Rules of Engagement: Using Tournaments to Increase Student Engagement and Performance

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CONTEXT

The widespread ubiquity of mobile and web technology enables the implementation of innovative teaching practices. Arguably the most recognised application of blended learning technology is the 'flipped classroom' which typically involves pre-class instruction therefore allowing greater flexibility within class for interactive activity. To assist lecturers in engaging with large audiences, a simple to use, but powerful web based audience response system, 'MARS', was developed to enable interactivity between students and lecturers via their mobile devices during normal lectures over the course of semester. Additionally, leading up to the final exam, MARS was used to conduct a supplementary and voluntary 'revision tournament' in the last week of semester. In this tournament, students were posed 30 time-limited questions which MARS calculated and scored in real-time.

PURPOSE

The purpose of this paper is to evaluate the student perception of the revision tournament and identify any correlations between performance in the final exam and participation in the tournament.

APPROACH

A mixed methods approach was utilised to evaluate the impact of the tournament-based approach in using an audience response system for enhancing the learning experience and learning outcomes. Student performance in the tournament was correlated with final exam marks, whilst a qualitative survey instrument provided greater insights into the learners' perceptions of the approach.

RESULTS

Students tended to enjoy the tournament and particularly found it valuable for revealing areas in need of revision. While participation in the tournament appeared to be helpful for revision, tournament performance was only very weakly positively correlated with exam performance.

CONCLUSIONS

The study found that conducting a tournament using an audience response system can be an efficient method of engaging students in a novel and enjoyable way – allowing them to reflect on the content that they have or have not mastered in the lead up to their final exam.

KEYWORDS

Audience Response System, Flipped Classroom, Engagement.

Introduction

The 'flipped classroom' – in which 'traditional lectures' are replaced with more interactive tutorial-like workshops – is perhaps one of the most recognised trends in engineering education today. Bishop and Verleger (2013) define flipped learning as

> *"… an educational technique that consists of two parts: interactive group learning activities inside the classroom, and direct computer-based individual instruction outside the classroom."*

While many lecturers have embraced this teaching paradigm, many more are in the process of evaluating or tentatively transitioning to it.

In order to assist lecturers who are hesitant about deviating from traditional lectures, we have developed a simple to use, web based audience response system, 'MARS'. This system, written in JavaScript, enables anonymous and efficient interactivity between students and lecturers via their mobile devices during lectures.

Evidence for the effectiveness of engaging students through Audience Response Systems is now quite strong. A meta-analysis of the effects of audience response systems by Hunsu, Adesope and Bayly (2016) found that Audience Response Systems have a "small but significant effect on cognitive learning outcomes". Furthermore, through their global meta-analysis, Castillo-Manzano et al. (2016) have shown that Audience Responses Systems are most effective when used to teach students in "Applied Hard disciplines" such as science based professions and engineering.
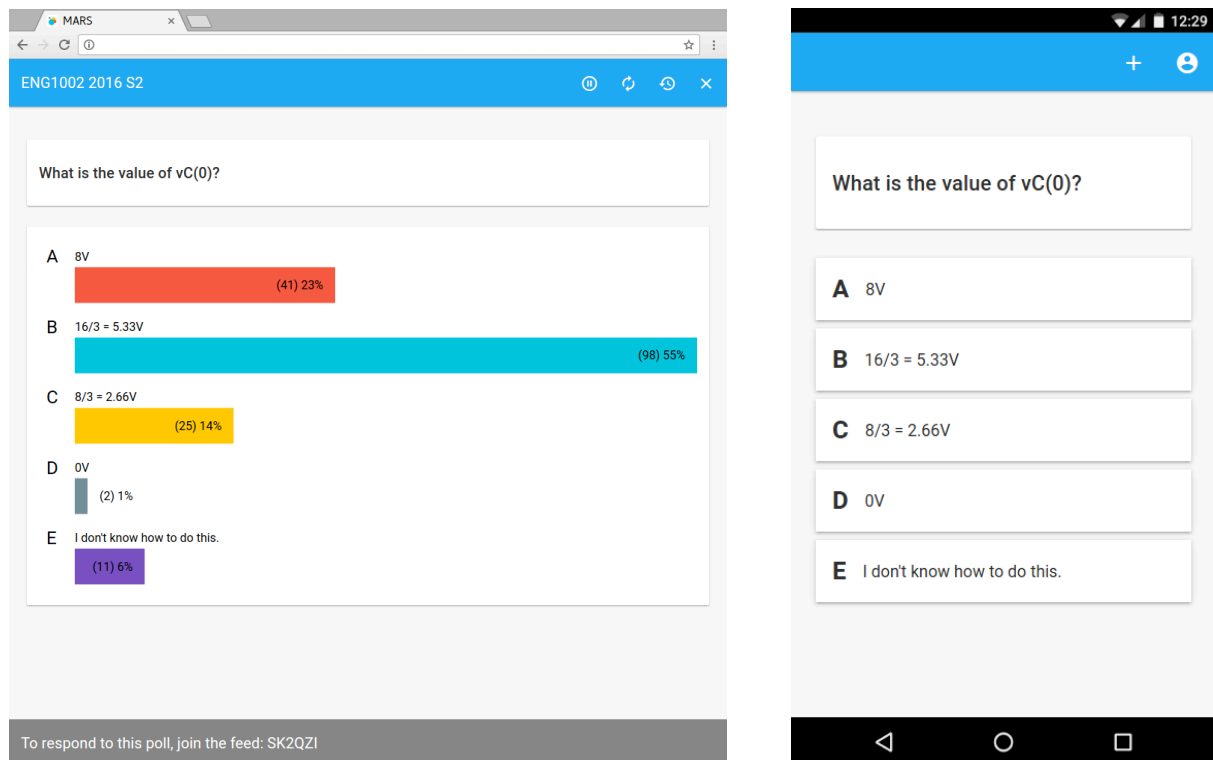
Figure 1: Lecturer interface (left) and student interface (right)

The MARS audience response software was used to conduct live quizzes in lectures in a number of units throughout the semester. In addition to this, leading up to one unit's final examination, MARS was used in a novel way to conduct a 'revision tournament' in the final week of semester. In the tournament, students were posed 30 time-limited questions. The

students' responses to these questions were automatically scored, tallied and arranged into a 'leaderboard' in real-time by the MARS system.

As with any flipped classroom intervention, the primary goal of this tournament was to provide students with more time actively engaging in course content. It was also hoped that the tournament would help students to identify any areas of weakness they may have, so that they could revise efficiently.

In addition to these goals, we also wanted to better understand students' perceptions of the tournament. As such, an online survey was conducted at the end of semester. The results from this survey were analysed along with the students' tournament responses and final examination marks to provide the insights detailed in this paper.

Method

This research was carried out in a project-based, first year Engineering unit which covered material from Chemical, Materials and Electrical Engineering. The class consisted of 469 students including 413 local (Australian/New Zealand citizens or students with Permanent Residency) and 57 International Students. The female to male ratio in the class was approximately 1:4 (103 females to 366 males).

The tournament was held in a lecture during the final week of semester – approximately three weeks before the final examination for the unit. Bojinova and Oigara (2013) found that students appreciated the ability to participate anonymously when using an Audience Response System. As such, the two lecture streams were made aware that their results and answers in the tournament would remain anonymous and, in addition, participation was made optional. Students were also made aware that there would be a $50 gift voucher prize available to the winner as a participation incentive.

Figure 2: A question from the tournament

The MARS software allowed students to answer anonymously or provide a pseudonym which was displayed to the class on the leaderboard in place of their real names. Only the lecturer had access to the real names of students.

The students were given between thirty seconds to four minutes (based on difficulty) to answer each of the questions with a short break in-between questions where they were given the correct answer. Students were free to discuss the questions with their neighbours during the competition.

The MARS system collected student answers throughout the tournament, automatically tallying up correct answers and generating a leaderboard. After the tournament, the response data was exported from the MARS application as a .csv file. This data included the username, selected answer and the time of response for each participating student.

A non-compulsory survey was posted on the unit's learning management system, Moodle, at the end of semester with the chance to win one of ten $25 gift vouchers for participation. This survey consisted of 49 questions including a combination of multiple choice answer, Likert scale and free response questions (see appendix). These questions were based upon work by Richardson et. al (2015). The survey was delivered through Google Forms and students were made aware that it was both optional and anonymous. In total, 94 responses were collected from this unit – a response rate of 20%.

Once the various data sets (tournament, survey and exam results) were available, a spreadsheet was created to combine the information. The data was then manipulated and visualised using NodeJS (a programming environment similar to Python) and D3.JS (a data visualisation library).

Results and Discussion

Correlation with Exam Marks

Due to extraneous variables such as intrinsic student motivation and ability, it is difficult to measure the precise impact and causal linkage between the intervention and student learning. However, there was a statistically significant ($p < 0.00001$) difference of 9.9 marks between the 207 students who participated in the tournament (mean final exam mark of 65.0) and the 262 who did not (mean exam mark of 55.1).
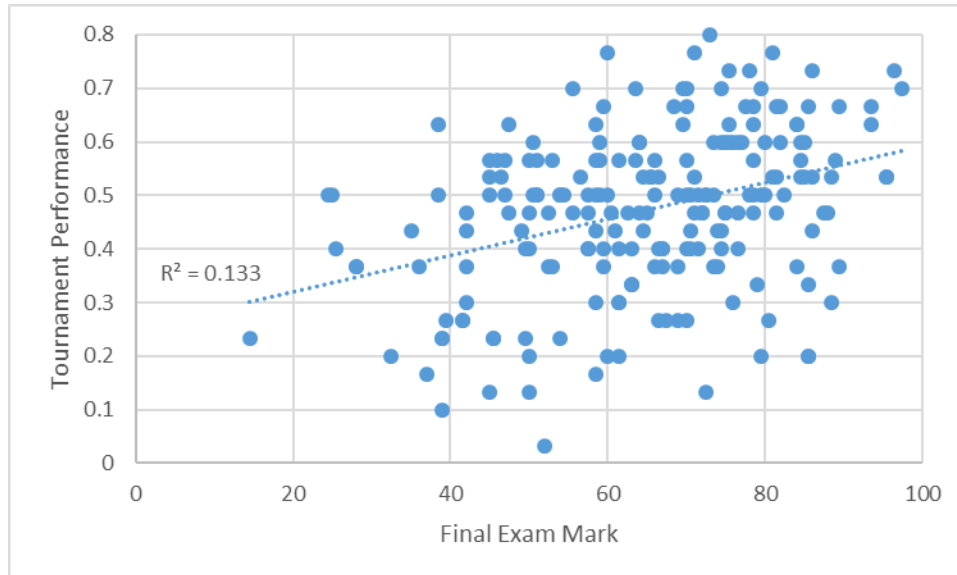
Figure 3: Exam Performance vs. Tournament Performance

Individual performance in the tournament was only loosely positively correlated with exam performance (Figure 3). Students were unlikely to have begun their revision for the unit at the time of the tournament and, given that the revision period is often where students exert the most effort, it could be argued that performance in the tournament was more of an indicator of natural ability. This would highlight the importance of other factors such as revision in the weeks before exams.

The weak correlation between tournament performance and exam marks may be worth highlighting to students as, for at least one student, this appeared to be a point of frustration expressed in the qualitative survey:

> "There was too much of a time rush, the MARS revision tournament actually decreased my confidence in this unit …"

This is clearly an undesired outcome and it is important for instructors to emphasise that performing poorly in the tournament does not forecast poor exam results. In fact, one student who placed among the bottom thirteen students of the tournament outperformed 94% of the cohort with a final exam mark of 85.5. The emphasis to students should rather be that the purpose of the tournament is to highlight areas requiring extra attention during revision.

Student Perception

The survey data showed that students tended to enjoy the tournament (Figure 4). In the free response section one student wrote "Absolutely awesome. The cash prize took it from good to amazing." while another student wrote "It was great! A very clever idea." However, students appeared to gain the most value from being able to highlight areas of study that needed attention (Figure 5).
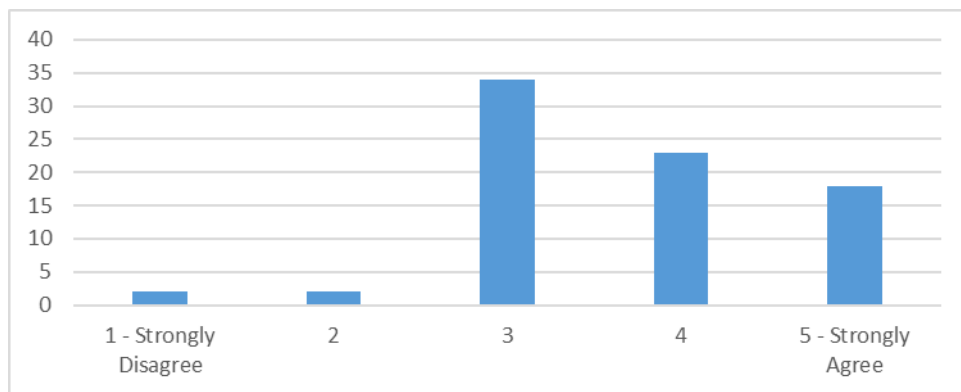


Figure 4: "I enjoyed participating in the end-of-semester revision tournament" - Student responses from survey
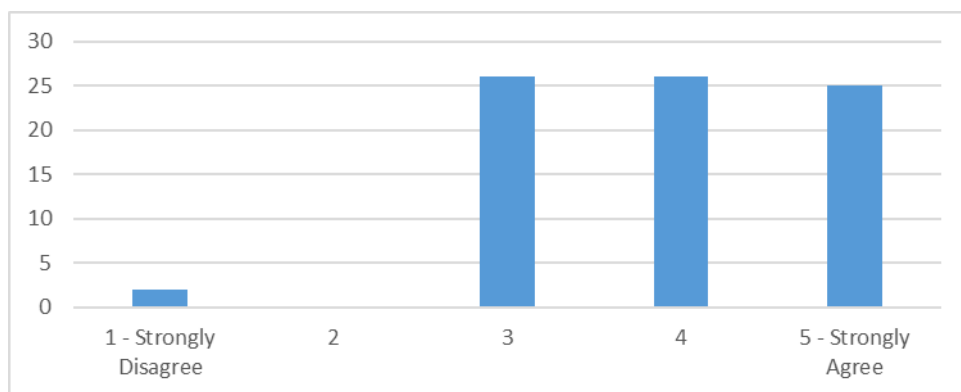
Figure 5: "The tournament helped to highlight the areas I needed to revise more" - Student responses from survey

These results were further supported by the large number of students who felt it would be worthwhile conducting revision tournaments in other units (Figure 6).
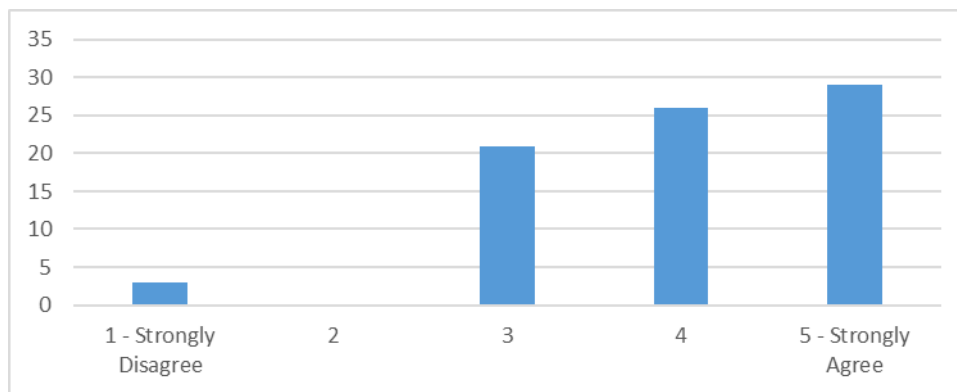

Figure 6: "I would recommend that other units run a revision tournament" - Student responses from survey

Students also appeared to appreciate the anonymity aspect with most students answering positively to the question "Other students could not see my answers, which encouraged me to be an active participant in the class". This supports research by Bojinova and Oigara (2013).

Gender and Competition

Among others, Niederle and Vesterlund (2007) have argued that females are generally less excited by competition compared to males. As such, it was deemed important to gain an understanding of the perception of the tournament amongst female students. Surprisingly, females actually appeared to enjoy the tournament marginally more than males as can be seen from the slightly stronger skew towards 'Strongly Agree' in the female sample in Figure 7.
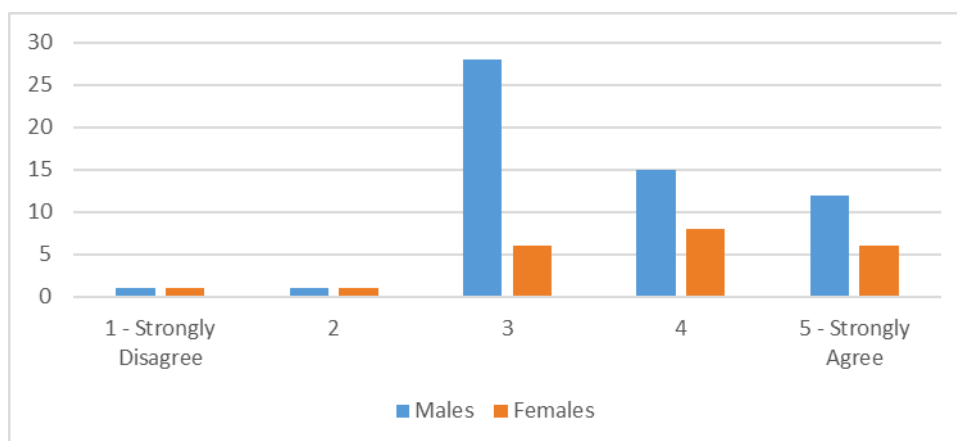
Figure 7: "I enjoyed participating in the end-of-semester revision tournament" - Student responses from survey

While the sentiment amongst both males and females was largely positive, clearly the number of female students who took part in both the tournament and survey was quite small and therefore may not be a representative sample. Additionally, even amongst the smaller female sample, there were two students who did not enjoy the tournament – the same number of males who did not enjoy the tournament. Given that the male sample was much larger, this may indicate that females' opinions on the tournament were more polarised (i.e. a

larger spread) while male opinions were more tightly focused around the mid-high end of the scale.

International Student Perspective

Research from Andrade (2006) found that international students often face unique challenges in English speaking universities. In particular, language difficulties amongst international students in Australian universities was found by Sawir (2005) to be preventing students from taking a proactive role in the classroom. As such, it is important to assess the impact any new classroom intervention has on this demographic.

While the sample size is, once again, quite small, the data did appear to show a trend towards people who speak English as a second language being more likely to endorse running tournaments in other units (Figure 8). It was also found that international students were more likely to recommend lecturers continue to use the MARS software as an audience response system in their lectures. These findings may suggest that students who speak English as a second language appreciate audience response systems to a greater degree due to the fact that the questions are written, not spoken, providing the students with a 'cognitive break' from listening to a non-native language.
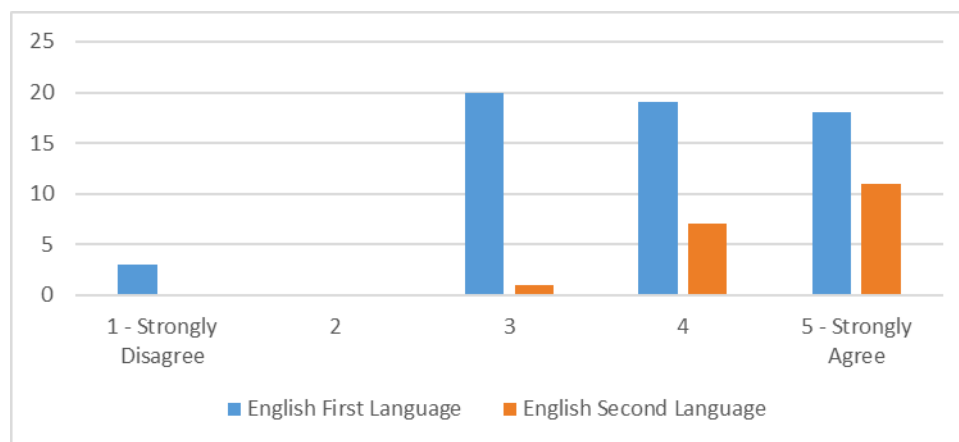

Figure 8: "I would recommend that other units run a revision tournament" - Student responses from survey

Reasons for Participating

Finally, in order to understand students' motivation for participating in the tournament, we asked students why they decided to take part. The survey showed that most students decided to participate to help them revise for the exam with 92% of students citing this as a reason they participated. The second most common reason for participating was for the prospect of competition amongst classmates with 57% of students citing this as a reason for their participation.

Conclusion

It is perhaps possible that some general guidelines for running tournaments in large classes can be inferred from this research. In order to concretize these insights, we propose four 'Rules of Engagement' which may be of use for educators conducting real-time tournaments of this nature:

1. Try to ensure that students feel safe from humiliation or embarrassment by keeping the tournament optional and keeping results anonymous. We found that students appreciated the anonymity afforded to them by the system.

2. Encourage a light-hearted, playful environment by, for example, offering prizes, allowing students to create pseudonyms and keeping marks (that count towards the unit) out of the competition. This appeared to appeal to a number of students.

3. Provide students with questions through lecture slides rather than vocally as this may ease the cognitive load for students who are non-native English speakers.

4. Reinforce to students that their performance in the tournament will likely be less reflective of how well they will do in the exam than other factors such as effort spent revising.

The tournament appeared to be an engaging and effective tool for students in their revision with most students stating that they would like (or strongly like) to see other units adopt the practice.

References

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Acknowledgements

Appendix

1. **My gender is: ***
   Mark only one oval.

   ⬭ Female

   ⬭ Male

   ⬭ Trans*

2. **English is my native language ***
   Mark only one oval.

   ⬭ True

   ⬭ False

3. **In which unit(s) did you use MARS? ***
   Tick all that apply.

   ☐ ENG1002

   ☐ ENG1003

   ☐ ENG1060

   ☐ MTE3542

   ☐ FIT1004

   ☐ FIT1047

   ☐ FIT2077

   ☐ FIT9132

   ☐ MED1011

   ☐ MED3051

   ☐ Other: ....

4. **Using MARS in lectures wasted too much time ***
   Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

5. **I would recommend that the lecturer(s) continue to use MARS ***
   Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	⬭	⬭	⬭	⬭	⬭	Strongly Agree

6. **The use of MARS helped increase the lectures' overall value** *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

7. **MARS use in my units motivated me to learn** *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

8. **I found this method of interaction between students and lecturer(s) effective** *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

9. **MARS helped me get instant feedback on what I knew and didn't know** *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

10. **The use of MARS helped increase my awareness of my peers' opinions and attitudes** *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

11. **MARS allowed me to better understand key concepts** *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

12. **My lecturer(s) used the results from MARS questions to gauge class understanding and reinforce material that was not understood ***

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

13. **Using MARS questions enhanced my learning of the subject ***

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

14. **I believe that MARS provided me with more control over my learning than in units that do not use MARS ***

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

15. **Using MARS helped me think more deeply about course materials ***

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

16. **I often voted for the right answer without really understanding ***

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

17. **Using MARS made me more confident to participate in lectures ***

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

18. **I used MARS most times when it was used in lectures** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

19. **MARS increased the frequency of my direct participation in the unit** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

20. **The use of MARS helped me to be active in lectures** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

21. **Using MARS helped me pay more attention in lectures** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

22. **Using MARS has helped my concentration levels** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

23. **Using MARS has encouraged me to attend lectures** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

24. **For me MARS was too difficult to use** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

25. **It was too hard to know what was expected of me using MARS** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

26. **There were too many technological problems using MARS** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

27. **Using MARS has increased my enjoyment of lectures** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

28. **Other students could not see my answers, which encouraged me to be an active participant in the class** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

29. **I was distracted from lectures after using my device in lectures** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

30. **I was distracted by other people using their devices in lectures** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

31. **I didn't like using my device to vote** *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

32. **I would like to receive credit for the correct responses chosen while using MARS** *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

33. **I believe that participation in the voting using MARS should contribute towards grades in my units** *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

34. **Registering to use MARS was too much hassle for me** *

Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

35. **Did you receive participation marks for MARS usage in any of your subjects?** *

Mark only one oval.

◯ Yes   *After the last question in this section, skip to question 37.*

◯ No   *After the last question in this section, stop filling in this form.*

36. **If you have any other comments that you would like to make about MARS, please write them below.**

....

....

....

....

....

Stop filling out this form.

Participation marks

You've indicated that one of your units assigned participation marks for MARS usage.

37. **Would you have used MARS if participation marks were not assigned?** *
    Mark only one oval.

    ◯ Yes

    ◯ No

38. **When you chose to vote in a MARS question, what were your reasons for participating? (Select all that apply)** *
    Tick all that apply.

    ☐ To receive participation marks

    ☐ To test my understanding of the subject matter

    ☐ It was a small effort to do so

    ☐ Other: ....

39. **When you did NOT vote in a MARS question, what were your reasons for not participating? (Select all that apply)** *
    Tick all that apply.

    ☐ I was unable to access MARS

    ☐ I was afraid to get the answer wrong

    ☐ It was too much effort

    ☐ I was not receiving participation marks that week

    ☐ Not applicable, I answered all MARS questions that I could.

    ☐ Other: ....

40. **Did you use MARS in ENG1002?** *
    Mark only one oval.

    ◯ Yes   *Skip to question 41.*

    ◯ No   *Stop filling out this form.*

Stop filling out this form.

MARS in ENG1002
These question relate specifically to the use of MARS in ENG1002

41. **Did you use MARS in the weeks that did NOT count towards your participation mark?** *
    Mark only one oval.

    ◯ Yes

    ◯ No

42. **Why? (Select all that apply)** *
    Tick all that apply.

    ☐ I couldn't keep track of what weeks I was supposed to use MARS, so I just answered to be safe

    ☐ I believe using MARS was beneficial to my learning regardless of whether I received participation marks or not

    ☐ I do not believe MARS is beneficial to my learning

    ☐ I was only using MARS to receive the participation marks

    ☐ Other: ....

43. **Did you participate in the "revision tournament" in the Week 12 lecture?** *
    Mark only one oval.

    ◯ Yes   *After the last question in this section, skip to question 45.*
    ◯ No

44. **Why? (Select all that apply)** *
    Tick all that apply.

    ☐ There was a prize for the winner!

    ☐ I thought it would be useful to help me revise for the final exam

    ☐ I thought it would be fun to compete against my class mates

    ☐ I did not think it would be useful to help me revise for the final exam

    ☐ I did not have my device/technological problems stopped me from participating

    ☐ I had higher priority things to do

    ☐ Other: ....

Stop filling out this form.

ENG1002 Revision tournament

45. **I enjoyed participating in the end-of-semester revision tournament** *
    Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

46. **I enjoyed competing against my peers in the revision tournament** *
    Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

47. **The tournament helped to highlight the areas I needed to revise more** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

48. **I would recommend that other units run a "revision tournament"** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

49. **If you have any other comments that you would like to make about the revision tournament, please write them below.**

....

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