'assessment & feedback' and 'organization & management', which have improved markedly since the introduction of LiftUpp.

The breadth and quality of the collected data is high and has helped to improve administration. We estimate that LiftUpp has saved approximately £150,000 in administration costs. Moreover, the data has been used successfully in several legal cases where students have challenged decisions, including via the Office of the Independent Adjudicator and the General Dental Council.

This success has caused other dental schools to take interest and LiftUpp is now deployed in 70% of UK dental schools. Moreover, in recent years there has also been interest from other workplace-based disciplines, leading to deployments in veterinary medicine, physiotherapy, nursing and other healthcare courses.

6 Conclusions & Future Research Directions

In this paper, we presented some of the challenges addressed by LiftUpp for supporting the development of learners' performance in dentistry. In particular, it addresses the difficulties that one faces in terms of data collection when trying to apply data-driven approaches as developed in the AIED community to educational programs based on workplace-based assessment. In addition, LiftUpp makes some first but effective steps in dealing with the resulting data fusion problem for a variety of uses, ranging from quality assurance, to various forms of feedback and instructional planning. Moreover, the years in which the system has been employed has now generated a wealth of data that may serve as the basis for better data fusion techniques and thus form the basis of many future directions of research, such as advanced statistical methods for data fusion, interpretation and calibration, adaptive tutoring and personalised feedback and student advice.

References

1. L. Dawson, B. Mason, M. C. Balmer, and P. Jimmieson. Liftupp: A technology enhanced framework for the continuous development, measurement, and exploration of professional competence. In preparation.
2. L. Dawson, B. Mason, V. Bissell, and C. Youngson. Calling for a re-evaluation of the data required to credibly demonstrate a dental student is safe and ready to practice. *European Journal of Dental Education*, 21:130–135, 2017.
3. F. A. Oliehoek, R. Savani, E. Adderton, X. Cui, D. Jackson, P. Jimmieson, J. C. Jones, K. Kennedy, B. Mason, A. Plumbley, and L. Dawson. Liftupp: Support to develop learner performance. arXiv, 2017.