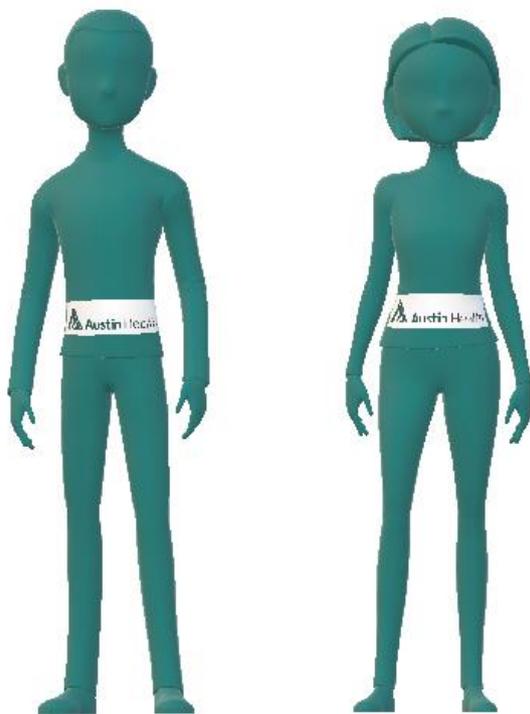


“Choose your own Adventure” Learning
for Interns and Junior Medical Staff:
Efficacy of Open Access Novel Adaptive
Clinical Learning Modules.



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Contents

List of Figures	2
Background	3
Smart Sparrow as an Adaptivity Platform.....	5
Why this project is important	6
The problem to be studied	7
Hypothesis.....	7
Research question.....	7
Aims and purpose of the study	7
Progress to date	7
Literature Review	7
Evaluation of adaptivity in our medical student cohort	7
Focus groups on the Smart Sparrow Platform.....	8
Content	8
Delivery and platform	8
Next steps	9
Development of Adaptive Virtual Scenarios	9
Development of Traditional Slide Based Scenarios	9
Participants and study design	9
Online Assessment.....	9
Intended process of analysis.....	9
Anticipated outcomes of the study	10
Subsequent Possible Evaluation of the study	10
Acknowledgements.....	11
References	11

List of Figures

Figure 1. Interactive question within an adaptive cytopathology tutorial(6).....	4
Figure 2. Immediate feedback within an adaptive cytopathology tutorial(6).....	5

Background

Online learning platforms which are adaptive to the individual learner have become increasingly popular in teaching as they provide personalised learning to participants. However, their role in education of junior medical staff and medical students have not been well studied.

Such adaptive eLearning approaches may provide a way to address the challenge in medical education of meeting competency expectations of students and clinicians. Such competency requirements occur not only from accrediting bodies such as the Australian Medical Council and Postgraduate Medical Council of Victoria but should also be implemented within the imposed time and resource constraints of educators and learners.(1, 2) Accreditors are increasingly looking to the tracking and assessing of trainee's knowledge in this process with the embracement of new educational tools to efficiently develop competency whilst meeting the increasing demands of service delivery.(1) At present, there is limited research investigating adaptive eLearning in this clinical education domain.

Adaptive eLearning is defined as eLearning activities where the learning objects are sequenced dynamically based on the system's model of student's knowledge level.(3) Adaptive eLearning Platforms (AeLP) exhibit three types of adaptivity(4);

- 1) Individualised, often immediate, feedback adapted to specific misconceptions
- 2) Sub-activities including questions and tasks that can be set-up to be sequenced adaptively depending on student performance.
- 3) Feedback to teachers who can adapt and modify the tutorials based on analysis of student behaviour in the tutorials.

One AeLP which fulfils all three types of adaptivity is Smart Sparrow.(5) Smart Sparrow is a free online learning design platform that enables educators to create interactive and adaptive courseware (5).

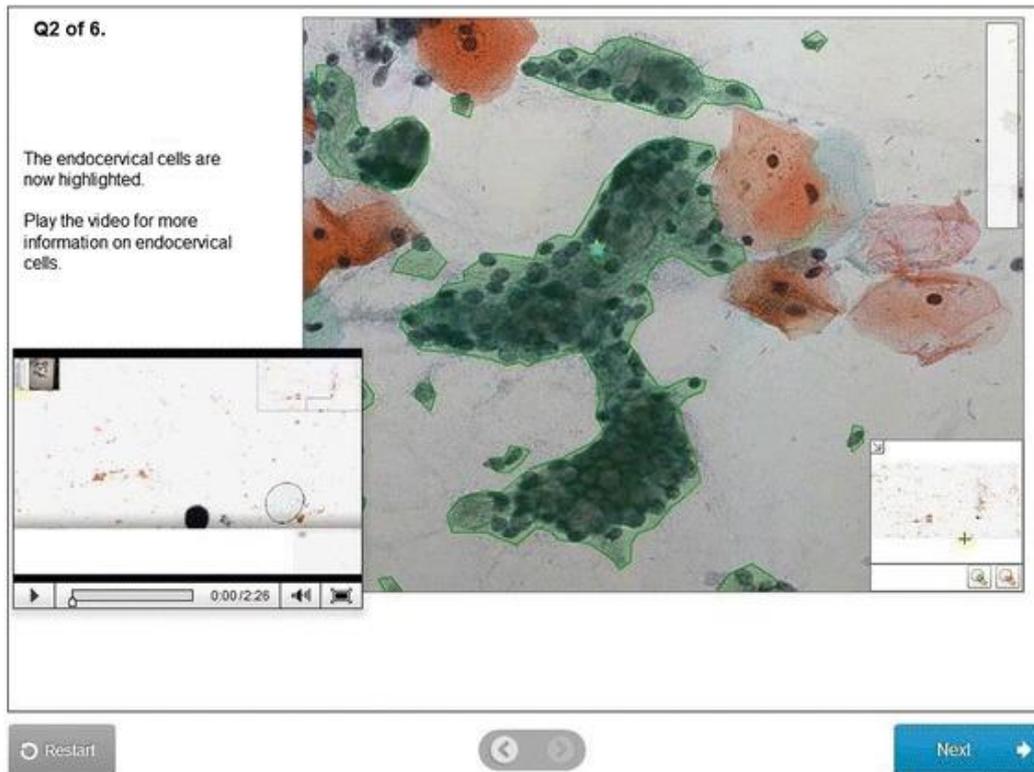
Figure 1 demonstrates adaptivity within the tutorials and Figure 2 demonstrates immediate feedback.(6) Educators can also benefit from the ability to track students' progress.(7)



Figure 1. Interactive question within an adaptive cytopathology tutorial(6)

In this example tutorial, if the participant drags the green star to an incorrect region, feedback adapted to the participant's choice is given and supplementary explanations can then be given. If the participant drags it to a correct region, they that participant can then progress more rapidly through the tutorial.

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**Figure 2. Immediate feedback within an adaptive cytopathology tutorial(6)
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Thus, Smart Sparrow is an AeLP which promotes learning by doing, personalises learning journeys through adaptive pathways and provides insights into how students learn and teachers teach.(5) With adaptive pathways, when students hit a roadblock, they can be directed to resources that help remediate their misconception. When students successfully grasp concepts, they can be ‘fast-tracked’ to more content to stretch their knowledge.(7) Feedback can thus be individualised and an adapted learning pathway is akin to using online simulation by allowing the learner to choose their learning pathway.(8) The motivation behind the AeLP in Smart Sparrow is the desire to create exploratory learning environments where students benefit from interaction and control over their learning experience.(7)

Smart Sparrow as an Adaptivity Platform

In this context, Smart Sparrow is an Australian designed AeLP that gives pedagogical control over the learner’s experiential learning by letting them “choose their own adventure” and in doing so, learn from their mistakes in a virtual environment.(7) By adhering to the fundamental pillars of a “flipped classroom”, it allows a flexible environment, a learner-centred learning culture, intentional content and educators that actively scaffold learning with timely and continuous feedback.(9)

Adaptive courseware allows at-risk learners to be supported and high achievers motivated simultaneously.(7) The program utilises adaptive learning in web-based clinical case scenarios where technology and accumulated data provide customised program adjustments (instruction and/or remediation) based on an individual learner’s level of demonstrated mastery.(10) Interestingly, the instruction and remediation can be nonlinear and adjust to a learner’s interactions and

demonstrated performance level(10). The ability to have multiple pathways within these teaching episodes also means that participants can experience clinical reasoning at their own pace with immediate private feedback of answers. Additionally, in an interdisciplinary health service, the ability to have different pathways during a virtual scenario allows teaching within different disciplines where clinical context may be slightly different between each of the disciplines. (11, 12) It can also support different learning styles whilst facilitating real-time dynamic mapping and sequencing of instruction to match individual learner characteristics.(13) Developed modules can be uploaded to the online site, the “best network” (www.best.edu.au) as a free resource for health services nationally and internationally.

As can be seen from the BEST Network site, Smart Sparrow offers flexibility to cover a vast array of courseware (see <https://www.best.edu.au/courseware/>). The BEST Network began as a government funded \$4.5M project in 2012 to establish a network of leading biomedical schools and peak industry bodies set to revolutionise biomedical education by addressing a critical need in biomedical education world-wide: the need for easy sharing of knowledge, expertise, courseware and technologies. In 2014, the BEST Network's Founding Members - UNSW Australia, University of Queensland, James Cook University, and University of Melbourne - established the network as a not-for-profit venture. So Smart Sparrow(7) is a novel AeLP that allows web-based simulation that can make clinical reasoning explicit in clinical case scenarios (see video links <https://www.youtube.com/watch?v=A1oLmPAFcA4>; <https://www.youtube.com/watch?v=zypzmcrc7eU>; <https://www.youtube.com/watch?v=rQnkN4QDSSo>).

Why this project is important

- A recent initiative called Choosing Wisely (www.choosingwisely.org) aims to change clinicians' practice to align with best practice by getting them to stop using unnecessary investigations and interventions that are not supported by evidence (14, 15). The Choosing Wisely Australia campaign was launched in January 2015 by the National Prescribing Service to engage clinicians and patients in meaningful conversation about tests, treatments and procedures that are unnecessary and that may, in fact, cause harm.
- It is a physician led movement to articulate the right investigations and treatments for the right patient, through the creation of evidence based lists of investigations and treatments.
- As interns and residents represent the vast majority of clinicians ordering investigations, a critical component to this campaign is to promote appropriate clinical reasoning in interns to order appropriately and instil a culture where “less is more” in terms of focused assessment and management. Traditionally, however, the teaching of critical clinical reasoning in this setting has been difficult as interns and residents lack the experience from multiple clinical encounters to form a useful storage of illness scripts.(16)
- To address this, we are exploring the efficacy of a novel learning platform that allows web-based simulation to instil a culture of collaborative learning and critical inquiry.(17) Once the efficacy of this novel learning tool is assessed and refined, its open platform characteristics can be rapidly implemented more broadly, creating a real opportunity for clinical change and better patient care at the local, national and international level.(18) *It therefore has widespread implication for interns and HMOs in all health services*

The problem to be studied

- Adaptive eLearning Platforms like Smart Sparrow have not been well explored in common clinical scenarios
- We will therefore explore the utility of such a platform in medical students and junior prevocational medical staff

Hypothesis

- Based on current literature (6, 19-21), we hypothesise that Smart Sparrow, as an AeLP, is an effective, efficient, personalised, interactive and engaging platform to teach medical students and residents clinical cases compared with traditional lecture based delivery.

Research question

- Does an Adaptivity eLearning Platform (Smart Sparrow) increase efficacy, efficiency, interactivity and engagement of learning in medical students and junior medical staff on common clinical scenarios compared to traditional slide-based lectures?

Aims and purpose of the study

- To develop (using the AeLP Smart Sparrow) adaptive common clinical scenario tutorials for medical students and junior medical staff (interns and residents)
- To develop traditional slide-based common clinical scenario tutorials for medical students and junior medical staff to act as control content
- To explore the efficacy, efficiency, usability, interaction and engagement of Smart Sparrow in clinical education using a randomised mixed methods crossover trial

Progress to date

Literature Review

We have completed an extensive systematised literature review on Adaptivity in Clinical Education that we are preparing for publication. Significant time has been taken to do this systemised review as it has importantly guided our methodology and planning. Austin Health has developed a reputation for establishing sound initiatives based on research and a thorough understanding of principles, hence the extensive literature review was quintessential given the resource commitment required to generate engaging adaptive content.

Evaluation of adaptivity in our medical student cohort

Our Melbourne University Austin Clinical Students underwent an adaptive tutorial on gastrointestinal bleeding. In this scenario, 47 medical students in 11 groups decided how to manage a virtual patient with gastrointestinal bleeding. Over a day, they participated in history, examination and management of this patient with manual adaptivity provided by faculty.

In general, students found the teaching session excellent and rated the overall method of learning highly. The interaction was also positively rated and most stated their learning needs and the

intended learning objectives were met. Objective assessment of competency also showed retention of important clinical signs in the case.

Decision pathways were analysed and unnecessary testing and management identified and fed back to the whole cohort in a face to face workshop. Final costs on health care ranged from \$238.25 to \$1478.25 with better clinical outcomes for the virtual patient in groups who spent the lesser amounts as the diagnosis was arrived in a more timely fashion. Questionnaire data reflected this in that groups who were more confident in avoiding unnecessarily investigations using less tests. Importantly, most felt strongly that the session was going to change their future clinical practice. Moreover, the overwhelming majority were interested in more adaptive virtual patient scenarios as a method of learning.

Focus groups on the Smart Sparrow Platform

To help with proper development of clinical scenarios within the Smart Sparrow Platform, we have been training on programming within this platform and seeking input from groups with experience both in programming and as end-users.

Content

Previous participants and clinicians from various backgrounds (students, interns, HMOs, registrars, consultants, nursing and allied health) have highlighted the following important suggestions about content;

- Content should not be too simple as adaptivity is best suited to complex cases
- There were suggestions of cases of sick, complex patients where time critical decisions need to be made
- Others suggested cases where issues around dealing with family or other staff were addressed. The latter would address our peer and mentor support initiative
- There were also suggestions to embed situational judgement and the hidden curriculum within the virtual scenarios

Delivery and platform

Previous users of Smart Sparrow have highlighted some pearls when designing cases using adaptivity

- Ensure the user does not get stuck and avoid generating frustration
- Avoid the clicking image interface as precision is required to use this
- Make it engaging, similar to the gaming industry
- Utilise learners and consumers in all stages of the process
- Make it complex
- Consider adding video

Next steps

Development of Adaptive Virtual Scenarios

The adaptive eLearning Platform developed by Smart Sparrow(7) will be used to create novel adaptive scenarios covering assessment and management of common clinical presentations encountered by medical students, interns and residents. Each scenario will have clinical assessment, investigations and initial management components with learning objectives aligned to curriculum from the National Intern Training Framework (where the Medical Board of Australia has agreed that the Australian Medical Council support intern training). This education also comes under the Confederation of Postgraduate Medical Education Councils' Australian Curriculum Framework for Junior Doctors.

In clinical disciplines, the use of cases with "real world" relevance were felt to contribute significantly to engagement.(6, 19-21) Thus, the clinical scenarios will be carefully produced to be realistic and with close engagement of content experts.

Development of Traditional Slide Based Scenarios

Concurrent with the development of Adaptive Virtual Scenarios on Smart Sparrow, a traditional slide set will be created in Microsoft PowerPoint 2013 or Office 365 which enables narration to be recorded with the slide show. This will allow consistent timing of delivery for the control group that can then be reliably measured during distribution when uploaded to our Andragogic based Learning Management System known as Atlas.

Participants and study design

Medical students, interns and residents will be recruited by broadcast email for a randomised crossover trial of the adaptive tutorials. The potential bias from exposure to face-to-face clinical education already present in hospital seminars, grand rounds and tutorials will be reduced with such randomisation.

Previous studies have suggested an expected clinically significant 20% difference(22) between groups so a minimum of 18 participants per study group is required to detect such a difference with 99% statistical power.

Online Assessment

Questions will be based on the topics covered in Smart Sparrow® and on their regular web resources. There will be a range of item types including multiple choice, selection and prioritisation lists.(22) Questions will be developed by content experts from the relevant departments in the hospital and reviewed by an examinations committee to look for bias, relevance and equivalence of difficulty in questions. Learners will be assessed under exam conditions.

Intended process of analysis

Baseline performance and time spent on the tutorials will be assessed using an unpaired student t-test and wherever significant differences are found, Cohen's d will be used to determine effect size. Cronbach's alpha will be used to evaluate internal reliability of the knowledge assessments.

From UES data, median scores on the Likert scale items in all relevant subscales will be coded and compared between groups using the Mann-Whitney test. For overall scores, median ratings

between groups will be compared using the Mann–Whitney test. Factor analysis will be performed to assess whether each UES subscale contributed significantly to variance in responses.

Anticipated outcomes of the study

Description of anticipated outcomes	Method of evaluation of outcomes / impacts
The “Choose Your Own Adventure” Adaptive Learning Modules are an engaging method of learning	The User engagement scale and feedback during the process
Interns and HMOs knowledge about appropriate assessment and management of common clinical conditions increases	The online assessments within the study should reveal any advantages over usual methods of learning. In other words, test answers from the assessments will provide a proxy for knowledge
Interns exhibit evidence behaviour in the assessment and management of the piloted conditions	Audit of a sample of conditions noting changes in assessment and appropriate management to determine to what extent interns choose evidence based options in the assessment and management of piloted conditions.

Subsequent Possible Evaluation of the study

If the adaptive learning platform is found to be efficacious, then we would confirm the findings in other areas and departments with larger numbers. Ongoing discussion and focus groups within the various forums will aid in such evaluation.

Then, utilising a steering committee, we will determine key stakeholders for an institutional wide rollout after factors such as change impact, readiness for change and change approach have been considered.

Formal evaluation of any initiatives arising from the research will also be undertaken.

Eventually, the steering committee, a project officer and project leads will determine Key Performance Indicators (KPIs) and their baselines prior to the wider project and then monitor progress through targets and agreed stages/timelines.

With ongoing project review, KPIs and their performance will be reviewed against common evaluation measures and recommendations made on any refinements necessary.

The ultimate aim would be to then have a “best practice approach” to utilising adaptive learning platforms in the health sector which can then be disseminated to other organisations.

Acknowledgements

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