Personalised and Adaptive Mentoring in Medical Education – the *myPAL* project

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Abstract. This position paper describes a long-term Technology-Enhanced Learning initiative at the Leeds Institute of Medical Education in which a personalised adaptive learning mentor will be deployed for all MBChB students enrolled in the course. The system, *myPAL*, is enriching the existing TEL programs embedded in the curriculum and will be leveraging recent advances in Learning Analytics and Open Learner Modelling. The paper presents the context of the project and the opportunities that deployment settings will offer, and highlights the research and development strands that will underpin it.

Keywords: Medical Education, workplace learning, adaptive learning, Design-based Research, intelligent mentoring system

1 Introduction

This position paper is a first attempt in describing a long-term Technology-Enhanced Learning research and development agenda that is being unrolled at the Leeds Institute of Medical Education (LIME[1]): the design and development of a personal mentor – aptly called *myPAL* – for students in medical education. The aim of the project is to enrich an existing program of technology in medical education (digital resources, computer-based assessments, mobile learning) by applying current advances in the field into our educational context, notably Open Learner Modelling and Learning Analytics [1, 2].

But as we will briefly illustrate, the specific requirements of medical education (e.g. practice-based learning) means that the focus *myPAL* will not so much on *tutoring* students through the curriculum – even in intelligent ways – but more toward *mentoring* them throughout their developmental pathway(s) across the educational and professional settings. And as the workshop is rightly querying about, questions will need to be addressed throughout the design and development of the system as to how we are supporting learners in that process (e.g. self-regulation, motivation), what are the tools and mechanisms (e.g. modelling, analytics, visualization, reasoning) that need to be

[1] http://medhealth.leeds.ac.uk/info/800/leeds_institute_of_medical_education/

deployed, and what are the conditions for learners to adopt and appropriate such a tool in the long term (e.g. workplace learning, lifelong professional development).

2 Context

The context of the work on *myPAL* is the 5 year undergraduate course program leading to the degree of MBChB (Bachelor of Medicine and Bachelor of Surgery) which allows successful students to provisionally register with the General Medical Council and start supervised practice of medicine (a further Foundation Year program being required for unsupervised practice in the UK). The MBChB curriculum is a challenging program based on professional values and core themes that are integrated throughout the five years, in what is usually described as a "spiral" curriculum [3]. In this structured learning approach, students are introduced, during the first year of the degree, to the core principles and themes that underpin clinical practices and form the foundation on which later years will be coming to again and again, building on what students have already seen and done.

At the same time, students are increasingly moving away from the lecture theatres and traditional academic delivery of foundations into placements and clinical settings[2], their growing experience and ability allowing them to progress on an "entrustability" scale (from *observe* to *supervise*, *initiate* and then *peer teach*), expressing higher level of attainment (and responsibility) in clinical settings[3].

The Leeds Institute of Medical Education has the responsibility to design and deliver the MBChB curriculum for the University. One the aspects of the innovative approach is the extensive adoption of Technology-Enhanced learning in the curriculum. For more than 10 years, the Technology in Medical Education (TIME[4]) team has been developing and deploying digital resources to students, working closely with clinicians, academics, students, patients and carers to ensure quality and relevance. Students have been encouraged to use mobile technology, initially through the delivery of PDAs to every undergraduate students but increasingly through a Bring-Your-Own-Device paradigm.

What we are now considering is how to bring that experience even further by enabling a more personalized and adaptive learning experience for students in medical education.

3 *myPAL* – Personalised Adaptive Learning

So what does this context means for an innovation and research agenda in the context of Technology-Enhanced Learning and Medical Education?

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[2] See https://www.medicine.leeds.ac.uk/curriculum/ for a description of each of the 5 years of the MBChB at the University of Leeds

[3] https://www.medicine.leeds.ac.uk/mbchb/assessment/Expectations/ExpectationsGuide(poster).pdf

[4] See the TIME website at https://time.leeds.ac.uk for a list and description of digital resources and computer-based assessment systems.

- The MBChB degree is recruiting about 250 students each year, which over a 5 years curriculum (plus intercalated year and Foundation Years) gives a cohort of significant size for data collection, longitudinal studies and volunteer-based co-design activities for our research and development projects.
- The "spiral" nature of the curriculum ensures that the learning focus and experience of the students is consistent and accumulated upon previous learning interactions, a feature that most modular, standalone academic undergraduate degrees don't share.
- The presence of a Technology-Enhance Learning team embedded in LIME and including researchers and software developers gives us the flexibility to develop our own systems in-house, enabling a much tighter interaction between research and development, in particular with methodology such as Design-Based Research and Agile prototyping.
- The widespread usage of computer-based approaches for the curation and delivery of digital resources (e.g. app- or web-based eBooks, educational videos, revision applications) and for the handling of academic assessments (e.g. summative assessments, reflective or end-of-placement reports) already gives us a wide and diverse range of learning and interaction data that could be exploited.
- The early adoption of mobile technology by students means that a comprehensive set of data covering the whole 5 years of the curriculum by a complete cohort of students, from entry to graduation, is now available for performance and predictive analytics.
- The mix of academic settings (lectures, workshop) and workplace settings (placements, practice-based learning) is a fundamental approach of the MBChB curriculum, to the point that *"practice, performance and learning are so interlinked they are inseparable and dependent on the specific setting."* [4]. This will create tensions with aspects of a learning mentor, especially when some if the data evidencing sources and performance of learning are not easily collectable or even identifiable.
- Even if placements are a significant part of the MBChB curriculum, one-to-one tutoring or mentoring activities remain relatively time and resource consuming, and therefore remain under-exploited. Even with the presence of tutors or senior clinical staff on a site, opportunities for feedback remains limited due to time or task constraints, and to tutors and learners (in)ability to deliver and – respectively – identify feedback.

This short analysis of the context is strongly indicating that is a niche for the deployment of an appropriate technological approach to mentoring, to support medical students during their learning and practice, in traditional academic settings but also, and more important, in work-based settings. How to design, deploy and study the adoption of such a socio-cognitive system will be the objective of our research agenda on *myPAL*.

4 A Design-Based Research Approach

What we investigate with the development of *myPAL* to exploit these opportunities will be prioritized in the following weeks and months, in particular to meet some of the MBChB timeline requirements. We already know that the design space opening up with

our vision of a personalised adaptive mentor for medical students will need to embrace social, cognitive, emotional and organisational aspects of learning and human-technology interactions. In order to systematically explore and evaluate the design decisions that will inevitably have to be made, the *myPAL* system will be designed, tested, trialled and evaluated with students in both controlled and real-life settings, following a Design-based Research (DBR) approach [5].

In recent years, DBR has become a popular methodology for moving learning systems beyond the stage of research prototype. Its main advantage is a pragmatic agenda of producing better artefact by utilising theory while advancing theory through the design and usage of these artefacts. The tighter integration between practice and theory, between researchers, practitioners and users allows the design and evaluation of interventions (technology-enhanced in our case) that are aiming at changing educational practices. In particular, the holistic approach of DBR in integrating real-life settings supports (even promotes) the exploration of emerging properties out of the interactions between technology, people and social spaces. The main disadvantage of DBR however is the theoretical and methodological diversity that is at the core of its premises and the sparse documentation and replicability of the procedures used in previous works. Frameworks such as LATUX [6] or Socio-cognitive engineering [7] will be valuable in shaping our own approach of DBR and contributing to its methodological fundations.

Rapid prototyping and Agile methodology will be used to ensure that the system is developed incrementally and embedded in the Design-Based Research cycles, that fixes, improvements and new features originating from the co-design sessions are integrated seamlessly and evolutionarily into the live system, maximising the chance of a long-term appropriation by students – and institutions.

The work on *myPAL* will be organized around 4 parallel but intertwined strands (see **Fig. 1**) running, in the first instance, over the next 5 years of the MBChB curriculum: co-design of the main system; research and development of targeted functionalities; exploitation of historical data; and development of the technological infrastructure.

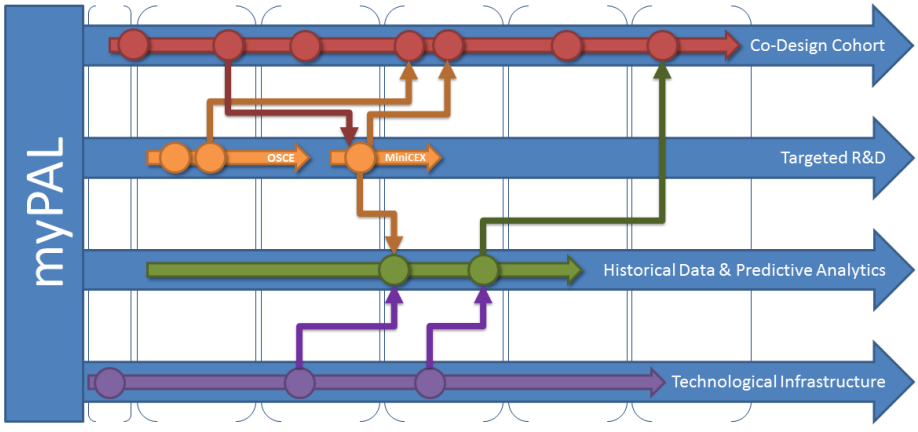

Fig. 1. The four strands of research, design and development of *myPAL*

4.1 Co-design cohort

This is to be considered as the principal strand of our work on the *myPAL* system, the overall objective being the study of its design and development with the new cohort of students starting their MBChB in September 2016, and its eventual adoption and appropriation over their interaction with the curriculum. This objective will be supported by series of participatory design activities spread across all stages of development of the system: initial co-design of ideas and innovation, testing of early prototypes, evaluation of impact, adoption and appropriation of the system, longitudinal studies of cohort (e.g. attitudinal shift to data privacy and sharing). For example, we will be exploring whether a dashboard is an appropriate interface for accessing learning-related data [8], or if a more adaptive, feedback-oriented interface might be defined.

4.2 Targeted Research and Development

The second strand of the *myPAL* project is the targeting of specific issues of research and development that could not be scheduled in the natural progression inherent of the cohort-led co-design activities. One such situation is to guarantee, as stated in the aim of the project, that every student will have access to some functionalities of *myPAL* as appropriate as possible according to their own progression in the MBChB curriculum. We might therefore have to focus on early development of functionalities that are more appropriate for Year 3 or Year 5 students, in order to keep them in the loop. For example, a significant part of the assessment process are Objective Structured Clinical Examinations (OSCEs), a competency-based assessment methodology that is linked with performance objectives, mapped to curriculum outcomes and is increasingly used in healthcare education programs [9]. OSCEs are a very concentrated – and stress-generating – experience where students are assessed on specific clinical competencies and their performance checked. But the strong competency frameworks underpinning their design – and the fact that feedback at such granularity is still not given back to the students – make them a very good candidate for developing the backbone for an intelligent mentoring system.

4.3 Historical Data and Predictive Analytics

As mentioned earlier in the document, we have now access to a large set of historical data on which to perform deeper predictive and learning analytics. The 5-year cover of the MBChB curriculum will give us opportunities to explore long-term learner modelling and, once combined with the data collected with live students, comparisons and baseline, whenever appropriate.

4.4 Technological Infrastructure

The final strand is the development of the technical infrastructure (i.e. front-end, back-end, data warehouse, etc.) according to our needs and requirements for interoperability

with existing systems or libraries. For example, we are considering the use of xAPI[5] as the metadata specification mechanism for the learning events being stored in *myPAL*'s Learning Record Store and exploited by the system and its associated analytics engines. The specification have been developed over many years and has reached a degree of maturity sufficient for observing a number of projects adopting it – see for example [10]. But a point made by many adopters of the specification – e.g. [11] – is that so-called *recipes* (i.e. the mechanism advocated by xAPI developers to standardise the expression of learning experiences) is a key condition for long-term adoption by the community. Therefore, we believe that our work with *myPAL* could play an important role in developing, testing and validating recipes for learning experiences related to mentoring activities in the context of medical education.

5 Toward an Intelligent Mentoring System with *myPAL*

At an early stage of the establishment of Learning Analytics as a research discipline on its own, a very important paper [12] identified 4 challenges facing the community: 1) Build strong connections with the learning sciences (e.g. how is learning taking place); 2) Develop methods of working with a wide range of databases in order to optimize learning environments (e.g. using Learning Analytics outside the confine of VLEs); 3) Focus on the perspectives of learners (e.g. extend criteria of learning success beyond grades, personalised visualisation); 4) Develop and apply a clear set of ethical guidelines (e.g. ownership and stewardship of data).

The design and development of myPAL, and its continuous deployment in real-life settings, with cohorts of students in the MBChB curriculum, open several perspectives for addressing many of these challenges. The workplace learning approach, with students in placements expected to observe, interact and learn from their experience, will provide a wide range of real-life settings where user-centric technological solutions will be trialed and deployed to supplement the generation of adaptive feedback, the multimodal collection of new learning data, the creation of nudges to trigger deeper learning.

In an application context for *myPAL* such as a medical education curriculum covering a whole 5-year of academic and professional development, traditional intelligent tutoring approaches, at the level of topic or problems, are neither realistic prospects (for one, there is no cognitive tutor that will do the job), nor desirable (intelligent simulation-based learning on specific aspects of the curriculum would be).

But an *intelligent mentoring system* that will support the learner in transitioning from academic to workplace learning by appropriate feedback is clearly a timely and pertinent approach. We believe that many aspects of the *myPAL* project could lead to significant contribution to such an endeavor: a focus on self-regulation of learning through appropriate feedback on learning; adding social machines functionalities [13] to complement inadequate (or missing) semantic information; the design of appropriate feedback mechanisms, both implicit and explicit, that will operate seamlessly and timely in settings when the immediacy of self-reflection and action for changes will vary a lot.

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[5] xAPI, or Experience API, https://github.com/adlnet/xAPI-Spec/blob/master/xAPI.md

Advances in Open Learner Modelling and Learning Analytics will provides us with many of the concepts, tools and directions require to explore many of the issues that the notion of *Intelligent Mentoring Systems* are raising and that the workshop will undoubtedly elicit.

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