Poster presentations as an approach to implementing a ‘flipped learning’ pedagogy in introductory physics

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Abstract. ‘Flipped learning’ or ‘flipped classroom’ pedagogies are gaining prominence in undergraduate science learning [1]. With the growing access to information through the internet, the traditional model of the teacher as the only facilitator of knowledge has become inadequate [2]. Lage et al. [3] consider the key purpose of the flipped classroom to be to shift the focus from rote learning to the students’ application of conceptual understanding. This presentation reports on a class group activity using poster presentations as a flipped classroom teaching medium. Poster presentations, a popular technique of displaying research at conferences, are being used increasingly as a teaching method [4]. In their teaching of mathematics, Denson [5] suggests that poster sessions are beneficial in that the preparation thereof promotes learning, it is an excellent alternative medium for developing communication skills, it encourages students to investigate a topic thoroughly, it provides opportunities for peer-learning and promotes a positive attitude in students. In this work, prior to making the posters, each student would submit a chapter summary before the topic was discussed in class. For the execution of the poster presentations, students were placed in smaller groups of three to four students to make group posters. When they presented their poster, it was in a smaller venue with another group of three to four students who would serve as their audience and a facilitator who would record the presentation. Hereafter the audience would present their poster, and the previous group who had presented would become the audience. The video recordings of the presentations were then embedded onto the University online learning facility via Google drive with the restriction that only those six to eight students were allowed to view, and review for peer assessment. To conclude the activity and to assess their understanding of the material students’ were required to complete an online multiple choice quiz. Nichols et al. [6] in their paper on using video in nursing education says that, depending upon the use intended by the instructor, a video may be able to tap all three domains of learning: cognitive, affective, and psychomotor. The purpose of the video recording of the presentation in this work is to provide the students with the opportunity to reflect on their presentation skills and to possibly use the video recording as a useful study aid. This presentation will discuss the extent to which this poster presentation intervention served as a means to assist students in improving their presentation skills, understanding the course content and becoming better, skilled communicators of course-related material/physics concepts.

1. Introduction

The flipped classroom is an innovative and widespread instructional model, where activities traditionally conducted in the classroom become home activities, and activities formally classified as homework become classroom activities [1, 11]. As information through the internet becomes more accessible the
role of the teacher would need to adapt accordingly [2, 3]. Using a flipped classroom the student becomes responsible for their own development of learning [12]. Therefore the purpose of the lecture period becomes an opportunity for the lecturer to engage with students in the form of discussion, groups exercises executed on whiteboards and exercises for solving problems proposed by the students [11]. The flipped classroom has been extensively utilized, and the advantages, from a broad spectrum of authors, have been summarized by Akçayır et al. [11]. In terms of learner outcomes, Akçayır [11] listed the frequency of outcomes by researchers from most to least found to be improvement in learning performance, satisfaction, engagement, motivation, increasing knowledge, improving critical thinking skills, feeling more confident, promotes creativity, focus on problem-solving, better retention, improves application, and information and communications technology, ICT skills.

At the University of the Western Cape (UWC), a South African University, a strategic plan for learning-and-teaching was established to ensure graduates from UWC would be more employable and possess a set of graduate attributes on the completion of their studies. These attributes are qualities, attitudes, and characteristics graduates should have and can be found in the Charter of Graduate Attributes, UWC, November 2009 [8].

This study was undertaken in an Extended Curriculum Programme (ECP), a programme designed to provide extra learning-and-teaching support over four years (instead of the norm three years) to prepare underprepared students from disadvantaged backgrounds. For the physics module of the ECP, it is divided into two full-year courses, Physics 151 (first-year component and focus of this study) and Physics 152 (second-year component). These two components have the same content to the mainstream physics component (duration of one year), but with a heavy emphasis on interactive engagement and group work.

In this study, two of the overarching skills and abilities are introduced and embedded for students in the first year of the ECP course as a class group activity. The first of the two skills explored in this work is for our graduates to be autonomous and collaborative: UWC graduates should be able to work independently and in collaboration with others, in a way that is informed by openness, curiosity and a desire to meet new challenges. The second skill is to become skilled communicators as reiterated by the Charter, "UWC graduates should recognise and value communication as a tool for negotiating and creating new understanding, interacting with diverse others, and furthering their own learning." These will all be experienced in the research activity by presenting physics concepts to their peers via posters through video. There are many benefits to using posters; the preparation thereof promotes learning, it is an excellent alternative medium for developing communication skills, it encourages students to investigate a topic thoroughly, it provides opportunities for peer-learning and promotes a positive attitude in students and self-development [5].

In this work, prior to the start of the poster creation, each student would submit a chapter summary (related to physics concepts), before the topic was discussed in class. For the implementation of the poster presentations, students were placed in smaller groups (3-4) to design and further develop their group posters. When they presented their poster, it was in a smaller venue with a group of similar size which would serve as their audience and a facilitator who would record the presentation using an android mobile device.

The intention of this research study is to evaluate if the preparation of chapter summaries, group poster preparation, and the presentation thereof is a “good fit” as a learning-and-teaching tool which could serve as a good flipped classroom medium, to assess the effectiveness of student poster presentations on their communication and understanding of physics concepts. The study involves each student producing a chapter summary, in their class groups together to produce a poster of the most important ideas in the theory chapter, the group presentation of the poster, peer assessment of the poster presentation, and concluding online quiz utilizing the institutional LMS, branded, iKamva.

When using student video recordings, Nichols et al. [6] in their paper on using video in nursing education says that, depending upon the use envisioned by the instructor, it may be able to tap all three domains of learning: cognitive, affective, and psychomotor. Barry et al. [7] looked at how to develop a protocol for video recording student group oral presentations, for later viewing and self-assessment by
student group members. Their investigations revealed that watching the video of their group presentation was an effective method of feedback and could improve both group and individual performance in the future [7]. The purpose of the video recording of the presentation in this work is to provide the students with the opportunity to reflect on their presentation skills and to possibly use the video recording as a useful study aid. The work presented in this paper discusses the extent to which the poster presentation intervention served as a means to assist students in improving their presentation skills, understanding the course content and becoming better, skilled communicators of course-related material/physics concepts.

2. Method

The poster presentations by video were done in the first semester by students in the physics ECP. Physics 151 in 2018 consists of 119 of which 85% of students have agreed to the authors’ reporting of the outcome of this study. The poster presentations covered the first five chapters of the course work, namely, i) About Science; ii) Atomic Nature of Matter; iii) Models of the Atom; iv) Radioactivity, and v) Fission and Fusion.

2.1 Chapter Summary/ Mind map

The students were asked to produce a chapter summary before the lecturer covered the course content with the specific instruction to draw out what they felt was important. Concurrently, the ECP students would have learned how to construct mind maps in their introduction to science course and were given the option to replace the summary with a mind map. This instruction intended to encourage students to come prepared to class before the lecturing team starts with the relevant chapter, in order to deal with any misconceptions that may arise during the lecture period, so that these could be addressed.

2.2 Poster assembly and presentation

For each poster presentation, each group of students was provided with a white A0 poster paper, an assortment of coloured A4 sheets of paper and glue stick. A pair of scissors was given to students to use and would have to be returned to the department after the activity.

2.3 Poster presentation recording and uploading iKamva

For the presentations of the posters, students in groups of 3-4 students presented their poster, in a smaller venue with a group of similar size. The second group served as their audience and a facilitator who recorded the presentation using a mobile device. The facilitators used for this study were volunteers and students who completed physics 151 the previous year, 2017. For the recording of the presentations, facilitators stored the recorded videos onto secure digital cards. The student poster presentation videos were uploaded onto Google Drive by the course teaching assistants, which in turn was hyperlinked and/or embedded onto the LMS within the lessons tool of the Physics 151 online environment - See figure 1 for illustration.
The lessons tool, which was recently termed as “online assessment compatriots” from van de Heyde & Siebrits [14] is an eTool that “allows for the incorporation of a range of multimedia resources…, activities…and assessments (e.g., test and quizzes, assignments) on a single streamlined page in a chronological order, which can guide and even improve students’ learning processes”. In addition, an added benefit of this eTool is the ability to link with external Learning Tools Interoperability (LTI) tools, as in our case Google Drive.

2.4 Poster presentation viewing and assessment

The rubrics used in the peer assessment was created using a Google sheet template created by Alice Keeler [10]. The educational Cloud-based add-on tool, termed, Doctopus is an extension that collaboratively works with the Google Office Suite (Docs and Sheets) to assist and guide a teaching team, and allows the user to send numerous Google Drive files to students using a generic template file. The rubrics were distributed by Doctopus (educational add-on), which works in conjunction with Google Sheets. When a student completed a peer assessment they would assess their peer for each category and the corresponding selection would be highlighted, as illustrated in figure 2. The students’ final result would be an average of the peer assessments.

2.5 Online Quizzes

The administered online quizzes were used in conjunction with an “online e-assessment type…called the question pool (digital repository or question bank)” which is also used extensively in the Physics and Astronomy Department at UWC [14]. The added benefit of using the question pool is the ability to randomly draw questions, “which will give each student a different set of questions (with the same or a different difficulty level)” [14]. The purpose of the quiz was to get a quick measure of the students understanding of each of the theory chapters.
### Figure 2: Student poster presentation peer assessment rubric

| Category | Acceptable | Good | Problem | Public Criteria | Weight | Score |
|----------|------------|------|---------|----------------|--------|-------|
| Introduction to research | 25% | 50% | 75% | 100% | 1 | 2 |
| The organization of the research | 25% | 50% | 75% | 100% | 1 | 2 |
| Supporting ads | 25% | 50% | 75% | 100% | 1 | 2 |
| Use of notes and visual aids | 25% | 50% | 75% | 100% | 1 | 2 |
| Audience | 25% | 50% | 75% | 100% | 1 | 2 |
| Audience | 25% | 50% | 75% | 100% | 1 | 2 |

**Score:** 66.67%
3. Results and Discussion

3.1. Chapter Summaries

The summaries of the chapters were assessed by their respective teaching assistant, TA who gave students an impression mark for their attempts. The results indicate that 64% of students received above 50% for their summaries and 23% received above 80%. However, when the data is further separated, it showed that the third and fourth posters had very few submissions. When probing the students, what surfaces is that they saw very little value in doing the summaries before the chapter was discussed in class. Remarks such as; “we would prefer if and it would be easier if we received the lecturer’s slides first”. At this stage in these students education, most of them would be are more familiar with rote learning where the teacher disseminates what is important, and therefore it can be expected that there would be resistance for them to take on a different style of teaching. This would be in agreement with the findings by Chen et al. [12] and included among the list of the challenges experienced using a flipped classroom [11], i.e. the students’ resistance to change, students do not prefer it and that students find it time-consuming.

3.2. Poster Presentations and Online Assessments

For the poster presentations, 92% of students received an average above 60% for the four poster presentations. The final stage of assessment was the online quiz. For the four quizzes given, 66% of students received below 50% for the quizzes. On further investigation into the quiz results, per category and as a whole, the quizzes were very poorly attempted. This ranged from 24%-47% of the students not attempting the quizzes. If we removed the lack of attempts, then the class received for each quiz above 52%. On probing students why they did not complete the quizzes, many said they did not know where to find it online (even though iKamva student training was given, as well as an online demo test, which was completed by all) and similar difficulty was experienced when trying to have students complete the peer assessment rubrics online. See figure 3 for an illustration of students’ poster presentations focusing on the topics, Atomic Nature of Matter and Fission and Fusion.

![Figure 3: Illustration of students’ poster presentations discussing the topics Atomic Nature of Matter and Fission and Fusion.](image)

3.3. Paper-based questionnaires

For the paper-based questionnaires, the questions and results are found in table 1. The outcome of this feedback allows for improvement in this class activity. Feedback to question 4 included complaints that the rubric was not marked fairly or just never returned to them, the teaching team intend to implement measures that to ensure that students fulfilled their roles of assessors more diligently. One measure would be to enforce a “no peer assessment no mark” rule. In light of the responses to questions 8-10, a strategic plan for the following year would be to communicate and implement an improved weighting and significance of the work in terms of the course work.

Future implementations of this work could include monitoring whether or not a student fulfilled the prerequisites (denoted by a star within LMS) imposed by the lecturing team, which can be done using the Lessons tool. Recently, van de Heyde & Siebrits put this idea in practice; where students had to
“comply with the prerequisites (watching videos and playing with the interactive…simulation)” [14] in order to take the online quiz. They further continued to state that, “[by] allowing the students to participate directly with the simulation, it allows them to manipulate the parameters [thus] granting [the] students control over their learning process[es]” [14]. In our experience, these students are very marks driven, and therefore perhaps the significance of the flipped pedagogy could be illustrated in terms of “marks” for example the total class activity mark be made up of summary 60% + presentation 30% + quiz 10%. Other measures the authors are considering are to explore methods of how to improve this experience, how to automate the feedback through the iKamva, by providing feedback per category and sending weekly reminders to students when they have not completed their assessments.

Table 1: Breakdown of paper-based questions distributed to students, with a related summary for each question.

| Questions                                                                 | Summary                                                                                                                                 |
|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| 1. When you were first given the instruction to put together a poster presentation with your group members, what were your initial thoughts? | Initially many of the students were not very receptive. They were fearful of the effects this would have on their grades and some were anxious about working with people they had just met. |
| 2. Was it easy or challenging working with your group members to put together a poster? If you found it to be challenging could you give an example of when or what was challenging? | ~50% of students found it easy to work on poster with members. The workload was divided equally amongst members, started immediately, and met frequently. The other half, found it challenging due to lack of communication (discussions only done during lecture time or via WhatsApp), doing the poster on day of presentation, group dynamics, language barriers, and social factors, which led incoherence amongst members, leading to one member completing the poster. In conclusion, all students agreed that the poster presentations became easier as time progressed. |
| 3. When making the poster and discussing the content with your classmates, did it help you understand the course content better? | Majority of students found that discussing the poster content helped them in their course work. Completion of poster by students was summarisation of theory content, and to grasp the work they presented. Furthermore by listening to their peers from other groups, gave them a fresh perspective of the numerous theory topics. Four students were undecided, as they felt it only helped a bit. Eleven students thought that the poster did not help them understand the course work. However, these correlated with the groups that did not work well together. |
| 4. Did the rubric assist in improving your presentation style?           | Eleven students thought that the rubric did not help them improve their presentation style. There were complaints that the rubric was not marked fairly or just never returned to them. The rest of the students found the rubrics very helpful. It gave them an insight into what they need to focus on, what they needed to improve and what areas they were excelling at. |
| 5. Did watching the video recording of your presentation help you to improve your presentations thereafter? | Majority of the students thought that the videos helped them immensely with improving their presentation style. Students were able to see their mistakes. Examples given from two students were not speaking loud enough and turning their backs to the audience. The fact that they unwittingly stared down at their notes instead of looking at the audience. By watching the videos afterwards, they were able to isolate their mistakes and improve for the following presentation. Ten students thought that watching the videos did not help their presentation style. Some simply did not watch the videos afterwards. |
| 6. Do you see the value in learning how to do a good poster presentation? | The majority of students saw the value in learning about good poster presentations. The presentations helped them remember their work, how to work in a team and how to work effectively in a short time period. Four students did not see the value. One student did not see the value because they think after the 1st year you only do PowerPoint presentations |
| 7. Who was your facilitator and was he/she able to run the poster presentation session well? | Students were very pleased with the facilitators they had for presentations. Students think that tutors ran the poster presentations very well. They said that the tutors were calm, patient, reassured students, and understanding. They gave students extra time if they were nervous or stuck. Students were happy that tutors kept order in the presentation sessions and made the surroundings comfortable. A minor group of students was unhappy that tutors asked questions after the poster presentations. |
8. Would you consider the grading received from your peers for your presentation to be fair? If you found it not to be fair, please elaborate?

| Thirteen students were unhappy about the grading they received for their presentations and felt that it was unfair. They got the sense that their videos were never watched and that the marker just gave marks haphazardly. A few only got an overall mark and could not distinguish between the gained and lost marks. The majority found their marks to be fair and an accurate representation of their poster presentation skills. |

9. How would you improve this experience?

| Students think that the experience can be improved by having lecturers present so that students can take it seriously. Students do not want to speak in front of a camera, want more time to prepare, and do PowerPoint presentations (instead of paper posters) to improve their overall skills set. Furthermore, they want the evaluation to be done by the lecturing team. |

10. Do you have any other feedback for the team?

| Students would like stricter rules when it comes to their peers who do not participate. Additionally, students would like the poster to be given earlier. |

3.4 Quantitative Data: LMS, iKamva

The data retrieved from the institutional LMS is shown in figure 4 and 5. The institution’s LMS, “allows for the gathering of detailed statistical information regarding online course activity, engagement, and participation, making it a potent research database and analysis tool” [9]. Figure 4 displays the total site visits and Test and Quizzes attempts since the commencement of the project. Particularly, this stand-alone secondary quantitative data will highlight the visibility (logins) and engagement (submission of Test and Quizzes) of the students. Figure 4 displays the number of visits (more than one per day) and unique visits (just one login for the day) to the LMS by students for the duration of the project (February – May 2018).

\[
\begin{align*}
\sum \text{Unique \_ Visitors} &= 441 \\
\text{Unique \_ Visitors} &= 110 \\
\sum \text{Visits} &= 1923 \\
\text{Visits} &= 481 \\
\sum \text{TestSubmissions} &= 857 \\
\text{Test Submissions} &= 171
\end{align*}
\]

As seen from the bar chart, there is an increase in terms of visits for each month. Furthermore, Figure 4 in terms of site activity for students, specifically the utilisation of the Test and Quizzes eTool highlights a gradual increase from February – May 2018, which gave a total of 857 online test submissions, spanning across the five tests done online, averaging a total of 171 submissions per test. Figure 5 is a pie chart displaying the numerous eTools used on the platform for the duration of the project and it can be seen that the Test and Quizzes tool comprised of 12.4% (with 857, that coincides with the total of figure 4).

Figure 4: Bar charts displaying the number of visits and unique visits (on the left) and site activity for utilisation of Test & Quizzes (on the right).
4. Conclusion
From the results, it becomes apparent that students enjoyed the poster design and development and the presentation thereof. However, the quizzes and summaries activities were both poorly attempted and even more so as the semester progressed. The results did, however, show that most of those who completed the summary and poster also performed well in the quiz.

Future work of this activity will look into how the summaries can be better monitored and its value better communicated and emphasised. From the questionnaire, students were concerned that the peer assessment could be monitored better. The authors found the activity to provide opportunities for improvement and consider this to be a good starting point for a flipped medium pedagogy to be implemented in the course.

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