Exploring Critical Success Factors In Online Programming Introductory Courses

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ABSTRACT

With an ongoing COVID-19 pandemic, the adoption of online learning by academic institutions has become common. However, its introduction has been associated with issues such as a disconnect between students and the instructor, and poor engagement with course materials, among others. This is where Critical Success Factors (CSFs) come in, as they help alleviate these issues. Although studies have identified a lot of CSFs, our focus will be directed towards two, namely student-instructor interaction, and gamification. This proposal explores potential tools, such as video-paired forums, the introduction of an instructor online availability timetable, in-video quizzes, and a gamified Learning Management System (LMS), which when implemented, could help embed the two CSFs into first year Computer Science Courses (CS1). We give insight into the procedures and methods that would go into the development and assessment of these tools. However, due to the broadness of the two CSFs, we conclude that the success of these tools would also be beneficial to online courses in general, and not just CS1.

1. PROJECT DESCRIPTION

This project shall be presented within the context of the Covid-19 pandemic which has wreaked havoc on the world. Online Distance Learning (ODL) is now more necessary and widespread than ever before in history and is becoming more sought after at an ever-increasing rate [5].

Introductory programming courses at a varsity level can be difficult to master, especially without any prior exposure to programming. These courses require constant demonstration of coding techniques and styles, as well as discussions between students and the instructor, as these help consolidate the understanding of the material. Online programming courses often rid students and the instructors of this, as they tend to lack ‘sufficient’ and effective interactions, which can have a negative impact on the learning outcomes [14].

The general issue that our research aims to address is the fact that institutions have seen a higher dropout rate in online learning courses than regular face-to-face ones [1, 2, 3, 6].

This proposal explores student-instructor interactions and gamification, as Critical Success Factors (CSFs). Student-instructor interactions refer to how instructors and students can engage in dialogue, how questions are asked and answered, and the promptness at which feedback is provided [19]. Gamification is defined in the Cambridge Dictionary as the practice of making activities more like games in order to make them more interesting or enjoyable. Gamification in our context refers to the incorporation of game-like elements into the Vula LMS, in order to encourage student engagement with the course.

It is difficult to foster student-instructor interactions in large online classes, and students generally perform poorly in the absence of interactions with the instructor [18, 23]. Online forums often suffer from delayed responses, and sometimes no responses at all. This impacts learning outcomes negatively [14].

Asynchronous lecture videos, although central to online learning, provide students with no efficient ways of asking questions in the middle of a lecture video, and questions verbally posed by instructors to students, do not guarantee responses from the students. With most academic institutions adopting an online learning strategy, effective methods of encouraging student-instructor interactions become key.

Online classes suffer from a lack of student captivation. We will be using gamification to alleviate this short-coming and to encourage students to have a higher course interaction, by increasing the engagement of learners [13].

The importance of our research is to enable universities and other academic institutions to better equip their students and instructors for successful online programmes. We aim to improve the current methods in which students can engage with course materials, through the addition of gamification and by improving the quality of student-instructor interactions.

2. PROBLEM STATEMENT AND RESEARCH QUESTIONS

Student engagement and interaction play an important role in course completion. Lecture videos are central to online learning and are found to be better at conveying information than text-based materials [17]. Although Vula provides platforms for interaction, such as chat-rooms and forums, our attempt is to find methods that improve asynchronous student-instructor interactions and overall course engagement. Thus, we pose the following research questions:

2.1 What is the student experience of using lecture-video paired forums (where each lecture video has its own forum attached to it, and questions posted are accompanied by timestamps of where the question fits into the lecture video)?

2.2 What effect does the introduction of an ‘instructor online availability timetable’ have on the students’ perceived immediacy of instructor feedback?

2.3 What is the perceived effect of incorporating knowledge-check quizzes into the lecture videos (these represent questions posed by the instructor), on student-instructor interactions? Do these quizzes improve the way in which the instructor can gauge the students’ level of understanding?

2.4 What is the effect of additional various gamification elements to the current Vula LMS? Does it increase the system’s effectiveness, or does it create additional complexities in the learning environment?

3. RELATED WORK

This section discusses the work that has been done that is closely related to our research interest.

Our research is unique, and better focused than other studies. There are many papers that highlight critical success factors (CSFs) in an online learning environment [1, 7, 8, 9, 10, 11]. However, few directly resemble the implementation of the tools that we aim to develop, in response to our research questions. We shall instead, discuss some of the work which is currently being used in an attempt to tackle the issues we have identified.

3.1 Gamification

Vula already has a statistical graph that shows the distribution of marks for a specific assignment. This can be incorporated as part of gamification in such a way that it resembles an anonymous leaderboard. Gamification concepts have been found to motivate people to engage with the content of a video or a course to build a vibrant community of participation [8]. The data collected suggested that the introduction of the gamification aspect of awarding virtual badges for obtaining full points in the quizzes, seemed to motivate students to learn [12].

3.2 Forums

Forums and chat-rooms are the dominant media used for asynchronous communication. They facilitate discussions between students and the instructor, which are core in introductory programming courses [16]. Questions and answers provided are public and accessible to all students, which reduces the repetition of similar questions. The quality of interactions hosted through these media are measured by the number of question-answer pairs, as well as surveys to gauge student satisfaction levels with the quality of interactions [22]. However, Onah et al. pointed out that forums cannot effectively host a large number of posts, as this leads to non-coherent topic discussions and can contribute to delayed responses [21].

3.3 Email

The use of email for student-instructor interaction is also common [24]. Although this method falls out of the platforms directly offered by Vula, it still helps ease communication for students that 'worry' about how other students will perceive them when they ask questions in public settings, such as forums. It also provides students with a 'one-to-one' relationship with the instructor [24]. However, similar to forums, the use of email is also vulnerable to delayed responses from instructors.

3.4 Mini quizzes

Student-instructor interactions are fueled when instructors ask questions that test the understanding of the material. Such questions form the basis for discussion, while also improving the students' knowledge of the material [20]. UCT already has a tool under development, called the Tsugi tool. This allows for the incorporation of quizzes and exercises that are spread throughout the video. However, the completion of these assessments is not deemed mandatory, as Tsugi simply notifies the students that they need to complete an assessment, yet allows them to continue watching the lecture video even if they opt out of completing the assessment. However, Cook et al. noted that students tend to ignore assessments that are not worth any marks [15]. Therefore, instructors may end up working with data that is not representative of the student population, when they use the results from these quizzes to gauge levels of understanding.

4. PROCEDURES AND METHODS

When determining success, the ideal core-success factor would be the pass-rate, as this is what we are aiming to maintain in our transition to an online learning medium. Since we cannot know the outcomes of the course for next year by the time this project is due, we shall use the feedback from our surveys, questionnaires and interviews to determine success.

The facilities made available to us from UCT will be used. We wish to use the students in the various undergraduate years and honours year and provide them with questionnaires and conduct virtual interviews to ascertain their ideas and beliefs of how to deliver better online courses. We shall provide them with questionnaires to identify their suggestions for improved ODL teaching models and find out what they would like to see incorporated into the presentation of their courses, so as to optimise the learning and teaching experience.

4.1 Lecture-video paired forums

This tool will be implemented as a plug-in or extension to UCT's Tsugi tool. The main components of the plug-in will involve a 'post' button that grabs the timestamp of the video, and embeds it into the question posted by a student. A separate forum would need to be created for each lecture video. The aim of attaching a video timestamp to a question is to immediately point out to the instructor, the section within the video, from which a student's question stemmed.

The effectiveness of this tool will be evaluated through user surveys. Once the development is done, we will require a group of students to watch a lecture

video and use general forums to post questions. Then we shall use the same group to watch the same lecture video, but this time they will use the video-paired forum to pose questions for the lecturer. Two surveys will be generated - one for the students - to gauge how they rate the efficacy of the two methods, and the other for the instructor – to determine which of the two methods they deem to be more effective in organising and navigating course-related questions.

4.2 Mandatory knowledge-check quizzes

These aim to enable the instructor to pose questions to the students at certain intervals within a lecture video. The Tsugi tool allows for the incorporation of quizzes and exercises that can be inserted at specific times throughout the video. However, the completion of these assessments is not deemed mandatory as Tsugi simply notifies the students that they need to complete a quiz. We aim to configure this tool to allow instructors to pose knowledge-check quizzes. These are short questions which are designed to consolidate students' knowledge and are not worth any marks. Unlike current quizzes in Tsugi, which enable the students to proceed watching the lecture video even without answering any questions, we aim to bring the lecture videos to a complete halt, until the questions posed by the instructor are answered. Only once these questions have been attempted would students then be able to continue watching the rest of the video. The design of the questions will be brief, and in multiple choice or drag-and-drop format, so as to automate grading.

Since the aim of this tool is to provide a way for the instructor to get feedback on the questions posed to the students, the evaluation of this tool will involve having a group of students watch a lecture video and complete the inserted quizzes. The instructor will then be able to access a statistical summary of the automatically graded results, in order to gauge how well the students understood the material. We do, however, note a pitfall with this method. As these quizzes are not worth any marks, students may simply select any answer from the options provided, in order to proceed with watching the lecture video.

4.3 Instructor online availability timetable

With this tool, we aim to enhance the immediacy of the feedback provided by the instructor to the students' questions, and to give students an indicator of when they can expect to get feedback from the instructor. A timetable will be generated and made available to students, to notify them of instructor's online availability in order to provide feedback to their questions. The responsibility for the creation of the weekly timetable would fall to the instructor, in order to accommodate their busy schedule.

Evaluation of this component will involve surveys to gauge if the introduction of the timetable helps the students feel better supported, by managing their expectations around the accessibility of their lecturers. Indicating availability and "contact time" (albeit through virtual/ digital means) could result in a win-win situation for both the lecturers and the students, as it would allow them both to manage their own time and responsibilities more effectively. Scheduling times in which feedback could be provided and questions could be answered like the feedback to their questions is being provided faster, and can, to some extent, be 'expected' to arrive at some time (i.e at a time when the lecturer indicated they would be online).

4.4 Gamification elements

This is where we try to gauge how well students use the game tools and elements that we shall be adding to their Vula. We can determine which tools the students and lecturers enjoy and use most frequently and effectively and which ones they do not.

This data shall be gathered through surveys, questionnaires and interviews, all of which shall be conducted virtually. After the data is collected we can decide if the game elements are useful and determine whether they increase interaction and enhance the overall value of the course or whether they are unnecessary and a waste of resources.

We shall make use of likert scale format as this is a simple and efficient method for data collection. This scale will also enable us to see common likes and dislikes of our ideas. The ones which trend well, can then be extrapolated upon and the ones that do not can be discarded or adapted accordingly. We shall do our best to keep bias out of our findings and to ensure that our research is data driven.

5. ETHICS: PROFESSIONAL AND LEGAL ISSUES

Since this research will involve people it is important that we remember to conduct our investigations ethically while remembering the issues that come with human testing as well as the psychological aspects that come along with this process. Our studies do not need to push any personal boundaries and should not be emotionally linked to people. The participants' personal information will not be recorded. The studies will be for data collection and we do not believe that they will elicit human harm in any form.

The research project will be performed through UCT, and should the researchers be contacted regarding the project, they intend to conduct themselves in a professional manner in all environments in which the project is to be showcased. Results from the research will be made publicly available for use, contingent on the university's permission. Previous work will be acknowledged and cited to ensure legal compliance and the maintaining of intellectual property rights for the resulting codebase and paper.

We do understand that it is important that our research is conducted to the best of our abilities as our findings and possible implementations (if they are adopted by an institution for example) could have a direct impact on the lives of the people who are using the systems we design.

6. ANTICIPATED OUTCOMES

Our research and the tools that we shall build, aim to enhance the learning performance of learners at UCT who will be enrolled in first-year programming courses that will be offered entirely online for the first time in 2022.

The aim is to ensure that our tools and findings impact positively on the course pass-rate and the results will help the case for implementing CSFs in online learning.

Our findings may directly impact the course structure and add value to it. This will be indicated by a decreased drop-out rate. We expect to see better course evaluations and more engaged learners who are better equipped to complete their courses. This will be due to an increase in their motivation which could be brought about by better self-regulated learning (SRL) (another CSF).

6.1 Impact

The impact that this research could have involves improved methods of student-instructor interactions and the addition of a new gamification component to the LMS. These interactions are often linked with high satisfaction levels of the course by students. Instructors could get a better understanding of the students' comfort with the material when a large number of students partake in knowledge-check quizzes. The online instructor availability timetable would encourage students to engage in discussions, as they would know when to expect the instructor to be online. If successful, results from this research could also be applied to courses other than CS1.

6.2 Results

We expect students to take a liking to the video-paired forums, as these will allow them to post questions on the spot, while they are watching lecture videos. This will potentially increase the 'quality' of the forum in the sense that questions posted would only be related to the material being addressed in each specific lecture video. It would also simplify the provision of feedback to students, as the instructor would immediately see the section of the video that relates to a specific question.

With the introduction of the instructor online timetable, we anticipate that students will find it to be quite helpful. This is mainly because to some degree, students would know when to expect the instructor to provide feedback to the questions they have posted. We do appreciate that the instructor's schedule may not allow for all questions to be answered in a single timetable slot. However, the timetable would still serve its purpose in that students may then assume that the instructor will use the next slot to tend to more questions.

Since the knowledge-check quizzes would be 'forced' on the students, we expect students to have a negative feeling towards them. However, we also expect these to encourage student-instructor interactions since more students will be taking them, this will help the instructor to gauge the levels of understanding at a much higher degree than before.

We expect students to enjoy the gamification features as they will hopefully be user-friendly and they will add a fun atmosphere to the otherwise bland learning environment. We do realise that not everyone will enjoy the game tools and therefore we can possibly make them optional with an opt-in/out button.

6.3 Key success factors

This section discusses the factors that will ensure the success of our project.

As our project is mostly research-based as opposed to software development, the success of our components will be measured through user feedback. This will be attained using surveys to gauge how users/testers of the systems feel about them.

We will then utilise the data to discuss the implementation of the factors that we feel would help realise the success of our project components, once they are implemented and utilised.

6.3.1 Instructor online availability timetable

The success of this utility will rely heavily on the flexibility of the timetable. In a situation where there are a few questions, or none at all, students may opt to use the timetable slots to interact with the instructor via the general forums. This would be because they know that the instructor is online, and could therefore tend to their questions immediately. However, not all students would be able to make the time slots in the timetable, and thus a flexible instructor timetable would cater to more students.

6.3.2 Mandatory knowledge-check quizzes

To ensure the success of this component, questions posed for the students need to be related to the main concept of the lecture video, and should not be lengthy to derail the students nor distract them from their learning from watching the lecture video.

6.3.3 Lecture-video forums

For this implementation to succeed, the tool must be able to grab the timestamp of the lecture video at the precise moment a student presses the 'ask question' button.

6.3.4 Gamification tools

For a positive outcome, our game-tools need to be fun, easy-to-use and user-friendly to add some variety to the learning process. They will be deemed successful if the learners use them frequently and if they increase the student's engagement with the course.

7. PROJECT PLAN

7.1 Risk matrix

This can be found in the appendix section as Appendix A.

7.2 Timeline

The research project is expected to run from the 17th of May, to the 18th of October 2021. The timeline is properly depicted in the Gantt chart in Appendix B.

7.3 Resources required

In order to carry out our research aims and thoroughly evaluate them, we will need access to students enrolled in a CS1 course, and their instructors, to provide us with feedback. Access to UCT's Vula LMS and the Tsugi test tool will also be required, in order to integrate our coding deliverables.

7.4 Gantt Chart

This outlines all the project details with regards to the deliverables and timeline. It can be found in Appendix B.

7.5 Deliverables

The core deliverables of this project include a new Vula forum extension, newly configured Tsugi test tool, gamification element additions and the initial course outlined submissions:

Project Proposal
Project Presentation
Project Paper
Project Poster
Project Website

7.6 Milestones

The research project milestones are represented as orange diamonds in the Gantt chart, and indicate significant stages of progress in our project. These are mostly code deliverables.

7.7 Work Allocation

Moses shall focus on the student-lecturer interactions and present his findings to do with enhancing this aspect of learning.

Roscoe shall focus on the gamification aspect of learning and try to integrate techniques that have been proven to work into his tools.

Moses and Roscoe shall work together on the necessary surveys, questionnaires and data-gathering tools.

8. CONCLUSIONS

In summary, this project shall explore specific CSFs related to improving a first-year introductory course in programming. It has the potential to have its findings extended to other courses presented in an ODL environment.

This project will be diving into the evaluation of student-lecturer engagement as well as gamification as the means by which to improve the quality of CS Education.

9. REFERENCES

1. Jennifer Campbell, Diane Horton, and Michelle Craig. 2016. Factors for Success in Online CS1. In Proceedings of the 2016 ACM Conference on Innovation and Technology in Computer Science Education (ITiCSE '16). Association for Computing Machinery, New York, NY, USA, 320–325. DOI:https://doi.org/10.1145/2899415.2899457

2. Sarah Carr. 2000. As distance education comes of age, the challenge is keeping the students. Chronicle of higher education, 46(23).

3. Yair Levy. 2007. Comparing dropouts and persistence in e-learning courses. Computers & education, 48(2):185–204. DOI:https://doi.org/10.1016/j.compedu.2004.12.004

4. Moon-Heum Cho and Demei Shen. 2013. Self-regulation in online learning. Distance Education, 34(3):290-301. DOI:https://doi.org/10.1080/01587919.2013.835770

5. Ghosh, Saima & Nath, Joyshree & Agarwal, Shalabh & Nath, Asoke & Chaudhuri, A. (2012). Open And Distance Learning (Odl) Education System: Past, Present And Future – A Systematic Study Of An Alternative Education System. Journal Of Global Research In Computer Science. 3. 53-57.

6. Lee, Youngju & Choi, Jaeho. (2011). A review of online course dropout research: Implications for practice and future research. Educational Technology Research and Development. 59. 593-618. 10.1007/s11423-010-9177-y.

7. Alqahtani, Ammar & Rajkhan, Albraa. (2020). E-Learning Critical Success Factors during the COVID-19 Pandemic: A Comprehensive Analysis of E-Learning Managerial Perspectives. Education Sciences. 10. 216. 10.3390/educsci10090216.

8. Korkut, S., Dornberger, R., Diwanji, P., Puthur Simon, B., & Maerki, M. (2015). Success Factors of Online Learning Videos. International Journal Of Interactive Mobile Technologies (IJIM), 9(4), pp. 17-22. doi:http://dx.doi.org/10.3991/ijim.v9i4.4460

9. Cheawjindakarn, Bussakorn & Suwannatthachote, Praweenya & Theeraroungchaisri, Anuchai. (2012). Critical Success Factors for Online Distance Learning in Higher Education: A Review of the Literature. Creative Education. 3. 61-66. 10.4236/ce.2012.38B014.

10. Priatna, Tedi & Maylawati, Dian & Sugilar, Hamdan & Ramdhani, Muhammad. (2020). Key Success Factors of e-Learning Implementation in Higher Education. International Journal of Emerging Technologies in Learning (iJET). 15. 101. 10.3991/ijet.v15i17.14293.

11. Volery, T. & Lord, Deborah. (2000). Critical success factors in online education. International Journal of Educational Management. 14. 216-223. 10.1108/09513540010344731.

12. Piccioni, Marco & Estler, Christian & Meyer, Bertrand. (2014). SPOC-supported introduction to programming. 10.1145/2591708.2591759.

13. Melanie Hibbert. 2014. What Makes an Online Instructional Video Compelling? https://er.educause.edu/articles/2014/4/what-makes-an-online-instructional-video-compelling

14. Appana, S. 2008. A review of benefits and limitations of online learning in the context of the student, the instructor, and the tenured faculty. International Journal of E-Learning. 7, 1 (2008), 5–22.

15. Cook, B.R. and Babon, A. 2017. Active learning through online quizzes: better learning and less (busy) work. Journal of Geography in Higher Education. 41, 1 (2017), 24–38. DOI:https://doi.org/10.1080/03098265.2016.1185772

16. El-Sheikh, E. 2009. Techniques for Engaging Students in an Online Computer Programming Course. Systemics, Cybernetics and Informatics. 7, 1 (2009), 1–12.

17. Korkut, S. et al. 2015. Success factors of online learning videos. International Journal of Interactive Mobile Technologies. 9, 4 (2015), 17–22. DOI:https://doi.org/10.3991/ijim.v9i4.4460

18. Lee, J. 2016. International Forum of Educational Technology & Society Patterns of Interaction and Participation in a Large Online Course : Strategies for Fostering Sustainable Discussion Published by : International Forum

of Educational Technology & Society Patterns of. 15, 1 (2016).

19. Murray, M. et al. 2012. Student interaction with online course content: Build it and they might come. Journal of Information Technology Education:Research. 11, 1 (2012), 125–140. DOI:https://doi.org/10.28945/1592

20. Offir, B. et al. 2008. Surface and deep learning processes in distance education: Synchronous versus asynchronous systems. Computers and Education. 51, 3 (2008), 1172–1183. DOI:https://doi.org/10.1016/j.compedu.2007.10.009

21. Onah, D.F.O. et al. 2014. Exploring the Use of MOOC Discussion Forums. Proceedings of London International Conference on Education. March 2015 (2014), 1–4. DOI:https://doi.org/10.13140/RG.2.1.3319.5042.

22. Picciano, A. 2002. Picciano (2002).pdf. Journal of Asynchronous Learning Networks. 6, 1 (2002), 21–40.

23. Swan, K. 2001. Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses. Distance Education. 22, 2 (2001), 306–331. DOI:https://doi.org/10.1080/01587910102202008

24. Vonderwell, S. 2003. An examination of asynchronous communication experiences and perspectives of students in an online course: A case study. Internet and Higher Education. 6, 1 (2003), 77–90. DOI:https://doi.org/10.1016/S1096-7516(02)00164-1.

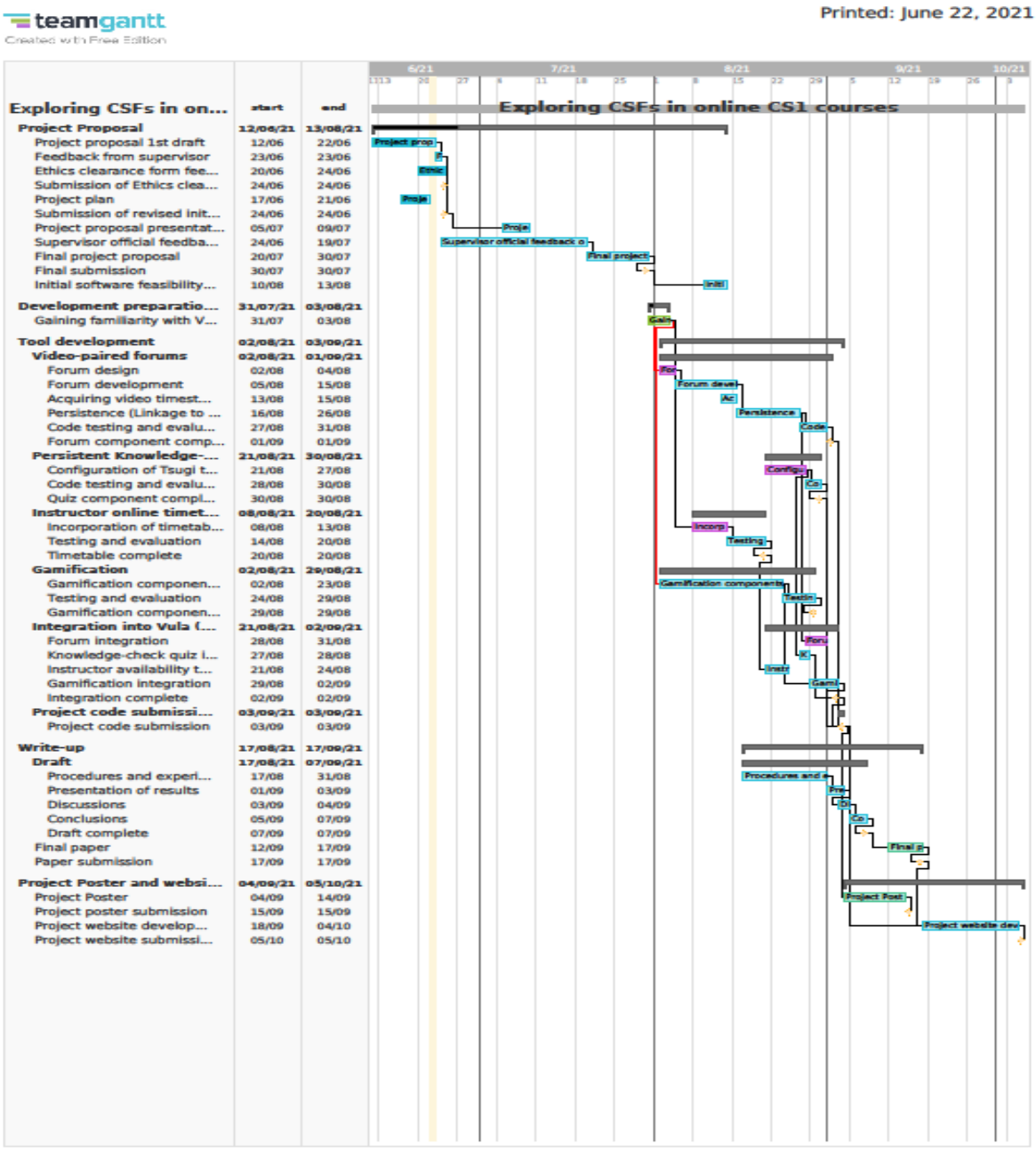
9. APPENDIX

Appendix A. Risk Matrix:

Risk	**Probability** (scale of 1 - 10)	**Impact** (scale of 1 - 10)	**Consequences**	**Mitigation**	**Management**
Team member dropping out	4	5	The member's experiment would be left incomplete, and the collaborative workload will be made heavier on the remaining members.	Ensure the team is communicating effectively and everyone is taking care of their health and is conscious of safety measures to be taken during the COVID-19 pandemic.	Exclude the member's experiment from the final submissions and redistribute collaborative work across the remaining members while also adjusting timelines as needed.
Lack of willing research participants.	9	10	Research would not have any results, and thus no conclusions would be drawn. Failure of research.	Offer participants incentive for participating in the research.	Ask friends/family to take part in the research instead. But this approach is vulnerable to bias.
Time constraints.	4	8	Failure to complete the research project on time (or at all). Research may be handed in with some components missing.	Have regular check-ups to see if everyone is abiding by the time frames set in the project plan. Reduce the scope if necessary.	Direct focus towards the core components of the research project, and neglect less important tasks.
Team disputes (creative differences).	3	6	Inconsistent and contradictory work. Demotivated team members.	Prioritise communication, and always ensure that both members contribute to the decision making regarding the project.	Communicate and sort out any issues. Seek a mediator if possible.
Team member/supervisor catching Covid.	4	6	Could result in project downtime needed for rest and recuperation. More work and responsibilities for the other team member.	Obeying laws and regulations with regards to Covid.	Hopefully working harder post recovery to make up for lost time.
Failure to meet the requirements of the project	3	8	Poor results for the project and a disappointed supervisor.	Research team to compare project outputs with requirements on a regular basis.	Reduce the project scope to ensure that it can be successfully met.
Lack of adequate capabilities to complete the project.	5	8	Project deliverables may suffer and not be as complete as originally wanted.	Try not to do too much by keeping the scope of the project manageable	Seek assistance from supervisor and other people who are more capable
Supervisor loses interest in the project.	1	7	Project could derail and lack direction due to lack of guidance and support.	Regular meetings and updates on project progress.	Remind supervisor of project vision and potential applicability in real-world.

Appendix B.

Gantt Chart.



Exploring CSFs in on...	start	end
Project Proposal	12/06/21	13/08/21
Project proposal 1st draft	12/06	22/06
Feedback from supervisor	23/06	23/06
Ethics clearance form fee...	20/06	24/06
Submission of Ethics clea...	24/06	24/06
Project plan	17/06	21/06
Submission of revised init...	24/06	24/06
Project proposal presentat...	05/07	09/07
Supervisor official feedba...	24/06	19/07
Final project proposal	20/07	30/07
Final submission	30/07	30/07
Initial software feasibility...	10/08	13/08
Development preparatio...	31/07/21	03/08/21
Gaining familiarity with V...	31/07	03/08
Tool development	02/08/21	03/09/21
Video-paired forums	02/08/21	01/09/21
Forum design	02/08	04/08
Forum development	05/08	15/08
Acquiring video timest...	13/08	15/08
Persistence (Linkage to ...	16/08	26/08
Code testing and evalu...	27/08	31/08
Forum component comp...	01/09	01/09
Persistent Knowledge-...	21/08/21	30/08/21
Configuration of Tsugi t...	21/08	27/08
Code testing and evalu...	28/08	30/08
Quiz component compl...	30/08	30/08
Instructor online timet...	08/08/21	20/08/21
Incorporation of timetab...	08/08	13/08
Testing and evaluation	14/08	20/08
Timetable complete	20/08	20/08
Gamification	02/08/21	29/08/21
Gamification componen...	02/08	23/08
Testing and evaluation	24/08	29/08
Gamification componen...	29/08	29/08
Integration into Vula (...	21/08/21	02/09/21
Forum integration	28/08	31/08
Knowledge-check quiz i...	27/08	28/08
Instructor availability t...	21/08	24/08
Gamification integration	29/08	02/09
Integration complete	02/09	02/09
Project code submissi...	03/09/21	03/09/21
Project code submission	03/09	03/09
Write-up	17/08/21	17/09/21
Draft	17/08/21	07/09/21
Procedures and experi...	17/08	31/08
Presentation of results	01/09	03/09
Discussions	03/09	04/09
Conclusions	05/09	07/09
Draft complete	07/09	07/09
Final paper	12/09	17/09
Paper submission	17/09	17/09
Project Poster and websi...	04/09/21	05/10/21
Project Poster	04/09	14/09
Project poster submission	15/09	15/09
Project website develop...	18/09	04/10
Project website submissi...	05/10	05/10