SMART ED

# FINAL PROJECT PROPOSAL


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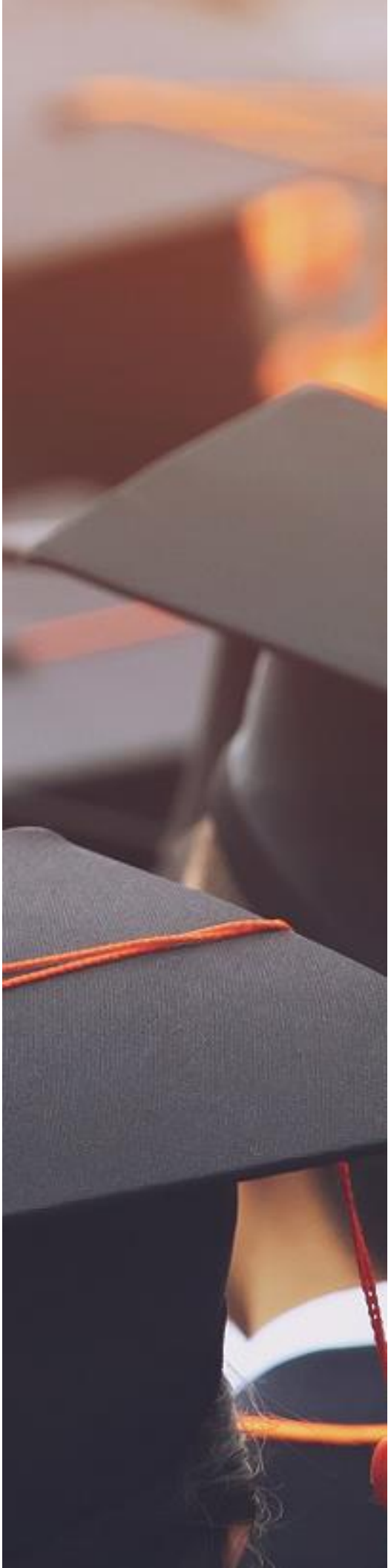
# 1. Overview

**SmartEd is an online system that is to be integrated with existing tertiary educational systems. It uses metrics gathered from various sources such as class attendance, etc. to identify deficiencies in the learning process to identify students at risk of difficulty or disengagement to reduce attrition rates and personalise the learning experience. This report aims to explore the design process from initial ideation to a final solution. We explore different aspects of academic research and use this to inform and narrow the scope of the problem. From here we are able to scope out and design the final product described above.**

**With the world moving to an increasingly digital and online learning ecosystem, identifying the deficiencies and problems early on are imperative and how an online learning system compares to the traditional face-to-face learning. With the emergence of COVID-19 this year (2020) and the forced and often rushed transition to completely online learning, it has become more important than ever to find a design solution that replicates the type of learning garnered from traditional methods. Thus, we plan to explore the intricacies of online learning models and optimise its efficacy.**



# 2. Background and Problem Space

## 2.1. What is the problem at hand?

### 2.1.1. Higher education in Australia and its evolution with learning

In 2009, the Australian Government, understanding the need for higher education for economic and social progress, set a target to have 40% of those aged 25-34 to have obtained a bachelor's degree or higher (Australian Government Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education, 2009). Now in 2020, Australians are pursuing higher education in record numbers with 33% of Australians aged 20-64 having obtained a bachelor's degree or higher (Australian Bureau of Statistics, 2019). However, data reports by the Australian Government Tertiary Education Quality and Standards Agency (TEQSA) have shown substantial first-year attrition rates for higher education providers with 20% for university and 27% for non-university providers (TEQSA, 2017). Furthermore, completion rates in Australian higher education show room for improvement, with 85% of all students in public universities completing their bachelor's degree as at 2018 (Department of Education, 2018). To improve retention and completion rates, TEQSA recommended the use of predictive learning analytics to identify students at risk of difficulty or disengagement as one of their good practices in a recent report, with results from the Swinburne University of Technology showing evidence of success (TEQSA, 2020).

On 8 April 2020, following the lockdown of most higher education providers due to the COVID-19 pandemic, TEQSA released a publication regarding online delivery and its key considerations for providers. In the publication, considerations of online delivery under the Higher Education Standards Framework included; how student engagement will be maintained throughout the delivery of the course, including peer-to-peer interaction, staff to student interaction, and student support; what additional learning, academic and personal support may be required in the online context; quality assurance mechanisms tailored for the changed delivery mode, including how to review, measure and improve outcomes (TEQSA, 2020). With little data concerning the use of online-learning on such a scale, we have yet to see if the relevant standards of the Higher Education Standards Framework to technology-enhanced learning (TEQSA, 2019) are enough to ensure that attrition, retention and completion rates of students engaged in tertiary education remain stable or are affected.

## 2.1.2. What is online learning and what is its prevalence today?

Distance education has existed in one form or another since the 1800s, when American institutions began to offer education via correspondence (Kentnor, 2015). In the 1900s, the advent of radio and television gave rise to educational broadcasting (Kentnor, 2015). It was about 80 years later that online learning was introduced to the world, not long after the early days of the internet (Ferrer, 2017). The first fully online institutions were founded in the 1990s, and since then online learning has expanded rapidly and begun to disrupt traditional education systems. In 2013, almost 30% of American higher education students were enrolled in an online course (National Center for Education Statistics, 2017). Despite the ubiquity of online learning today, attrition rates remain higher for online students compared to their face-to-face counterparts (Jazzar, 2012). Now that the world faces a pandemic, a lot of Australian universities have transitioned completely to online education, placing the viability of holding entire courses online under a global spotlight (Kwan, 2020).

Nguyen (2015) found that learning outcomes for online students were the same as, if not better, than traditional students, and that students were generally satisfied with online learning. Nguyen also reviewed studies that demonstrated similar learning outcomes for both traditional and online students, but that the cost-savings and potential productivity gains made online learning a more attractive choice. The National Research Center for Distance Education and Technological Advancements (DETA) has operated a database since 2004 which now contains over 355 research reports that have found no significant difference between online and traditional education platforms (and some with a significant difference in favour of online platforms), which supports the claim that online learning is at least as effective, if not better, than traditional education platforms (DETA, 2019).

Twigg (2001) outlined that the key to online education becoming generally more effective than traditional platforms is personalising learning to individuals. Personalisation of learning should consider individual differences such as existing knowledge, need for interaction with instructors and peers, learning pace, emotional intelligence, and motivation. Broadbent and Poon (2015) found that students who were successful in time management, effort regulation, and critical thinking performed better in online learning platforms than students who lacked these skills. Additionally, metacognition, which is awareness of one's thought process and knowledge about how one learns, was associated with better academic outcomes in online environments.

## 2.2. What methods of learning are best supported by research?

### 2.2.1. What are the benefits of peer learning?

Within the higher education sector, peer learning is used to encourage peers to provide each other with useful information whilst sharing their experience, knowledge and ideas. Whilst not all information students receive is accurate, it becomes part of the process to learn to judge the accuracy of the information they receive. Web-based activities are considered to be more effective when there's a direct interaction between the teaching staff and students as well as the students themselves. Collaborative learning includes open-ended but focused tasks for students to work together to achieve a goal, thus encouraging interdependent learning. This should include critical thinking, problem solving, sensemaking and personal transformation, exploration, discussion, debate and criticism (Boud et al., 2014).

According to Boud et al. (2014), the four design features that are considered to be important when developing peer learning activities are:

1. consider the context,
2. focus on general goals/outcomes,
3. difference between learning strategies and assessment tasks,
4. consider resource implications.

The outcomes and skills this aims to assist peers in understanding and learning are working with others, critical inquiry and reflection, communication and articulation of knowledge, understanding and skills, managing learning and how to learn and self and peer assessment (Boud et al., 2014).

Broadbent and Poon (2015) found a strong effect of peer learning on successful online learning outcomes, arguing that it should be prioritised when designing online learning platforms. Peer learning encompasses student collaboration, interaction, and discussion. Broadbent and Poon recommended platforms to encourage active and passive student participation in discussion forums. Hansch, Newman, and Schildhauer (2015) also found that strengthening the social elements of online learning can reduce dropout rates and improve student engagement. Kizilcec and Schneider (2015) demonstrated that engagement was higher in massive open online courses (MOOCs) where students were enrolled in a course with colleagues or friends.

According to researchers, there are basic principles of learning-rich peer interaction (Havnes, et al., 2016). Educators should focus on implementation and outcomes rather than process of

data and incorporate the structuring of peer interaction settings, dynamics of the peer-to-peer interaction and the way in which knowledge and problems are attended to (Havnes et al., 2016).

Support for peer learning is also demonstrated by nudge theory, which is a concept in psychology and behavioural economics that employs positive reinforcement and subtle suggestions to direct behaviour and decision making (Thaler & Sunstein, 2008). The Government of the United Kingdom's Cabinet Office has shown that making an activity or system social by showing how other people are participating in that activity or interacting with that system can increase participation in a desired behaviour (Behavioural Insights Team, 2015).

### 2.2.2. Is meaningful gamification an achievable objective?

Gamification refers to the "use of game mechanics and game design techniques in a non-gaming context" (Dorscheidt, 2015). Such mechanics include competition, a sense of accomplishment, tangible rewards, the use of objectives, and timely feedback (Behavioural Insights Team, 2015; Dorscheidt, 2015). Nguyen (2015) found that gamification can increase engagement, motivation, and productivity in a variety of non-game contexts. However, multiple researchers have noted that gamification must be utilised in a meaningful way. Tsay, Kofinas, and Luo (2018) found that focusing too much on achievements should be avoided, as learning based on extrinsic rewards is not sustainable long term, and extrinsic motivation eventually destroys intrinsic motivation (Deci, Koestner, & Ryan, 2001). Online learning activities should be designed in a way that intrinsically motivates students (Nicholson, 2015), for example, by empowering learners to outline their own goals, and asking users for feedback frequently and at various stages of a system's development (Tsay et al., 2018).

Hansch, Newman, and Schildhauer (2015) found that there is no one-size-fits-all manner for applying gamification to a system that is guaranteed to increase student motivation and reduce dropout rates. Dichev, Dicheva, Angelova, and Agre (2014) found that a frequently employed style of gamification; points, badges, and leaderboards; emphasises performance metrics over mastering and understanding content, while relying too much on extrinsic rewards that reduce long-term student engagement. In an educational context, gamification elements must combine extrinsic and intrinsic motivation to enhance students' internal desire to learn. Hansch, Newman, and Schildhauer demonstrated that meaningful ways of implementing this involve both personal and social gamification. Personal gamification utilises personalised feedback, progressive rewards, and progress tracking, while social gamification includes sharing

learning experiences with peers, interacting with peers, following peers' learning progress, and up-and downvoting posts on discussion boards.

### 2.2.3. What effect can different learning styles have in education?

There are two different yet important concepts of learning in education: cognitive and learning styles. Cognitive styles are stable characteristics relating to a person's typical manner of acquiring and processing information whilst learning styles focus on a user's preference for the different types of learning situations. Kolb (1984) designed an experiential learning model to assess learning styles. The four stages include concrete experience, reflective observation, abstract conceptualization and active experimentation (Arthur, 2007). It assists educators to design teaching strategies for adults and include all four stages in their work. Whereas the Dunn and Dunn learning style model focuses on five stimuli that students should be aware of their reaction to. These include their reaction to an instructional environment, emotional elements, sociological inclinations, physiological characteristics and processing tendencies (Arthur, 2007).

Cognitive psychologists have divided learners into three separate categories: visual, verbal, and tactile or psychomotor (Jonassen & Grabowski, 1993). Others have expanded the list to include print, aural, interactive, visual, haptic, kinesthetic and smell. Learners also process information in their own way. A typical distinction between the global and analytical is taking in the whole idea first and then the details verse taking in the details step by step to picture the whole idea later. Whilst teaching, it is suggested that information should be presented in a "whole-part-whole" approach to accommodate both learners. This presents information with the global idea, the specific details and then the global idea is repeated.

Individuals vary in their approach, strategy and preferences during learning activities. Understanding each individual’s learning differences will assist in making andragogy more effective. Educators should tailor the manner in which educators apply the core principles to fit learner’s cognitive abilities and learning style preferences. According to Knowles et al., individual learner differences can be divided into three categories. The first is cognitive which includes general mental abilities, primary mental abilities, cognitive controls, cognitive styles - information gathering and information organising, learning styles. The second is personality which consists of attentional and engagement styles, expectancy and incentive styles and lastly is prior knowledge (Knowles et al., 2014).

To assess learning styles early in the course, students could participate in a simple diagnostic tool that can determine their learning style. Janet Arthurs created a list of aids that can be incorporated into their coursework to personalise the content to specific learning styles (Arthur, 2007). Educators and learners should also acknowledge environmental, emotional, physiological and psychological factors. The list is as follows:

- Visual: use of photos, graphs, videos, symbols and charts
- Auditory: use of lecture, discussion and group sessions
- Readers/writers or digital: note-taking and rewriting of notes
- Kinesthetic: incorporation of lab demonstrations and opportunity to work hands on

Computer-based instruction (CBI) design is the computer programming of content and lesson design that takes into account the individual learning differences to achieve the learning goal level (Havnes et al., 2016). It can provide an opportunity for problem solving, corrective feedback, elaboration, visual and graphic cues, control of the routine by the learner and appropriate wait time between input and response (Havnes et al., 2016). Within CBI design there are four separate units: instructional control, instructional support, screen design and practice strategy. There are three types of instructional control: program controlled where the program guides the learner, learner controlled where the learner determines the options, adaptive controlled which is a combination of program and learner controlled where control is based on the learners response (Havnes et al., 2016). Instructional support enhances the understanding of the instructions when seeking assistance. A form of instructional support is feedback which influences the learning process by motivating the learner or providing additional information. Screen design incorporates the display of information at a consistent location or relevant graphics helps facilitate learning. It can maintain the interest and attention of the students. Educators should integrate instructional visuals designed using information-processing learning theories and screen design strategies to enhance transfer of information. Lastly practice strategy varies by the difficulty of the subject matter and individual learner characteristics. It is suggested that more detail should be provided if a high achievement is an important goal of the instruction (Havnes et al., 2016).

## 2.3. Competitor analysis

The two most prominent learning management systems (LMS) at present are Blackboard Learn (proprietary software) and Moodle (open-source software), which are utilised around the world, mainly by tertiary institutions (Corich, 2005). However, both of these platforms' main focus is providing a system that supplements traditional face-to-face learning, rather than a system that solely focuses on online learning. Additionally, neither of these systems offer integrated personalised learning within their respective platforms. Even though these existing systems weren't designed specifically for online learning, many institutions in Australia utilise them for their online ("external") courses, meaning thousands of students across Australia are using these systems in an online-only context (Open Universities Australia, 2020). Therefore, even though Blackboard Learn and Moodle don't aim to solve the same problems that we do, because of their dominance in the learning platform industry and the fact that they are used by students and educators in an online-only context makes both of them some of our key competitors.

Platforms that are designed to be used in a solely online context include MOOC platforms such as edX, Coursera, Khan Academy, and Udemy, among many others. These systems are more direct competitors, as they deliver online-only courses and are not necessarily affiliated with traditional brick-and-mortar institutions. Some of these platforms offer free and paid courses from leading universities like Harvard, MIT, and Stanford (e.g. edX), while others are completely free and independent (e.g. Khan Academy). Users (i.e. students) can participate in these platforms' courses directly and on their own accord, without having to enroll in a traditional institution. Additionally, traditional institutions can other some of their courses (either fully or partially) through these platforms, like the University of Queensland which offers standalone courses through edX (UQx), while integrating edX with their face-to-face courses (e.g. first-year psychology courses).

Although it can be hard to conduct research on the internal workings of MOOCs, it has been demonstrated based on available data that MOOC platforms are not utilising AI to personalise students' learning experiences (Yu et al., 2017). At present, MOOCs mostly replicate the traditional classroom experience, focusing on standardisation rather than personalisation. MOOCs tend to have fixed course structures and don't reap the benefits of analysing how learners use their systems and interact with course content (Yu et al., 2017). Additionally, many MOOC platforms are merely *platforms*, that is, course structure and content is determined by each institution, and so the onus is on them to offer personalised learning, rather than the MOOC platforms themselves.

With regards to traditional platforms like Blackboard Learn and Moodle, it is evident that their only goal is to support traditional face-to-face learning and that they do not provide any support for the use of data analytics, AI, or machine learning for institutions or educators to utilise or integrate with their course offerings.

Refer to Table 1 for a brief overview of the differences in the prominent learning platforms that will be our key competitors.

| | **Blackboard Learn** | **Moodle** | **edX, Coursera, etc.** | **Khan Academy** | **SmartEd** |
|---|---|---|---|---|---|
| **Learning model** | Traditional | Traditional | Online | Online | Online |
| **Used in which settings?** | Traditional, partly online, & purely online | Traditional, partly online, & purely online | Partly online & purely online | Purely online | Purely online |
| **Target customers** | Institutions | Institutions | Institutions & students | Students | Institutions & educators |
| **Cost model** | Paid | Free | Paid & free options | Free | Paid |
| **Software model** | Proprietary | Open source | Proprietary | Open source | Proprietary |
| **Data analytics for use by educators** | N | N | Y | N | Y |
| **Personalisation of learning** | N | N | N | N | Y |

*Table 1: A Brief Comparison of Prominent Online Learning Platforms*

Moving on to platforms with a much narrower target audience than ours, Duolingo is a language learning app with just a single goal of teaching its users a language of their choosing. Duolingo is important for us to investigate as it makes use of personalised learning, aspects of meaningful gamification such as motivated rewards, and adapts based on learning styles. In this regard, Duolingo is not a competitor, rather an existing system that we can learn from and determine how AI has contributed to their success.

Duolingo utilises deep learning to determine a user's progress and initial language ability, determine if their answers are correct (which are in the form of sentences and can have many different correct alternatives), and predict the likelihood of a user answering a particular question correctly (Peranandam, 2018). It continuously analyses users' achievements and abilities to personalise its learning experiences, e.g. each user and word combination has a personalised "forgetting curve", which is a function of the probability of remembering something and time since last studied. Duolingo's use of machine learning has allowed it to improve user retention rates (Reneau-Wedeen, 2018), increasing user engagement by 12% after it first integrated its machine learning algorithms (Sawers, 2019).

One of Duolingo's core goals is to utilise AI to provide an online experience that is as close to human-to-human as possible (Sawers, 2019). To do this, it has implemented bots that help teach language through text-based conversations. These bots reply with a large range of possible answers, and adapt over time.

It is clear that Duolingo has achieved success, in terms of increasing user engagement and decreasing attrition rates, by utilising AI to personalise learning. However, it is not possible to conclude the effect Duolingo has had on language learning and language retention without conducting an independent study.

## 2.4. Research synthesis

Through the research conducted, SmartEd has discovered the existence of the different learning styles and the importance of the consideration of them when learning. There are many different learning style models that can be followed when taking these into consideration within our designs. We also discovered methods and techniques that can be included into online learning content that is suitable for all styles. Our focus is on adult learners and the research was conducted with this as our focal point**.** In our research about the different learning styles, it was indicated that screen design and layout were important factors when successfully designing an online learning platform (Havnes et al., 2016). This information will be taken into consideration in our designs and tested through user testing. The content displayed within our application will attempt to consider and cater to all forms of learning styles, with the aim to maintain the interest and attention of users.

SmartEd sourced a range of academic references using the library provided by the University of Queensland and Google Scholar. The team has sourced information from government websites, academic websites, published journals, and books. The sources were selected due to their relevance to the chosen topic as well as the reliability of the source. Whilst there are an abundance of sources available to access that would contain beneficial information to our research, the sources chosen provide the team with a wide range of knowledge to allow the team to further understand the issues within online education and the users learning styles.

# 3. System Scoping and Design

## 3.1. Conceptual Design

### 3.1.1. Stakeholders

The target customers of our system are educational institutions (e.g. universities, TAFEs, etc.) along with individual educators (lecturers, tutors, etc.). The system can be utilised institution wide (e.g. like Blackboard Learn), or by individual eductors on an ad hoc basis (e.g. like Piazza and Slack). The primary users of our system are intended to be students and educators. Thus we have identified three key stakeholders: students; educators, which includes lecturers, professors, tutors, and course coordinators; and learning institutions. Along with some secondary and tertiary stakeholders, ones that will be affected by, but won't directly use the system.

#### Primary Stakeholders:

**Students**

The primary users of our system will be students. We are designing our system so that students can have the best possible experience with online learning, one that we intend to be as effective as possible compared to traditional learning.

It's frequently the case in many subjects at university in particular, that a lot of students will have issues with specific topics or subjects, as the educator is unable to portray the topic in a way that makes sense to the student. Being able to identify a students learning style and adjust the educational content based on this will be revolutionary to current students. The current education style is one size fits all, with (at university) tutors doing their best to fill the gap. The problem with this, is that if the tutor and lecturer have the same teaching style, which is likely the case, this results in a loop of miss-understanding for the student. If there are no educators to match a student's style on a specific topic, the educators could then seek out resources online, or from other institutions, where this problem has been solved in a style that suits the student.

**Educators**

Educators are the other primary users of our system, and their experience is just as important as the students', as education is a two-sided process. If SmartEd isn't easy to use and beneficial

to educators, then the learning process will be hindered for everybody, and students and learning institutions will get no value from the system. Thus it's extremely important that the solution is easy to get started with and provides lasting benefits to the educators.

The primary benefit to the educators will be the data provided by the system, being the learning (and teaching) style of educators and students, any specific issues the learner is having and many more. This will help the educators become more efficient and even better at what they already do.

As the system is completely online, all this data can be saved and re-used for next time, meaning that each time an educator uses the system, the easier it gets, and the better the educational output becomes. One of the challenges to the system will be the educators who are used to and quite enjoy the traditional education system. These educators may be resistant to change and may need some proof or push from the learning institutions they are employed by.

**Learning institutions**

Institutions will have a vested interest in ensuring the product is performing at peak effectiveness in providing an online learning platform for both its teaching staff and its students.

The earlier these institutions invest in a system like SmartEd the better, an online system like this will have compounding benefits. The more data that is collected, and the more solutions to problems found, the more efficient the learning will become. As an example, a math subject may have 30% of the student struggling with a single concept. This provides data to institutions that some more time or some alternative approaches should be developed by the primary educator, so the secondary educators like tutors will need less contact hours with students. This will result in both cost savings, and better educational outcomes.

With all the data collected, and courses being run over years, this provides the institution with options to recommend courses to students, based on their learning style, interests and proficiency in areas. This along with giving real educational examples of the course work will allow the student to make more informed decisions about the courses taken. This will result in a reduced drop-out rate and failure rate, allowing for better statistics for the university, and pushing the students onto higher education faster.

## Secondary Stakeholders:

The secondary stakeholders are the stakeholders that won't be using the system in a conventional sense, but do have a vested interest or impact in it's success.

**Course systems (e.g. Blackboard Learn)**

Our first secondary stakeholder is the systems currently in place. These systems will be providing a large amount of the data and will be strongly integrated with SmartED. It's important that these systems are onboard with the system to make sure that all the data is collected and shared safely and with full user consent. SmartED will be building off and strengthening the foundation that blackboard and sinet have created.

**State governments**

The state governments invest money into (public) Universities to help allow the population to grow and become more educated. Thus making the learning process more efficient (cost and education wise) will make each state which invests in their university see the benefits earlier.

**Other learning companies**

As mentioned elsewhere, our target audience for this system is at the tertiary/university level. However, through group discussions other significant groups were identified as being able to benefit from this system such as third party online learning companies such as Udemy, Khan Academy. While these groups are different from our main audience, the stakeholders of learners, educators, and learning institutions are universal among groups that could potentially use the system. Especially while getting started, it's expected that a lot of educators will prefer to make use of these systems over dealing with the massive work loads to develop content for each learning style.

## Tertiary Stakeholders:

The tertiary stakeholders are those who will be indirectly affected by the system, as education plays an important role in our society, everyone and everything will be minimally affected. From companies hiring better workers, less privileged families getting a leg up due to accessibility improvements, etc. A few important ones have been selected.

**Federal governments**

Similar to the state government, the federal government helps provide financial support and grants to the universities. Having a higher educational and research output will mean better use of their funds, meaning better economic and educational outcomes for the country.

**Friends and family**

With better educational outcomes and easier use of online services, this will enable regional towns to allow residents the ability to better study from their hometown. This will mean current friend and family circles will not be displaced along with not having to give up any current commitments in the town.

It's a fact that regional towns are losing more and more population, with Australia's youth migration (15-24 years, change of residence in last 5 years) a staggering 52%,country regions losing over 50,000 young Australians to the big cities (Australian Bureau of Statistics, 2003). Though it's hard to define exactly what is and isn't rural, SmartED can really help keep educated and young Australians in their rural home towns.

# 3.1.2. What do the stakeholders say?

## Interviews and Surveys

Interviews were conducted with stakeholders of AI in education to obtain data that would support the design process. The questions used are listed below. All interviewees were given a brief rundown of AI in education, current developments in the technology and a basic idea of our proposal.

Appendix 9.1 has the full list of interview responses, with a summary analysis of the responses portrayed here. The general consensus from the interviews was that technology is being underutilised in teaching, though everyone agreed much more is needed to be done to assist the educators and felt that AI/technology could only partially replace educators. This aligns with our goals of helping learners primarily through assistance to the educators, and the specific issues brought up by some teachers, that some students have very specific requirements for their learning.

## Observations

### UQ/QUT StalkerSpace Post

Another strategy used as part of the contextual enquiry was to put out a post on a social media forum such as Reddit or Facebook in an effort to generate more data in a non-structured way such as a questionnaire.

The question was posted to QUT and UQ groups called StalkerSpace. The question posed was “Collecting some opinions for research in a course I am taking but I am wondering, in relation to the current situation at UQ and other universities, how do you think UQ's move to online learning has/will affect pass/fail rates?” The responses received back fell in line with the same ones received from the questionnaire. Below is a summary write up of the responses gathered from the two posts:

- Preliminary observations are that fail rates are very dependent on the course. If a course is quite prac heavy then fail rates can/will be high.
- Also depends on the course coordinator too, some naturally fit online learning, some go above and beyond to adapt their course and some are too lazy, don’t have time or don’t care
- Followed up with one poster and they revealed that when physically attending there is lots of encouragement/reminders whereas they are losing that in the current climate. Also, they lose motivation because home is a place for relaxing.

    - Additionally, if a course doesn't have compulsory lectures they are too intimidated to attend and thus don't
    - Lastly, after asking "I also just wanted to touch on one last thing, I liked when you said that home is a relaxation zone for you whereas if you were at uni you would be more likely to study, is there someway you feel like the uni could change that through something like blackboard or another piece of software" the interviewee revealed that an app version of blackboard would actually help a lot
    - More data to back up the unpreparedness of lecturers, if someone is trying to study but have kids etc. then it can be difficult to find the time to study especially if the lecturer does not make the content available until the very last minute
- Willing to make a 3 hour trek into the university to study (because that's where they learn best)
- Another respondent finds that balancing work and uni is challenging and then finding the motivation to study from home is difficult. Feels that grades will definitely take a hit.

To briefly summarise the responses (a more in depth and expansive analysis is provided in 3.1.2.3), based on the responses garnered, physical or face to face learning is when respondents learn best and will undertake long travels to attend a physical class because that's when they learn best. Additionally, online learning experiences can vary from course to course based on the lecturers competence with technology, motivation, etc. and thus through no fault of their own a student can have a worse learning experience than another student. The potential design implications being that in order to ensure an even learning experience between courses, SmartEd has to be simple and easy to use, as well as non-intrusive so that lecturers don't feel like they are required to operate another piece of software.

## Key themes and trends

From the above research it can be seen that two clear themes are present amongst student needs when attempting to study online, those being motivation and interactivity when learning. When it comes to motivation, students are finding that studying at home is reducing their motivation as home is often associated with fun, comfort and relaxation. Additionally, lack of access to simple things like instant notifications about assessment etc. is causing frustration and in turn a lack of motivation.

The next prevalent theme identified was interactivity when learning. To be able to learn effectively, students need to be able to interact with some form of teaching device, and not just have dot points read from a slide show. As mentioned above, there is strong evidence to show that interacting with peers and teachers greatly helps learning and when that is stopped or minimised through reading off a slideshow then a students learning goes down.

### 3.1.3. Concept Technologies

Eom, Wen, and Ashill (2006) showed that students learn more effectively using online education when they're taught in a learning style that they best understand. Using the VARK model, learning styles can be identified as visual, aural, read-write and kinesthetic. SmartEd is planning to develop a way to identify students' learning styles by utilising artificial intelligence to measure how a student responds to the various learning approaches combined with preliminary testing. We understand that people do not learn or teach in a singular way and the categorisation would simply be style that the technology identifies as being the most useful. Kinesthetic learners and other students with requirements that can only be met within a physical classroom or lab would have trouble learning "hands on" in online classes and would need to attend a physical location to be best educated. In areas that it would be possible, online interactive 3D models can be utilised via augmented reality technologies such that kinesthetic learners can be virtually hands on with educational models. SmartEd are planning on using this technology in the future to better cater for this kind of learning style, Section 4 discusses this further as a future area to investigate.

### 3.1.4. User Stories

To effectively create a system that users will actually use and more importantly, enjoy using we have to utilise various design methods/techniques. One of those methods is to develop user stories (on behalf of our users). By doing this we can brainstorm what we think users will most likely want/need from the system and develop them without having to consult stakeholders initially to gather the idea(s).

Below are the user stories generated by the group. We were able to generate these user stories from the research as well as interviews with stakeholders. From these user stories we plan on further expanding them out into requirements statements and helping us to form user profiles and the overall system workflow.

| |
|---|
| As an **educator**, I want to **deliver content to students** so that they may obtain the highest level of learning and engagement. |
| **Acceptance Criteria** |
| I should be able to create one piece of content which is modified by SmartEd to cater for different learning styles |
| I should be able to edit content created by the AI to ensure accuracy and relevance to the student's learning |
| Details and analytics about course material should be displayed. |
| I should be able to monitor the effectiveness of each student's learning and provide personalised measures to improve each one. |

*Table 2: User story about delivering content to students as an educator*

| |
|---|
| As a **student**, I want to **receive course content** and material in such a way that it is **engaging, personalised and accurate**. |
| **Acceptance Criteria** |
| All material should be presented to me in a convenient manner. |
| Most teaching resources should be personalised to how I learn best. |
| I should know which areas the AI believes I am lacking, and have ways suggested to build my knowledge |
| I should be able to personalise my learning style if I don't agree with the AI test |

*Table 3: User story about receiving personalised course content as a student*

| |
|---|
| As a **university institution**, I want to **receive and view course evaluations and feedback** so that I can **evaluate the courses offered and determine if any changes need to made to curriculum** |
| **Acceptance Criteria** |
| Data metrics will be presented in a manner that makes quantifying the data easy |
| The metrics will be extensive enough and draw from multiple sources such as SeCat data, course participation, etc. |
| Metrics should be able to be broken down further and explored within its section separately |

*Table 4: User story about evaluating courses as a university institution*

| As a **student**, I want to be **alerted early on if I am at risk of failing a course** so that I can **contact teaching staff and implement early intervention steps to prevent myself from failing** |
|---|
| **Acceptance Criteria** |
| Students are detected early enough that changes can be made to prevent the failure |
| Students are not falsely flagged during the first part of the semester when assessment submissions are low |
| When a student is detected, teaching staff are also informed |
| A student who is detected and alerted is given (via electronic communication and auto generated) resources to help get themselves back on track such as tutor contact information, university support contact information etc. |

*Table 5: User story about being alerted when at risk of failing as a student*

| As an **educator**, I want to **better the course I teach as well as my own teaching capabilities** so that I can **provide a more engaging, fun, interesting and beneficial course to my students** |
|---|
| **Acceptance Criteria** |
| An educator is given useful insights at the conclusion of the course that will help them improve their teaching and the course |
| An educator is able to improve their teaching capability at the conclusion of the course based on the metrics provided to them |
| An educator is able to improve the course based on the metrics provided to them |

*Table 6: User story about improving teaching capability and course engagement as an educator*

| As an **student**, I want to **control what metrics is collected by the SmartEd system** so that I know and can control what data the university collects and stores of mine |
|---|
| **Acceptance Criteria** |
| Students can see every metric that is being collected or can be collected |
| Students are able to turn on/off any metric they choose |
| If a metric is turned off any collection of that metric must stop immediately with any previous data being retained |

*Table 7: User story about controlling the data collected by the SmartEd system as a student*

## 3.1.5. User Profiles

User profiles are a great way of imagining and representing different types of users of the system. With these profiles we are able to visualise the potential users to better explore the features needed for the complete system and compare these to any user testing/feedback we receive from real life stakeholders. Thus we have come up with three user profiles that represent a few of the key stakeholders of the system.


*Figure 1: User profile for a 'typical university student'*

Luke Lissner, in figure X, represents the typical university student. He is technologically inclined and wishes to achieve an above average GPA. Luke has identified that he has trouble in lectures and tutorials, particularly when he is forced to write notes in his book. He is already taking in the information from the tutor but the constant stopping and writing causes him to lose focus and struggle to understand the content. Luke wishes there was a way where he could listen to lecture and tutorial content in a way that it all flows together and doesn't cause him to lose focus so that he can achieve a high GPA.


*Figure 2: User profile for a 'typical educator'*

Vera Verbalis, in figure X, has been developed to represent our typical educator. She loves to talk lots when she teaches her classes. Unfortunately, some of her students don't appreciate this and have asked her to speed up her lectures because they are "dragging on". Vera also loves to help students that are struggling with her courses, but she finds it hard to know which students just need reminding and which ones need in depth tutoring. She wishes there was a way that she could upload an online lecture that portrays all the useful information in a quick and smooth manner, as well as, to be able to use analytics to determine which students are struggling with the course and which ones are just being lazy.


*Figure 3: User profile for a 'non-typical' university student*

Hailey Handler, in Figure X, represents an atypical student who is not very technologically inclined and does not use/understand the university portal. She is a very active learner and typically learns best when she is doing something. She doesn't enjoy her lectures very much as sitting and listening for two hours feels like a waste of her time. She wishes there was a way that she could watch an online lecture that would be interactive and encourage her to complete relevant educational activities. She feels as though this would be far more engaging for her and improve her university results significantly.

## 3.1.6. Requirements

In order to simplify the different types of requirements in the project, we have decided to break them up into their own sections so that each area can be addressed fully and with clear context.

### 3.1.6.1. FUNCTIONAL REQUIREMENTS

| **Create goals for the semester** |
|---|
| Users create goals for each course at the start of a semester. Goals can be anything achievable throughout the semester e.g. 90% attendance at lectures, GPA of 6 for the course |
| **Rationale:**<br>The feature will be used by a user who needs visible goals to stay motivated with the course |
| **Notes:**<br>"I am a lot less motivated online as I feel like I'm not getting anything done" (Anonymous student from Online Learning Investigation Questionnaire)<br>By creating their own goals, a user is theoretically more inclined to try and complete those goals if they are visible and can see their progress towards achieving them. |

*Table 8: Requirement statement describing Semester Goal Creation*

| **Detect and alert when a student is at risk of failing a course** |
|---|
| The SmartEd system will use different metrics such as class attendance, assessment marks, etc. and calculates a predicted overall grade for the course and if it falls below a passing grade then the student is marked (in the system) as potentially going to fail. After detection, the system will send an email to key teaching staff to follow up with the student to get them back on track. |
| **Rationale:**<br>The feature is necessary because by utilising different metrics and identifying students at risk of failing early, then teaching staff can proactively step in and hopefully get them back on track before it is too late. |
| **Notes:**<br>According to the TEQSA, student engagement and teacher to student interaction should be highly considered (TEQSA, 2020).<br>Student motivations have also been identified as a factor affecting students with online learning. By having the system detecting students early on and enabling teaching staff to reach out early, even with a simple email it can inspire students to remain focused on their work and can push them to work harder and get back to a passing grade. |

*Table 9: Requirements statement describing detection of students at risk of failing*

| Personalise and modify dashboards and content views |
| --- |
| Students are able to personalise and modify the dashboard and content views to be able to view their upcoming assessment, grades, progress and other personalised information. Lectures are able to label and define content, assign different versions of activities to different students and view a performance overview of their students. Users can see content that is personalised and relative to them. |
| **Rationale:**<br>Users are able to view personalised information and customise content on their dashboard for themselves. This allows users to engage in the content presented personally to them and become more interested. Users take more interest in content that is designed for them or created specifically for them and thus engage more with the information. Having the choice of what content to display allows more interaction with the display and they are more likely to take note or action. |
| **Notes:**<br>● CBI design takes into account the individual's learning styles to provide for problem solving, corrective feedback, elaboration, visual and graph cues, control of the routine by the learner and appropriate wait time between input and response (Havnes et al., 2016). |
| **Personalise displays available to users** |
| Users are able to personalise the information displayed to them. Users can hide and show any displays that they find helpful/unhelpful to them. |
| **Rationale:**<br>By being able to hide and display displays, graphs etc. it helps prevent cluttering up a user's dashboard with information that might not be helpful or useful to them. A modular system would provide interactivity and encourage users to personalise their own learning. |

*Table 10: Requirements statement describing how displays are personalised to a user*

| **Predict students' grades based on previous assessment** |
| --- |
| SmartEd will use data analytics and machine learning algorithms to maintain continuously updated predictions, with confidence intervals, of students' final grades for each course that they are currently taking. Students will be able to clearly identify which courses they are struggling with and which courses they are excelling in. These metrics will allow students to efficiently allocate their time to the subjects that need it the most, while encouraging them to maintain a high standard of work in other subjects. |
| **Rationale:**<br>● Students are more motivated when they have the information necessary to prioritise their learning activities and can continuously track their progress |
| **Notes:**<br>● Broadbent and Poon (2015) found that students who were successful in time management, effort regulation, and critical thinking performed better in online learning platforms than students who lacked these skills<br>● Online learning activities should be designed in a way that intrinsically motivates students (Nicholson, 2015), for example, by empowering learners to outline their own goals, and asking users for feedback frequently and at various stages of a system's development (Tsay et al., 2018).<br>● Hansch, Newman, and Schildhauer (2015) recommend personal gamification, which utilises personalised feedback, progressive rewards, and progress tracking |

*Table 11: Requirements statement describing how displays are personalised to a user*

| Predict students' course satisfaction |
| --- |
| SmartEd will use data analytics and machine learning algorithms to maintain continuously updated predictions, with confidence intervals, of average course satisfaction among students based on a variety of data sources. These include lecture and tutorial participation, lecture and tutorial incompletion rates (i.e. how many people leave a lecture or tutorial prior to its scheduled end time), and continuous course feedback collected from students. |
| **Rationale:**<br>● If students enjoy taking a course, they are less likely to drop out, so course satisfaction analytics can be used to continuously improve courses.<br>● The ability for students to provide continuous feedback improves online learning outcomes |
| **Notes:**<br>● Online learning activities should be designed in a way that intrinsically motivates students (Nicholson, 2015), for example, by empowering learners to outline their own goals, and asking users for feedback frequently and at various stages of a system's development (Tsay et al., 2018). |

*Table 12: Requirements statement describing how displays are personalised to a user*

| Evaluate course effectiveness |
| --- |
| Calculate course effectiveness in regards to its educational outcomes. Identify the relevance to real world applications. Help identify course work issues (too much, too hard, not relevant, etc). |
| **Rationale:**<br>● Courses need to be relevant to the real world for them and their associated degrees to hold value.<br>● Courses need to be reviewed for their difficulty and load to ensure the course is as useful as possible, with the correct workload.<br>● If students are consistently failing the course or the students who are failing have a shared issue, this should be addressed. |

*Table 13: Requirements statement describing how displays are personalised to a user*

## Provide personalised insights to users

**This feature encompasses the targeted presentation of information based on gathered data about the user to which it is being presented.** This includes:

- Key Point Indicators (Attendance, Grades, Rank etc…)
- Goals and Progression Insights
- Recommended Courses of Action
- Historical Information

The deliverance of this information is decided based on data specific only to the student. The goal is not to create an extrinsic reward mechanism for students, but rather gamify the system using personalised feedback, progressive rewards, and progress tracking. Hence, the insights are not delivered with a "one size fits all" methodology. Users are also encouraged to outline their own goals (Refer to "Semester Goal Creation" Feature) which work in tandem with this feature. For example, a student making a goal to receive a certain mark on a piece of assessment will be shown insights relating to that goal while another student will not.

**Rationale:**

Research has shown that while gamification (use of game mechanics and game design techniques in a non-gaming context) can increase engagement, motivation, and productivity (Nguyen, 2015), focusing too much on achievements should be avoided (Tsay, Kofinas, and Luo, 2018). Research suggests that online learning activities should be designed in a way that intrinsically motivates students, for example, by empowering learners to outline their own goals (Nicholson, 2015). The core element of this feature that separates it from other common methods of gamification (achievements, badges, scores etc.) is the personalisation element that results in gamification that is distinct and applicable only to the user that it was created for.

Additionally, studies show the prevalence of learning styles and their effect on education. Individuals vary in their approach, strategy and preferences during learning activities based on differences in cognitive abilities and learning style preferences (Knowles et al., 2014). To help provide a qualitative framework for the personalisation of insights, the use of a diagnostic tool to evaluate student's learning styles will be used to enhance the quality and degree of personalisation that is possible.

**Notes:**


Knowles, M., Holton, E., & Swanson, R. (2014). *The Adult Learner*. TPB.

Nguyen, T. (2015). *The Effectiveness of Online Learning: Beyond No Significant Difference and Future Horizons*. *11*(2), 11.

Nicholson, S. (2015). A RECIPE for Meaningful Gamification. In T. Reiners & L. C. Wood (Eds.), *Gamification in Education and Business* (pp. 1–20). Springer. https://doi.org/10.1007/978-3-319-10208-5_1

Tsay, C. H.-H., Kofinas, A., & Luo, J. (2018). Enhancing student learning experience with technology-mediated gamification: An empirical study. *Computers & Education*, *121*, 1–17. https://doi.org/10.1016/j.compedu.2018.01.009


*Table 14: Requirements statement describing how displays are personalised to a user*

| Visualise course participation |
| --- |
| A display of lecture and tutorial Attendance in a graph/number visual |
| **Rationale:**<br>• To keep a record of which students come to class as this would allow for analytical interpretations as to why a class may be decreasing or increasing in attendance rates. A lecturer can use these interpretation findings to make strategic decisions to engage with their students and keep attendance rates higher than usual. |
| **Notes:**<br>• "To improve retention and completion rates, TEQSA recommended the use of **predictive learning analytics** to identify students at risk of difficulty or disengagement as one of their good practices in a recent report, with results from the Swinburne University of Technology showing evidence of success" (TEQSA, 2020).<br>• Course participation will be one of the factors that will be used as an input for predictive learning analytics regarding students at risk of disengagement. |

*Table 15: Requirements statement describing how displays are personalised to a user*

| Visualise course feedback and satisfaction |
| --- |
| A display of Lecture Satisfaction and Tutorial Satisfaction in a number visual. A Suggestions Page will be accessible for students and tutors to give advice to lecturers as to how to improve areas in a course. |
| **Rationale:**<br>• To understand if students are satisfied or not with the lectures and/or tutorials to then allow for analytical interpretations as to why a lecture or tutorial may have less or more satisfied students. A lecturer can use these interpretation findings to make strategic decisions to keep satisfaction levels higher than usual. |
| **Notes:**<br>• "To improve retention and completion rates, TEQSA recommended the use of **predictive learning analytics** to identify students at risk of difficulty or disengagement as one of their good practices in a recent report, with results from the Swinburne University of Technology showing evidence of success" (TEQSA, 2020).<br>• Course satisfaction will be one of the factors that will be used as an input for predictive learning analytics regarding students at risk of disengagement.<br>• The ability to send a lecturer feedback will assist the lecturer with knowing what problems students may be facing. |

*Table 16: Requirements statement describing how displays are personalised to a user*

| Visualise passing and failing students |
| --- |
| Display of students who are predicted to pass or fail at the current point in time in a table format |
| **Rationale:**<br>● To assist the lecturer/course coordinator in understanding which students may need extra assistance in order to pass a course<br>● Can display which students might be finding the course too easy so they can potentially be given additional learning tasks to challenge them |
| **Notes:**<br>● 3.1.1: Interview – Teachers have brought up their concern for some students requiring personalised assistance with some learning activities |

*Table 17: Requirements statement describing how displays are personalised to a user*

| Visualise the highest and lowest performing learning styles |
| --- |
| Displays the learning styles that on average perform the highest and perform the lowest in a table format |
| **Rationale:**<br>● To assist the lecturer in catering for student learning styles who are finding the course to be difficult |
| **Notes:**<br>● 2.3 – 'Individuals vary in their approach, strategy and preferences during learning activities': this statistic will assist lecturers with managing the variety of learning approaches. |

*Table 18: Requirements statement describing how displays are personalised to a user*

| View key insights as a lecturer |
| --- |
| Lists the top three key insights regarding student learning. Can be expanded for a full report. |
| **Rationale:**<br>• To quickly and easily display the main statistics a lecturer/course coordinator may be interested in. These may include facts regarding learning styles, assessment submissions or scores etc. |
| **Notes:**<br>• "To improve retention and completion rates, TEQSA recommended the use of **predictive learning analytics** to identify students at risk of difficulty or disengagement as one of their good practices in a recent report, with results from the Swinburne University of Technology showing evidence of success" (TEQSA, 2020).<br>• The predictive learning analytics will output various insights, some of which can be visualised as a 'key insight' report. |

*Table 19: Requirements statement describing how displays are personalised to a user*

| View actionable insights as a lecturer |
| --- |
| Lists the top three actionable insights a lecturer can perform. Can be expanded for a full report. |
| **Rationale:**<br>• To quickly and easily display the main actions a lecturer/course coordinator can *do* to assist individual students, tutors or the course as whole. These may include activities such as emailing specific students who are at risk of failing, answering a common question that seems to be coming up often, respond to suggestions on the Suggestions Page etc. |
| **Notes:**<br>• "To improve retention and completion rates, TEQSA recommended the use of **predictive learning analytics** to identify students at risk of difficulty or disengagement as one of their good practices in a recent report, with results from the Swinburne University of Technology showing evidence of success" (TEQSA, 2020).<br>• The predictive learning analytics will output various insights, some of which can be visualised as an 'actionable insight' report for the lecturer to be able to easily *do*. |

*Table 20: Requirements statement describing how displays are personalised to a user*

### 3.1.6.2. DATA REQUIREMENTS

Data requirements highlight the specific types of data that is required to be collected in order to reach a MVP (minimum viable product). All of the following data requirements are based on research gathered in the conceptual enquiry. Data requirements are broken down into three sections; before learning which refers to data collected before the course commences and learning takes place, during learning refers to any data collected during the semester while the main learning is taking place and after learning refers to data collected after the main teaching/learning period is concluded and after semester is concluded.

**Before learning:**

| **Users' determined learning style** |
| --- |
| **Rationale:**<br>Section **2.2.1.3** goes into more depth about different learning styles and the benefit of catering and by that analysis it is rational to incorporate the collection of such data in the system for each course as a user's learning style might change over time or reviewed by course admin staff to evaluate the course as a whole. |

*Table 21: Data requirement describing the collecting each user's learning style*

| **Users' previous study** |
| --- |
| **Rationale:**<br>Data regarding a user's previous course results can be found in an institution's student database. This information will need to be given with consent and will assist the analytics algorithm to give more precise insights based on past experiences. |

*Table 22: Data requirement describing the collecting of a user's previously studied courses*

**During learning:**

| **Class attendance** |
| --- |
| **Rationale:**<br>Class attendance can be tracked in two main ways: attendance marking and lecture views. For tutorials, the attendance can be recorded during class by the tutor as they will know which students come each week. For lectures, SmartEd can keep track of the students that have watched their online personalised lecture. |

*Table 23: Data requirement describing the collecting of a student's class attendance*

| Class involvement |
| --- |
| **Rationale:**<br>Class involvement will be determined by SmartEd via tracking whether a student is interacting with the lecture as well as as by tutors and lecturers based on their activity within tutorials, lectures and other online platforms. |

*Table 24: Data requirement describing the collecting of a student's involvement in class*

| Course progression (grades) |
| --- |
| **Rationale:**<br>SmartEd will be able to collect the grades that a student is receiving throughout a semester via an institution's database (e.g. the way BlackBoard sends student's their results) |

*Table 25: Data requirement describing the collecting of a student's grades*

**After learning:**

| End of semester results |
| --- |
| **Rationale:**<br>SmartEd will able to collect the final result that a student is receives via an institution's database (e.g. the way mySI-Net sends student's their results) |

*Table 26: Data requirement describing the collecting of the student's final grade for the course*

| Course satisfaction and enjoyments |
| --- |
| **Rationale:**<br>Data regarding a student's satisfaction with a course after they have completed it will be collected via a quick survey that uses a 7-point scale and optional written text questions to determine how the student felt, progressed and what they found enjoyable or difficult. |

*Table 27: Data requirement describing the collecting of a student's post course satisfaction*

### 3.1.6.1. SOCIAL AND EMOTIONAL REQUIREMENTS

| **Recommend services for high risk mental health struggles** |
|---|
| SmartEd will provide institution recommended services for those at suspected higher risk of mental health struggles. |
| **Rationale:**<br>Students who are struggling with workload or having low/erratic engagement could be struggling with mental health issues. This is a negative for all parties involved so a light nudge in the direction of seeking help/knowing help is available could be a big factor. |
| **Notes:**<br>According to the Victorian State Government, low or erratic engagement can be an associated factor in mental health struggles (Victorian Department of Education, 2020).<br>"Mental health services embedded within school systems can create a continuum of integrative care that improves both mental health and educational attainment for children." (Fazel et al, 2014)<br>Though not all institutions using SmartEd are schools, the research and information is vital, along with most institutions already have facilities to deal with mental health issues. |

*Table 28: Requirements statement describing detection of students at risk of failing*

| **Clear student engagement** |
|---|
| Any student and/or teacher engagement is clearly displayed and readily available for viewing where appropriate. |
| **Rationale:**<br>To encourage student interaction, all interactions should be public where appropriate. This will hopefully allow for students to feel more comfortable to put themselves out there and ask more questions, along with feeling more involved with peers and course teachers.<br>This will encourage both passive and active peer learning. |
| **Notes:**<br>Both passive and active peer learning is linked with successful online learning outcomes (Broadbent and Poon, 2015) |

*Table 29: Requirements statement describing detection of students at risk of failing*

| Optional real name or anonymous contributions |
|---|
| During student engagements the student and instructor can choose to display either their real name or communicate anonymously. |
| **Rationale:**<br>Allowing for a clear distinct option between real names and anonymous posting means that students can better distinguish between different peers, which would help with building relationships between peers. Secondly it would allow students who aren't as confident to still ask questions without feeling as though it's a poor question or point of view. |
| **Notes:**<br>Broadbent and Poon (2015) noted that active peer learning has a strong impact on positive learning outcomes, and so any method to encourage all learners to participate should be pursued. |

*Table 30: Requirements statement describing detection of students at risk of failing*

| Peer accessible discussion board |
|---|
| Students have a discussion board where they can ask questions, where peers and teaching staff can respond and/or follow up. |
| **Rationale:**<br>Having a centralized location where students can publicly (with real name or anonymously) or privately ask questions will give more information to other peers and to educators on any issue or struggles that are going on. This will allow the group as a whole to learn better and further improve the educational outcomes. |

*Table 31: Requirements statement describing detection of students at risk of failing*

## 3.2. Conceptual Model

### 3.2.1. Problem Sentence

From the conceptual design we have been able to develop a foundation for the final solution and thus we have been able to decide on a final idea. We will design and develop a system to integrate with existing university management software that utilises predictive data analytics to identify deficiencies in the learning process to identify students at risk of difficulty or disengagement to reduce attrition rates and personalise the learning experience.

### 3.2.2. System Workflow

The SmartEd system will collect and process data where appropriate to help reduce attrition rates and improve educational outcomes. Through this data 'smart features' through the use of artificial intelligence/machine learning will be developed to really bring SmartEd to the front of the online learning space. Some of the data gathered, such as assessment grades, class attendance and tutor feedback could be used to help course coordinators to better prepare their tutors for helping students, especially if there are patterns of issues found by the system. For the students in particular, there will be every step taken to assist the end user in achieving their own level of accomplishment in their learning. One of these features is goal creation; This will increase user engagement and help keep them on track to pass the course, along with utilising their customisable dashboard to help guide and view progress on coursework.
This dashboard will also be where the learner can access more resources to do with their personalised learning. Resources that are chosen via educators and the machine learning that has had a track record (or predicted) of helping students with a combination of: their learning style, their area of struggle, their engagement and various other factors.

The educator side of the dashboard will be a bit more outcome focused, with information or any alerts of positive or negative trends in the course work, all students having significant trouble with one concept in the tutorial, for example. This will also be where the educator can put forth more resources on any of those issue areas, or even set their own goals of having things complete or updating material to help improve their own teaching standard.

### 3.2.3. Interaction Paradigms

As an analytical data service that focuses on personalisation and customization, SmartEd is designed to interact with the end user in a more active way than other information or data services might. This interaction should be focused on providing win-win opportunities that have been identified by the system for the user to take advantage of rather than the simple delivery of data. SmartEd is designed as an augmentation or supplementation to existing learning systems such as Blackboard, and as such interactions are thus limited to those that already exist in those systems. Nonetheless, SmartEds primary interaction paradigm should be active rather than passive, meaning the delivery of key insights should not depend entirely on the active engagement of the user. This can take the form of notifications or tasks that already exist in many of the learning systems that SmartEd will be built upon.

Active participation by the user is also catered for with an additional analytic page whereby the user may browse more specific information such as data of high interest, SmartEd's insight generation process and the collection options.

### 3.2.4. Interaction Modes

SmartEd has three primary interaction modes. An insight mode, a data exploration mode and a feedback mode. The insight mode utilizes the SmartEd neural network system to identify quick actionable steps that users may take that have a high chance of returning high results based on the data gathered. This mode is designed to be the forefront of the SmartEd system and focuses on limiting that amount of cognitive processing and time required by the user to maximize engagement. This mode delivers items such as an actionable insight report, recommended resources and time-based notifications.

The second interaction mode is the data exploration mode where the user can explore key quantifiable statistics that may help with issues that SmartEd's insight mode has not yet identified. This mode delivers things such as trendlines for important indicators, growth and decline statistics, and other data the SmartEd might collect. This mode also shows the origins of insights that the insight mode is built upon enabling the user to understand this aspect more if they choose to. Unlike the insight mode, the data exploration mode does not offer any form of active interaction or actionable opportunities to the user and is instead designed to be a passive information hub that is optionally accessible.

The last interaction mode is the feedback mode. As the research showed, a constant flow of feedback, rather than spikes of erratically timed feedback, are necessary to improve the efficacy of a system such as SmartEd. This feedback mode can take the form of something simple such as a smiley or sad face below any actionable insight that is delivered with a short line, “is this insight useful to you?”. This in turn gives SmartEd an additional layer of preference based data regarding the user which can be further utilized in the neural network process to increase the quality of suggestions and personalisation.

### 3.2.5. Key Interface Metaphors

The key interface metaphors that the design of SmartEd integrates revolve around the increasing the ease of use by partitioning relevant sections of information in small digestible formats. The most suitable interface metaphor is a sticky note method of presenting data on a dashboard. This interface model emphasises decreasing information overload and directs the users attention to single sections of data or “sticky notes” each of which will include an insight which can be viewed as a sort of to-do list.


*Figure 32: A comparison of how a sticky note interface metaphor might influence SmartEd’s insight mode*

The use of this interface metaphor takes advantage of a user’s pre-conceived knowledge of sticky notes to correlate with things to-be-done, hence increasing a user’s chances of acting upon a suggested insight.

## 3.3. Scope and Overview of Solution

The scope of a solution that is presented in the form of SmartEd is by nature descriptive, predictive, and prescriptive. However, as it is designed as an extension to existing learning systems and is mostly dependent on the quality and quantity of the data it can gather from these systems, the scope is limited as such. The features of SmartEd are aimed to support existing learning systems to deliver a personalised touch to the functions they already provide and additionally to provide qualitative feedback as to where these systems may suffer flaws and provide insights as to why and where these flaws may arise. As shown in the research, data analytics such as SmartEd, when provided in this nature can help reduce attrition rates which is ultimately the big picture purpose.

SmartEd is unable to address issues that may affect education that is unrelated or cannot be identified using the data that is collected. These may be wider cultural changes, environmental circumstances and additionally problems students may be suffering from at an individual personal level. In these situations, due to the high complexity, SmartEd's neural network-based insight recommendations can only give generalised solutions. However, SmartEd's secondary purpose and mode as a descriptive indicator can provide and notify users of such changes which can then be utilised and addressed further up at a managerial scale.

## 3.4. System Workflow Diagrams

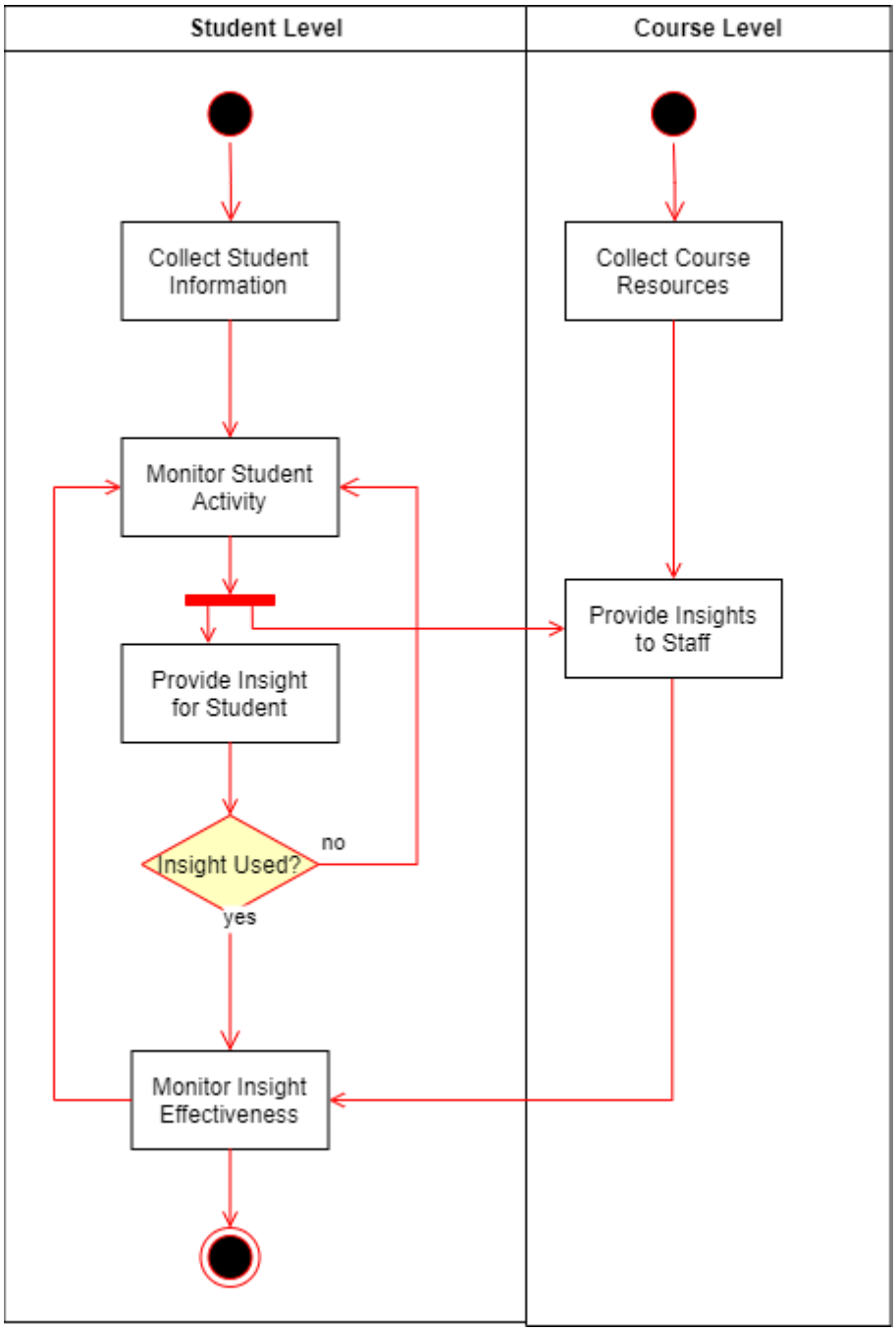



*Figure 33: A workflow diagram depicting the insight generation process of SmartEd*

The following level 0 data-flow diagram shows the various inputs and outputs of information primary stakeholders can expect by interacting with the SmartEd system. As can be seen, students exchange personal info and study behaviour information for personalized resources that is generated by the system. Course coordinators and/or other educators can also expect to course analytics from the system

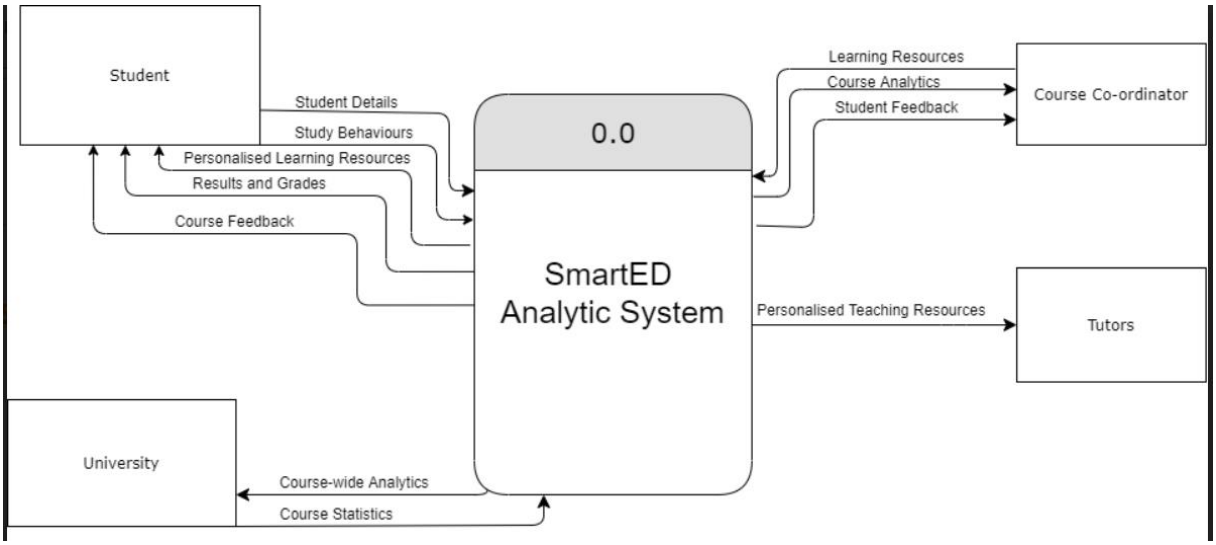



*Figure 34: Level 0 SmartED Data Flow Diagram*

The following use case diagram shows the basic functionalities of the analytical system and how the main users would interact with these features. For students, it can be seen that their primary use case is obtaining personalised learning resources. Students also participate in the use cases of detecting at-risk (of failing) students and providing data for course wide analytics

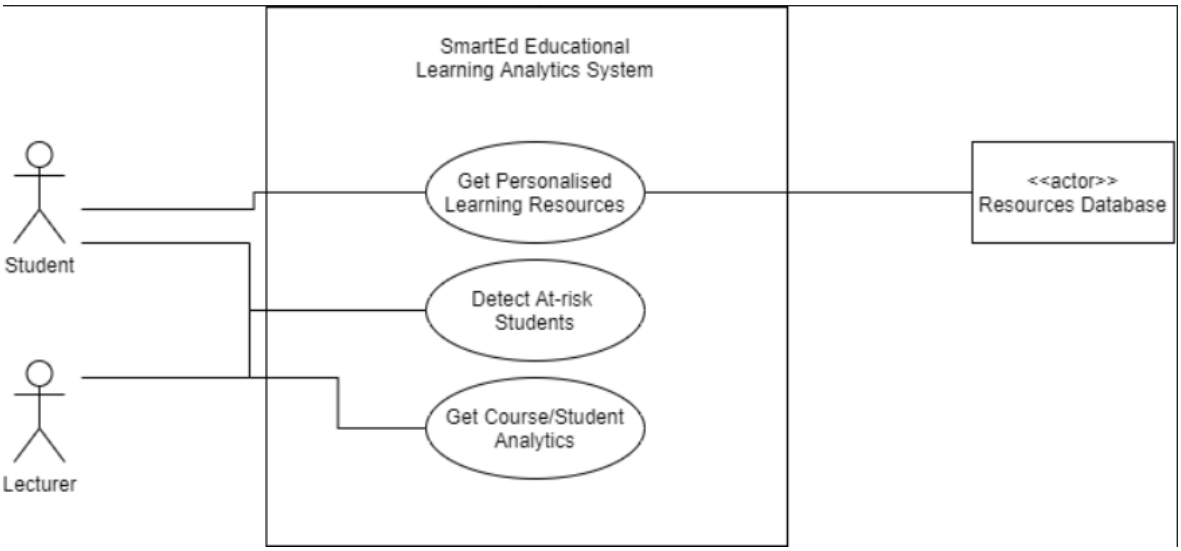



*Figure 35: SmartED Use-Case Diagram*

# 3.5. Detailed Designs

## 3.5.1. Evaluation Protocol and UI Testing

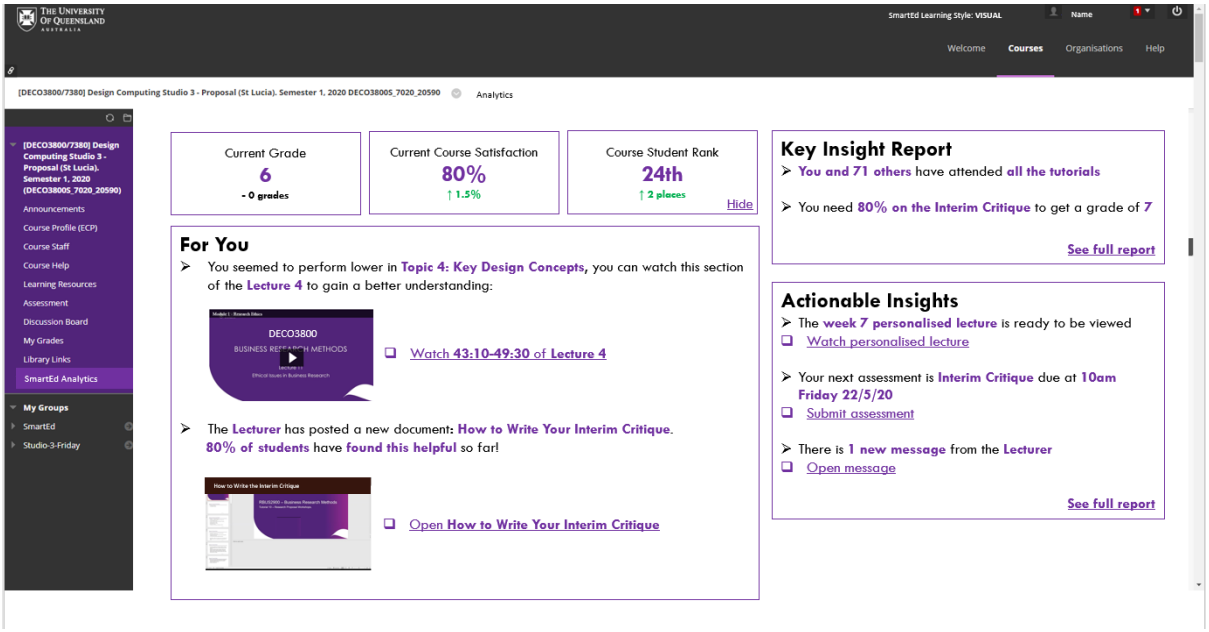



*Figure 36. A screen used for user testing*

The evaluation protocol is designed to measure the usability and user experience of a prototype. The prototype is to be given to future end users to understand if they can navigate the system easily or if there are issues with the design that make it difficult and frustrating for the user.

Participants were given an overview of SmartEd and it's uses as well as a brief description of how it would be integrated with blackboard. Participants were also asked about their proficiency with blackboard in terms of how many years they had used it. The participants were given control of the low-fidelity prototype and were given specific tasks to follow in which their reactions, intuitions on how to perform it, and time taken were observed and noted. The tasks used are listed below.

| Order | Task Description |
|---|---|
| **1** | <u>You are a Student.</u> Take the SmartEd Learning Style Indicator test |
| **2*** | Select one of the courses you are studying in Semester 1, 2020. |
| **3** | Open the new message you have received from the Lecturer (after you receive the message, click anywhere to close the message) |
| **4** | You seem to have trouble learning about Topic 4 so you click something that should help better explain it for you (after you view it, click anywhere to close it) |
| **5** | <u>You are now a Lecturer.</u> An insight makes you aware that students are having trouble knowing what the word count is for the assignment. Let the students know what it is. (after you do it, click anywhere to close it) |
| **6** | You are interested in seeing which students are performing poorly in the course so that you may give them the extra assistance that they require. How would you do this? (after you do it, click anywhere to close it) |

*Figure 37. Tasks given to participants*

| Name | Age | Experience with BlackBoard (Years) | Task 1 (H) - Indicates a hint was given | Task 2 | Task 3 | Task 4 | Task 5 | Task 6 |
|---|---|---|---|---|---|---|---|---|
| Ainsley Nand | 25 | 5 | 1:12 (H) | 0:12 | 0:33 | 0:13 | 0:11 | 0:26 |
| Harrison Condon | 20 | 3.5 | 1:05 | 0:05 | 0:07 | 0:10 | 0:24 (H) | 0:11 |
| Alexander Kidd | 20 | 3.5 | 1:11 (H) | 0:07 | 0:22 | 0:21 | 0:08 | 0:04 |
| Tavish Healy | 21 | 1 | 0:09 | 0:08 | 0:28 | 0:06 | 0:06 | 0:08 |

*Figure 38. Performance times of Testers*

## Analysis

It can be seen from the results that the most difficulty participants had was with task 1, which was taking the SmartEd Learning Style Indicator test. Three of the participants all took more than 1 minute to find the correct link, with two participants needing hints to complete the task. The fourth participant who had the least experience with blackboard, however was able to complete this task with no problems. The first and third participant both assumed that the task would be located in the tasks section of BlackBoard and attempted to navigate there using the "Tools" panel on the left. When that was not achievable, they assumed the red notifications on the top left would take them to this task. It is apparent, that due to their preconceived knowledge and experience with BlackBoard and its systems, this hindered them in completing this goal, suggesting that the SmartEd test button should be placed in a more intuitive location. One participant likened the SmartEd test to the plagiarism review and acceptance letter that has to be done at the start of each semester and naturally assumed that such a test would be located in a similar area.

For tasks 3 and 4 regarding student use of SmartEd, participants navigated this section with relative ease. It can be noticed that participant 3, though completing task 4 in a timely manner, failed to read the sentence description of the link and instead assumed the button was applicable to the task which can be a form of testing bias. This may suggest there may be a better word to image ratio for such links.

For tasks 5 and 6 regarding lecturer use of SmartEd, only participant 2 had trouble with task 5. Participant 2 attempted to go to the announcement page and make an announcement directly instead of utilizing the SmartEd function. Upon being given a hint that the word count question was a SmartEd insight, he identified the correct link. There were no issues with task 6, though participant 1 did assume sending an email to students who did not attend lectures was an alternative solution.

## 3.6. Success Criteria

We have outlined the following success criteria which can be utilised to determine if the implementation of SmartEd achieves its main goals. We have identified success criteria both during the development process and whilst in use of SmartEd. During the development process, user testing will need to be conducted to measure the success criteria.

| Criterion | Method of measurement |
|---|---|
| **Educators can deliver personalised content to students** | The user can assign different content to different students |
| **Students can receive course content that is engaging, personalised and accurate** | The student can view personalised content and generic information shown is limited |
| **University institutions can receive and view course evaluations and feedback** | Institutions have access to view course evaluations and students have the option to give feedback |
| **Students can control what metrics are collected by SmartEd** | User can access and change their settings and alter what data is collected |
| **SmartEd will allow students to view their grades and their progress within the course** | Students can view grades/progress on their dashboard |
| **Users are able to view their timetable including their upcoming classes** | The users next classes are viewable from the dashboard with an option to view full timetable |
| **SmartEd will be able to identify the user's learning style with an option to alter the options if inaccurate** | AI will be able to predict the user's learning style. Students will be able to edit results after completion |

Table 39: Success criteria during the development process

| Criterion | Method of measurement |
|---|---|
| **Students consistently achieve better grades when using SmartEd compared to online courses they have previously taken** | Assessment and course grades |
| **Students are more motivated to learn when using SmartEd compared to online courses they have previously taken** | Self-reported student feedback |
| **Students can take actionable steps to improve their grade from a fail to a pass or higher while they are taking a course** | SmartEd data analytics |
| **Attrition rates decrease when institutions adopt SmartEd as their online learning platform** | Institution attrition rate statistics |
| **Educators are able to take actionable steps to improve their teaching quality as the result of ongoing student feedback** | Self-reported student feedback |
| **Institutions achieve better overall academic outcomes** | Institution grades statistics |
| **Students enjoy online learning via SmartEd** | Self-reported student feedback |
| **Lecturers and tutors enjoy online teaching via SmartEd** | Self-reported educator feedback |

Table 40: Success criteria when completed and in use

## 3.7. Organisational, Cultural, and Situational Factors

### 3.7.1. Organisational factors

Organisational factors include elements that are influenced by the organisation, including human and individual characteristics. SmartEd has devised the organisational factors within including the cultural organisation factors such as shared values, norms, and beliefs. These factors include the intention for use by students and lecturers, designed and produced in and for an online environment and with a goal to improve student satisfaction and outcomes. The organisational cultural factors consist of the belief in improvement and equal opportunities for all students, providing students the best opportunity to achieve by providing personalised learning, and the desire to improve attrition rates and lower failure rates.

### 3.7.2. Cultural factors

As there is an increase in international students within Australia, there is the necessity to encompass cultural factors into the design of SmartEd. In our design, we suggest that the system's navigation is intuitive and clear with a balance between images/graphs and text. Within the analytical content, the individual components should be conspicuous with similar themes sharing similar visual aspects. It is important to display clear, straightforward information with options or the ability to view more when desired. The colours used represent the universities colour scheme and were not chosen in favour of any cultures. Language barriers should also be taken into account during the development with the option for users to switch to their native language if desired.

### 3.7.3. Situational factors

Situational factors are factors that occur from influences around the organisation including the environment and people around. Within SmartEd these influences incorporate the requirement for internet access, students to be enrolled in the university and an electronic device to access SmartEd. The system should be used in a study environment when learning and requires the layout of SmartEd to be easy to decipher. Other students' grades and activities have an impact on the individuals personalised content on the course and their current positioning.

## 3.8. Ethical Issues

Researchers at the CSIRO have published Australia's artificial intelligence ethics framework for the Australian government. We aim to adhere to this framework, which means we must fulfill the following in the design of our system:

- not harm any individual or group,
- comply with all relevant local, state, national, and international laws and regulations,
- protect all users' privacy,
- not discriminate or show bias towards any individual or group through algorithms or otherwise,
- be transparent and able to explain the use of algorithms and how users' data are used as inputs for algorithms,
- provide users with an efficient process to challenge an algorithm if they have been impacted by it,
- be accountable for any impacts of the system's algorithms, unintended or not

(Dawson et al., 2019).

Since our system collects and analyses user data, users may have security and privacy concerns. To address these, SmartEd will be completely transparent regarding how user data is collected, stored, and used. Stakeholders and users will be able to clearly understand the processes in place to protect their data and privacy. Additionally, users will be able to opt out of data collection at the outset and at any time during their use of the system.

# 4. Questions and Areas to Investigate

While we have arrived at a mostly complete solution, there are still areas and questions that warrant further investigation. These include:

- What are the specifications of the machine learning algorithms?
- How do we integrate meaningful gamification into the system?
- Should we integrate augmented reality (AR) into the system to improve its effectiveness and if so, how?
- What are the social and emotional impacts of the use of data analytics in learning?

In regards to machine learning algorithm specifications, more knowledge of how such algorithms work is required, and is beyond the scope of this project. However, there needs to be some machine learning specification in place before the build phase. In regards to meaningful gamification, our research has demonstrated that when implemented in the right way, it can be extremely effective at maintaining user engagement on an online platform. However, since we have focused on personalised learning and data analytics, we have not conducted enough feedback gathering or research on the best methods of implementing gamification into SmartEd. Therefore, this should be completed in a future iteration of SmartEd. In regards to AR, we have not conducted any research into the impacts of integrating AR into an online learning platform, so in the future this could be a potential new avenue for research into improving our system.

In regards to the social and emotional impacts of the use of data analytics in education, a future release of SmartEd could focus on researching these impacts through looking at existing studies as well as conducting user interviews and surveys on current and potential users. Knowing these impacts at some stage is vital to the success of SmartEd, as our background research has demonstrated that online learning is much more effective when there are social aspects involved (peer learning) and when students are motivated (which can depend on emotional state).

# 5. Plan Reflection

The team created a plan throughout the development process to help us move forward and remain focused. We identified questions relating to the product that we required further investigation into whilst developing a solution. These questions included:

- What are the social and emotional impacts that users may experience when predominantly using online systems to learn?
- How do users perceive the product and the environment? How does it gain and maintain their trust?

As well as investigating the answers to the above questions, the team broke down feedback received from both video presentations and iterations of the written report. We then planned to determine how we can incorporate that feedback into our proposal. With the feedback given after the first milestone, we reduced our scope and put focus on primarily delivering effective education online via the use of artificial intelligence. To move forward, we decided to create new strategies and processes for the next stage of the project. To manage the scope and specifications of the project we worked on a 'running document' that defined the problem identified and then proposed our solution in-depth. This document was continuously worked on in order to be in a state so other teams will be able to understand our proposal and implement it themselves using our document. SmartEd originally planned to produce more documentation in regards to the development plan, including milestones, work breakdown, testing plans, and project schedule. This however was removed from the plan due to tutor feedback, allowing future teams to have freedom over their own development plan.
We created a list of tasks to be completed, based on feedback and group reflection. After further evaluation, the team broke these tasks into two week sprints to help the team remain on schedule. The sprints were set to begin during the production of the interim critique and include:

**Sprint 1**

- Finalise concept and identification of problem
- Conduct more stakeholder feedback surveys (especially for the prototype designs)
- Gather all research data from surveys, interviews, etc. and quantify/categorise the data in an easy to view format so that the group can map out future plans
- Refine how AI can be used effectively and map it into features
- Explore pain points of current solutions and define areas of improvement

**Sprint 2**

- Continue to iterate over the solution idea and prototypes

- Expand more on designs and flesh them out
- Integrate and delve deeper into the legal and ethical frameworks concerning AI and how it affects our product

**Sprint 3** (15th June to 24th June)

- Finalise
    - Detailed designs
    - Success criteria
    - Use cases
    - Ethical issues and measures taken to ensure appropriateness
    - Organisational, cultural and situational factors

Along with the formal document, our team created a number of informal, team only documents that will layout data, scope, feature requirements, a requirement spec, etc. Additionally, the team decided to break down any tasks to be completed during a meeting and divided them evenly amongst each other. At the next agreed upon meeting time, the team shared our findings and our insights with everyone. Each team member changed the task or section that were previously worked on to allow for all team members to be involved in the development and knowledgeable on all aspects. This allowed for any team member to insert themselves into any role if we reached a time where the assigned team member cannot continue with their part.

As with any software development project, risks to the project were inevitable. However, they did not have to be road blocks and we believed that the main risks to our project were; unfocused group goals/plans and unknown legal/ethical problems associated with using AI. To combat these risks, the methods mentioned above such as developing a requirement specification, scope, etc. as well as continued research, both internet and formal, prevented these risks from stopping the project or slowing us down so much so that little to no work can be done.

# 6. Feedback

## 6.1. Problem Identification

Points of improvement:

- Needs better competitor analysis
- Poor relation of project idea to background research
- Primary stakeholders are good, but needs more depth especially in secondary and beyond stakeholders
- Conceptual model needs further and more obvious linking to background research
- Surveys/Questions lack scope due to small depth in stakeholders
- Feedback from surveys and prototypes need to be better integrated back into the conceptual model
- Clearer project milestones
- Presentation - too many slides

The primary thing taken away from our first round of educator and peer feedback was a need for more flow and linking between sections of the report, specifically with bringing the background research and stakeholders into the actual conceptual model.

A competitor analysis section was added with the expansion of background research, along with more specific references throughout the project back to said research. Secondary and tertiary stakeholders were added, such as family and friends. Further surveys and questions were developed to better understand how those secondary and tertiary stakeholders could be affected by a system such as SmartEd. Some milestones for the project development were made, and the following report contained less slides, but contained more information.

## 6.2. Interim Critique

Points of improvement:

- More specifics on what was found from survey
- Expand on how the research has actually influenced the solution
- Better comparisons with competitors discussed in competitor analysis
- More details on stakeholders and how the system would personally affect each of them
- Presentation - Ensure viewers can see the specific change made, as they may not remember the old iteration of the model/plan
- More flow through report, specifically on what 'AI' and 'machine learning' will do
- Clear milestones of sprints
- Presentation had some (unnecessarily) long pauses
- Small structure issues in report

The survey results were further expanded on, along with further developing said surveys. The research was again further included into the discussion of decisions made along with how the research supports our ideas over the competitors.
Some areas of the report were re-written with a clearer distinction between gathering data and the actual processing of said data (the 'AI' and 'machine learning' components). Along with this more examples tied into what the actual processing of data would look like to the end users, both educators and learners.
As the team had internal milestones that were not mentioned, in the future said milestones or sprint goals will be included in reports.

## 6.3. Ongoing Peer Feedback

Points of improvement:

- Confusion of what features are compulsory and what are optional
- How is motivation for students balanced from their goals (compared to others)
- More prototyping and feedback from users to propose a better solution

Throughout the sprints the team has added in more clear options of what the student has control over, the ability to customise their own dashboard to display the information they want, for example. We also made it a bit more clear that the data collection (along with other features) can be opted out of, or are not the default option to begin with.
The prototype designs were further iterated and brought to end users for more feedback and changes.

# 7. Team Reflection

## 7.1. Operations

### 7.1.1. Process

Throughout the course of the project we have continued to collaborate and refine our working processes. After receiving useful feedback from the problem identification presentation, we as a group reflected on where we can improve. The main area we agreed on was maintaining consistency and a general consensus with ideas and features. As mentioned above, we achieved this by creating a document dedicated to developing the conceptual model. This proved to be of great help for the group because we were able to flesh out ideas in greater depth and explain the rationale behind each feature with links back to the research conducted. In turn, it was easy to incorporate the work done in this dedicated document into the report as it expanded on and improved on the existing work we had done. This method was used when developing the project scope and system requirements.

One process the team used since beginning the project was the use of meetings and sprint style task allocations with specific deadlines. Towards the end of the project, we began incorporating a sprint plan into the workflow to help us outline specific tasks and when they need to be completed by. By following the sprint plan outlined in the report we were able to keep ourselves on track and deliver all requirements on time.

The team made a slight change to the team charter since the move to an online course. This allowed for a more relaxed approach to team members if they are late or don’t show up to team meetings. As a group we understand the strain of the current learning situation and that work commitments, other subjects, etc. can affect a group members attendance. Additional to a more lenient approach to attending meetings, we had taken a more lenient approach to responding to messages. Generally one member of the group would always promptly reply but we had relaxed the rules defined in the team charter. Despite these relaxed rules, we as a group had continued to work well and within the timeframes we have given ourselves.

The team had a very centralized process regarding goals and tasks revolving around individual longer meetings and single task requirement documents. With some meetings taking upwards of three hours, it was observed that effectiveness of the team's ability to produce valuable content decreases in proportion to the time elapsed in a meeting. A remedy to this could have

been to focus on having shorter meetings of approximately 30 minutes focusing solely on report backs and goals, with minimal collaborative work time focusing on editing rather than production.

### 7.1.2. Communication

Due to COVID-19, the course was moved from an in-person environment to online platforms. This had an effect on our whole group, having a harder time keeping on top of assessment and altering our everyday work process to adapt to online learning. We agreed to have a scheduled meeting every Tuesday as well as a catch up or meeting in our Friday studio. We frequently used messenger to remain in communication as well as Discord and Zoom to conduct our meetings. As outlined in our team charter, all team members updated other team members when they would be absent from team meetings. We experienced some abnormality with our own schedules including sleeping patterns and communicated if these changes happened to affect our team however this didn't impact the work being completed. Whilst we did experience a slightly different gap in time that we are available (i.e. those who are up late at night and sleep in verse those who sleep earlier and are up early), we were able to use Facebook Messenger to keep track of updates and concerns we had and team members were able to reply when convenient.

Possible improvements to the communication model could be greater utilisation of voice chats such as discord in a non-official meeting context but rather a more casual conversation about work tasks. This would help to improve alignment of team goals and thinking rather than relying on a single meeting and/or document to ensure that team work goals are in synergy. However, this would require more frequent usage of discord without schedule times and may be difficult to arrange.

### 7.1.3. Idea Refinement and Ideation

Moving our project to a more focused and narrow scope of our AI implementations to help student learning outcomes and satisfactions made it much easier to execute on other feedback of linking our conceptual model to our background research, as almost all of our research was directed at learning style and ways AI could help teaching. As part of our concept design, the team completed requirement statements with rationales to assist the team in creating a greater link between the features and the research or testing conducted. In order to produce more responses to some of our questions, we began posting on community pages for further discussion rather than relying on the responses purely from our surveys. This created the ability to have an on-going discussion with the respondents and clarify any parts that are unclear. The

team would discuss any new ideas and their benefits or purpose before committing to them in our design. This gave us time to explain the rationale and assess their suitability to our task.

### 7.1.4. Structure and Organisation

During meetings, our team had a typical structure that we followed in order to share and divide our work. Each sprint lasted two weeks in which the team created a work calendar with due dates for tasks allocated. After we have created a calendar, the team collectively created a list of tasks that need to be completed by the end of the next sprint. Each team member took it upon themselves to allocate tasks and the team would step in if the workload is unfair. We took responsibility for our work and to report back our findings to the team. The constant exchange and division of tasks allows for the team to work on different sections and have a broader understanding of the entire project.

### 7.1.5. Decision-Making

Whilst each member of the team completed their tasks, they had the responsibility to make an educated decision. We then shared our decision with the team during our report backs. Whilst doing so, our team had encountered many differences of opinions. When we encountered these differences, we had a discussion within the team to share our opinions and why we felt that way. If the majority of the team decided with a certain opinion, we went with that. However if the team was unsure or unable to make a decision, then we required more information in order to make an educated decision.

Most major decisions involving project goals, direction and main functionalities were made as a group though there was a great deal of liberty regarding minor things such as presentation styles, writing tenses and data collection. Overall the team saw this as a positive as it allowed for greater productivity without the bottleneck of over communication and/or guide documents.

## 7.2. Direction of Project and Project Goals

### 7.2.1. Initial Idea

When we began our problem identification process, we brainstormed a variety of different problems we saw with student learning and educator teaching at a tertiary level. We also, however, happened to be going through an isolation period where we encountered many issues with how online learning was being executed. This led to SmartEd trying to define a problem that consisted of the various issues with tertiary education not being personalised, mixed with the issues of online learning caused by the multiple programs that were needed to run the learning process. The prototype was built as a way which would integrate various current software platforms (including Zoom, BlackBoard, and Slack) and add an original artificial intelligence system which would determine a persons' learning or teaching style, for students and educators respectively. This would help streamline online education while creating classrooms for which the students and teachers would all benefit from. The scope of this idea, however, was far too broad for a semester's worth of work. During our problem identification presentation, we were advised by the course coordinator, Stephen Viller, that we should narrow down our idea and focus on either platform integration or personalising education. SmartEd decided that platform integration was less likely to be a long term solution as it would primarily assist with the temporary issues caused by COVID19, so the group would research further in depth about personalising education and ways in which we can lower the attrition rates of university courses (that is students failing or dropping out of courses because of fear of failing).

### 7.2.2. The Idea Now

In the period between the end of the problem identification phase and the beginning of the interim critique phase, SmartEd created a document called Project Scope and System Requirements. In this document, the group developed a problem statement, a concept model, surveys, and a list of what was in scope for this project. This ensured the group all had the same understanding of what the problem was and maintained consistency when designing possible solution ideas. The idea that we proposed in the interim critique report was to create a software system that determines a person's learning style (or teaching style for educators) and provide the student with course content that has been modified to match the style that the student learns best. The system will also provide an in depth analytics dashboard which will enable a student to easily learn the parts of the course that SmartEd sees them struggling with and assist the student with staying on track with assessment and attending classes. An educator will also have their own analytics dashboard which will display various information

regarding student attendance in lectures and tutorials and their satisfaction with those classes. Other analytics will display student ranking such that the lecturer can assist those nearer the bottom to succeed. Both students and educators will have access to a Key Insight Report to gain an understanding of areas that may motivate a change in behaviour (e.g a student realises they need 78% on their next assessment to get 6 in the course and so they put in extra effort or an educator sees that student with an auditory learning style are struggling and provides those students with a personalised message). The final feature is an Actionable Insights report whereby student and educators are given points which they can perform to improve or progress in the course (e.g. a student receives a clickable notification to watch their personalised lecture, or an educator is given a notification regarding specific students that are falling behind and suggests that an email goes out to these students).

## 7.3. COVID-19 Impact

### 7.3.1. Challenges

In light of recent events, the way we were allowed to communicate was vastly different from what we consider normal. The team was unable to meet in person and have face-to-face interactions. This removed the ability to receive eye contact, understand body language, notice when someone is about to speak, or have deeper discussions about concerns or issues we are encountering. With this in mind, there was less pressure for team members to complete the workload as they did not require to face the team in person and it became easier to avoid messages and tasks online. It became harder to ensure that our team remained on track and that productive work was being conducted. To rectify this, the team had to put in place measures to resolve any issues when working online.

### 7.3.2. Solutions

In order to combat these challenges that we had been facing, the team created a few rules and methods that help mitigate these issues. Our team conducted weekly meetings to float big ideas through to receive near instant feedback that you would receive from a physical group environment. Whilst this did not replicate the same situation, it allowed for our team members to enter an environment where they can feel comfortable about discussing their concerns and receive constructive feedback and advice. The team presented empathy to other team members that were having tough times with other assessments but still required them to make time for this course when assessment was nearing.

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# 9. Appendix

## 9.1. Interview Answers

**Name: Kristian Thomas**
**Occupation: High School History Teacher at St Aidan's Anglican Girls' School**
**Number of years' experience in education: 7 years**

1. 4
2. 5
3. 7
4. None
5. Using AI to mark assessment for easily identified mistakes or errors like spelling or grammar. Obtaining data about students interests in certain topics and how that might affect their grades.

**Name: Brad Nielsen**
**Occupation: High School ICT Teacher at Marist Brothers College Ashgrove**
**Number of years' experience in education: 9 years**

1. 2
2. 8
3. 10
4. Many areas of the curriculum for IT is designed around data collected from past years to determine how effective it was.
5. The primary application of AI is the ability to process "big data" in a way that humans cannot. Even though data is not being collected in education as much as other fields, the opportunity presents itself for this data to be collected, including study habits of students, truancy, development of grades and more. I think this information could really help to improve the quality of education in many of the smaller ways by just optimizing the decision making of the people involved.

**Name: Vinzent Schlagkraft**
**Occupation: Teaching Aide at Mitchelton Special School**
**Number of years' experience in education: 2**

1. 5
2. 1
3. 4
4. None.
5. In my case, dealing with learners that have very specialised requirements, a lot of it comes down to personal experience. I really could not think of ways AI could assist in an area with that large of a scope of variance.

**Previous tutor**

1. 2
2. 7
3. 9
4. Mostly computer vision related tasks including classification and object detection.

5. -

**Home school teacher**

1. 5
2. 5
3. 5
4. Nil known
5. Not sure - sorry

**University tutor (med)**

1. 2
2. 5
3. 8
4. Currently not aware of specific AI being utilised in my work place although I'm sure plenty is being used
5. Most of my job revolved around pattern recognition being married with human intuition. I feel AI would greatly assist the diagnostic part of medicine

**Private tutor**

1. 2
2. 3
3. 10
4. -
5. Previous methods of explanation to best suit student

**High school teacher (and IT HOD)**

1. 2
2. 7
3. 8
4. None
5. Seating plans, classes with too many trouble students, academic class lists, reporting generation, assessment marking, plagiarism detection

**University tutor**

1. 7
2. 6
3. 9
4. Nil that I am aware of
5. monitoring and flagging lecturers and teaching staff self efficacy against the grades of the students would be interesting

**Private tutor**

1. 3
2. 4
3. 5
4. -
5. -

**Private tutor**

1. 5
2. 4
3. 8
4. -
5. -