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**ASSESSMENT OF RUBRICS FOR HEALTH SCIENCE EDUCATION AT THE SCHOOL OF
MEDICINE AND HEALTH SCIENCES, UNIVERSITY OF PAPUA NEW GUINEA**

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Corresponding author. ruth.pape@cqumail.comSubmitted: February 2020; Accepted: March 2020***ABSTRACT**

This study carried out at the University of Papua New Guinea investigates undergraduate medical imaging science (MIS) students' perceptions of the usefulness of individualised feedback using a rubric. In the first semester of 2017, 15 fourth year students in the research proposal design course were assigned to an assessment rubric, which comprised a detailed description of how their work was to be graded. Students were instructed to submit an initial draft of their writing. Electronic feedback was then provided to support the revision process. The benefits of the rubric and feedback were evaluated at the end of the semester using a paper-based survey, which provided participating students with the opportunity to critically reflect on the learning experience. The majority (93.3%) of the students were satisfied that the feedback on their draft proposal assisted their understanding on research methodology concepts which informed their progress with respect to achieving the assessment learning outcomes. This study has demonstrated that the use of a rubric as a formative assessment tool has had a positive impact on students' learning experience. Reflection on the results of this study will lead to further refinement of the existing rubric and the development of others.

Keywords: assessment rubrics, formative assessment, summative assessment, effective feedback mechanism, medical imaging, Papua New Guinea

INTRODUCTION:**Effective Feedback Mechanisms in Higher Education:**

Feedback in higher education is an important aspect of enhancing student learning, and utilises various strategies; to improve academic

performance and achievement. The traditional form of feedback typically comprises written comments [1]. However, McCarthy [1] highlighted several problems associated with written feedback that are widely recognised in

higher education literature including the focus on mechanical aspects of the submission rather than concentrating on the core of the work; vague and inconsistency in the quality and quantity of feedback across markers, which should be managed by a moderation process. With universities moving to electronic marking as opposed to traditional handwritten feedback, issues with illegibility of written feedback has largely been negated.

In response to the problems associated with written feedback, McCarthy [1] outlined two main alternatives applicable to both summative and formative assessments. These are the use of audio and video feedback. Both audio feedback, as well as, other video-based learning techniques, has been demonstrated to have been successfully incorporated into teaching and learning in higher education [1]. McCarthy [1] noted advantages of using both the audio feedback and video feedback including both files providing a permanent record, which can be stored on a USB (Universal Serial Bus) flash drive or if written printed out and reviewed at the students' convenience.

Feedback can potentially be found in every aspect of a well-designed curriculum: through self-reflection in lectures, group discussions in tutorials, guided readings, interaction with staff, and assessment [2]. It is well-known that assessment is important to student learning in higher education, and that feedback is a

significant aspect of the assessment process in terms of elevating student performance and achievement [1-3]. Giving timely and effective feedback has been widely supported and recognised in higher education [1-4]. There are many advantages in giving fast, effective feedback to students to improve their learning in terms of both the formative (performance) and summative (achievement) assessment tasks. There are seven key conditions necessary for assessment to support student learning, which relate to feedback. Feedback must be given often enough, and in enough detail, to be truly formative; should focus on students' performance, not their characteristics; must be timely enough for students to have time to use it to improve their learning; should be appropriate in terms of what the assessment is actually designed to achieve; should relate to students' understanding of what they are supposed to be doing; must actually be received by the student; and should be acted upon by the student [2, 3]. Of these conditions, ensuring action by the student is usually out of the control of the academics.

Students should also make use of the feedback process to enhance their learning, rather than expecting the academic to provide all the answers. Brown and Race [4] highlighted four key strategies that can help students to make use of feedback. Of these four, the two most important include giving students marks only when they have tried working problems out

themselves thus, making use of feedback given on their work; and getting students to make judgments on their work, by filling in a short self-assessment questionnaire before they submit the work [4].

These authors [4] identified seven key approaches that can save staff time when assessing, however these tend to involve additional time and skill in the design process. Three of these are applicable to a small cohort of students and require prompt and efficient feedback to individual students, rather than inform a large cohort of students. They include the use of assignment return sheets, showing how marks link to learning outcomes, and enabling students to indicate the extent to which criteria have been achieved by completing the Likert scales. The scale ranging from “fully met” through “partly met” to “not yet met” and so on. This may also include the importance of providing model answers which demonstrate good answers, and explaining why they are good; and to incorporate elements of self and peer review, particularly formatively, so that students can measure the quality of work by applying criteria to each other’s and their own work [4].

Feedback can be of two types: formative and summative which are essentially based on the same concept. According to Naylor et al. [2] formative feedback is constructive and used to improve learning (and teaching); occurs during learning so students are able to act on it and is

not punitive, and enables students to advance their understanding through making mistakes then learning to correct or avoid them. Summative feedback is the final judgment on student achievement [2].

While there are good feedback practices promoted by higher education worldwide to enhance student learning (and teaching), it is also important to recognise the obstacles of feedback that may hinder students’ learning. For example, students should be provided with clear assessment criteria to guide their work (and therefore their learning); assessment criteria should be carefully designed to guide student learning and ensure they are being accurately assessed on how well they have mastered those learning outcomes [2, 5].

Other obstacles of feedback that academics should be aware of in higher education include the decrease in the level of motivation to learn by students’ due to sole focus on their final grades; students are strategic workers and if a piece of work is not assessed, they are often reluctant to engage it. By definition, formative results should never be a part of the final grade. If they do, they are not formative. As such, academics should be cautious about over-representing formative results in the final grade [2]. It is very important for teachers in higher education to minimise the obstacles of feedback in higher education, while incorporating good feedback practices in their curriculum to enhance student learning.

Significance of Assessment Rubrics in Higher Education:

Students in higher education can improve in a summative assessment task when provided with three main resources: a detailed, well-structured marking rubric (criteria); feedback through comments from both academics and their peers; and through the students' own self-reflection and self-assessment [1, 4, 6]. The role of formative assessment using rubrics, needs careful design and planning to ensure that: key learning outcomes are addressed; engagement in the tasks prompts the kind of learning most desired; the task is timed to ensure that there is an opportunity for students to benefit from the comments they receive; and that there is time within the semester to put their learning into practice in subsequent activities [6]. This important information in a formative assessment is best integrated into a well-structured rubric so that students can use it to enhance their performance as independent learners, rather than depending solely on their lecturers' comments.

Summative assessment task in higher education leads to the final grading to determine the overall success of the student. Summative assessment refers to "grades or marks that are collected and weighted within and across course units to provide an account of a learner's overall performance in a program of study" [6]. Summative assessments are given to students at the end of a set time

period, or at the end of the semester, to assess what has been learned and how well it was learned [1]. It can be utilised as assessment for learning if it is structured properly. McCarthy [1] noted the importance of rubrics used for summative assessment to determine a student's overall achievement. Rubrics include a set of standards, expectations or criteria, which can be provided to students before they start working on the assessment task so that they are aware of the key criteria and their subsequent weighting. Rubrics are also utilised by academics during the marking and feedback stages, leading to an objective final grade, by following the same criteria students used to complete the project [1].

Therefore, the three key components that should be included in a well-structured rubric as part of both formative and summative assessment include: the criteria; level of performance; and descriptor [7, 8]. Of the three key components, the level of performance determines the score, final grade or mark that reflects the summative assessment.

Formative Assessment Using Rubrics to Support Improved Learning:

The use of standard rubrics as a formative assessment tool has been widely used in higher education to enhance student learning and achievement. Lipnevich et al. [8] focus on the three feedback conditions using the exemplar and /or the rubric as a form of data collection to determine student performance in

their learning experience. They also pointed out the importance of providing effective formative feedback to improve undergraduate student writing performance. Another study by Strangman and Knowles [9] revealed significant improvements in three of the five learning outcomes before and after implementation of the new lesson evaluated using a grading rubric. Osterbur et al. [10] focused on student recall of electronic and handwritten feedback as a form of formative assessment. They noted that student consumption and recall of feedback are necessary preconditions of successful formative assessment. They also found that students who preferred or received handwritten feedback recalled more feedback (quantity), as compared to those who received electronic feedback with more accurate (quality) recall comments. Therefore, there is great value in a formative assessment using rubrics to support improved learning.

Our present study assesses the use of rubric and formative assessment of students in Medical Imaging Science (MIS) in University of Papua New Guinea (UPNG).

Research Problem and Aim of Study:

Currently there is no published study of the MIS program in UPNG that has examined potential benefits of using marking rubrics as a form of feedback for assessment of students. Therefore, to address this and other issues, a rubric was designed and implemented as a

formative assessment tool to achieve the learning outcome of the Research Proposal Design course. The final year MIS students used the formative assessment rubric as a form of feedback strategy to enhance their research proposal writing skills. Thus, the major objective of this research was to investigate students' perceptions of the usefulness of individualised feedback using a detailed marking rubric.

METHODOLOGY:

This study was carried out in the discipline of Medical Imaging Science in the SMHS UPNG. All the fourth year students registered for the "Research Proposal Design" course during semester one in 2017 academic year were eligible to participate in this research study. All the students consented to participate. As part of the course requirements, students were asked to write a research proposal demonstrating their basic understanding of research methodologies used to conduct research in the field of diagnostic radiography. Prior to the assignment, a lecture was delivered on research methods and proposal writing stages. Information provided in the assignment guidelines included a list of criteria delineated in an instructional rubric for the assignment, with detailed description of five performance levels [8].

Students were assigned to only one feedback condition: *Rubric*, in which students received a

detailed description of how their work would be graded, broken down by different levels of performance [7, 8]. Upon receiving feedback, each student was encouraged to use the materials to revise and resubmit their write up. As part of the procedure for the course, the students were told to submit their first draft of their writing on a specified date, and then course materials would be hand delivered to them to support the revision process. They were also given a specific date to submit their second draft. The mark allocated for the proposal was based on their revised submission. The score on the final proposal accounted for 10% of their overall grade in the course. Finally, the students were asked to provide written feedback through a survey on their perceptions of the benefit of the rubric. Participation in the survey was voluntary and all responses were anonymous.

Data collection and analysis:

Analysis of the results of the survey was by descriptive statistics [11] and thematic analysis [12, 13]. The responses of the participants' were also analysed using both quantitative and qualitative methods as part of mixed method approach [11] where both closed-ended and open-ended questions were asked.

Ethical considerations:

Ethical approval was granted by James Cook University Research Ethics Committee; approval number H7065.

RESULTS:

Of the 15 students enrolled in the Research Proposal Design course in semester one 2017 academic session, 11 (73.3%) were male and 4 (26.7%) were female students. The age range of all the students was 20-24 years. The survey response rate was 100%.

Rubric helpful in preparation for proposal writing task:

Eight students (53.3%) "Strongly agree" and five (33.3%) "Agree" that the rubric was helpful in their preparation for the proposal writing task (Figure 1).

Content and course learning outcome (CLO):

The majority (80.0%) of the students "Agree" that the content covered in the rubric supported the attainment of the CLO, with one student (6.6%) "Strongly agree" (Figure 2).

Feedback using rubric and student progress:

Eight students (53.3%) "Strongly agree" that feedback on their research proposal drafts using the rubric provided them with information about their progress with respect to achieving the CLO. Six students (40.0%) had slightly different perception and "Agree". One student (6.7%) "Strongly disagree" opposed the notion of feedback using rubric in enhancing research proposal writing skills (Figure 3).

Student consultation times and reviewing of assessment drafts using the rubric:

Four students (26.7%) strongly agree and six students (40.0%) agree with the time dedicated during individual consultation in using the rubric to review their proposal drafts. A small number of students (13.3%) indicated that the consultation times and the review of assessment drafts using the rubric was not sufficient, while another two students (13.3%) were uncertain with their responses neither agreeing nor disagreeing. Only one student (6.7%) indicated a negative perception towards consultation times and reviewing of assessment drafts using the rubric (Figure 4).

Feedback and final grading assisted students' understanding to perform better:

All but one of the students reported that feedback and final grading assisted their understanding to perform better. Six students (40.0%) strongly agreed that feedback and grading of their final research project proposal assisted their understanding of key concepts to perform better in future proposal writing tasks with eight students (53.3%) who provided a positive response and agreed (Figure 5).

Key advantages of the rubric and future resources to support students' learning in this course:

Other advantages of the rubric as well as future resources that might support students' learning in this course were highlighted as the main two themes by the students. They suggested that the logical arrangement of each of the contents, level of assessment, weightings and

the learning outcome in the rubric enabled them to focus and improve in their proposal writing task: *"The different content described for each part of the proposal within the rubric was very useful. This helped me to better improve my proposal writing"* (Student 1). *"The most useful aspects of the marking rubric are the detail content and the weightings of the rubric itself. These provide clear understanding as to how we are marked and which areas we need to improve on"* (Student 2). *"The marking rubric is useful because it helps me to achieve the learning outcome in line with the content so that I could satisfactorily complete my work"* (Student 3). *"The aspects that were most useful was having a wide range of areas under each level of assessment where the student can see where he/she can do much better by including many information under certain topics"* (Student 4).

When discussing effective feedback mechanism, students appreciated that the academic's feedback and highlighted areas in the rubric were given on time and assisted students to understand key concepts in writing research proposal: *"Feedback on my proposal drafts assisted my understanding of key concepts in research proposal writing"* (Student 5). *"The highlighted areas with description of what to write really help me to complete my proposal"* (Student 6). *"The timely feedback from the proposal using the rubric was useful to help me improve in future written tasks"*

(Student 7). “The other thing is the area that we need to improve on are also highlighted this is truly helpful” (Student 8).

Students were also given the opportunity to provide suggestions for future resources that might support their learning in this course. Few students stated that some exemplars of proposals and rubrics should be provided to them: “Provide past proposals and rubrics to students to better assist him/her to improve in their writing tasks” (Student 9). “Provide an example on how to use a rubric using past exemplars” (Student 10). “This is my first time to use a rubric, therefore I suggest past proposals should be provided with the rubric and explained earlier on how to use them” (Student 11).

Some students suggested that different sections of the research proposal, marking rubric and basic research writing skills should be taught in class apart from the Research Proposal Design course: “It is recommended that the coordinator should go through the marking rubric in class and explain as some students do not really understand the content of the paper instead of just giving it to students for reading” (Student 12). “We need to at least have few sessions on basic research writing and rubrics more to give us a good foundation of writing research following a standard way” (Student 13). “For more understanding, each rubric item should be given one at a time for each week as for more understanding of what is required for that specific component” (Student 14).

Figure 1: Helpfulness of rubric in preparation for proposal writing task

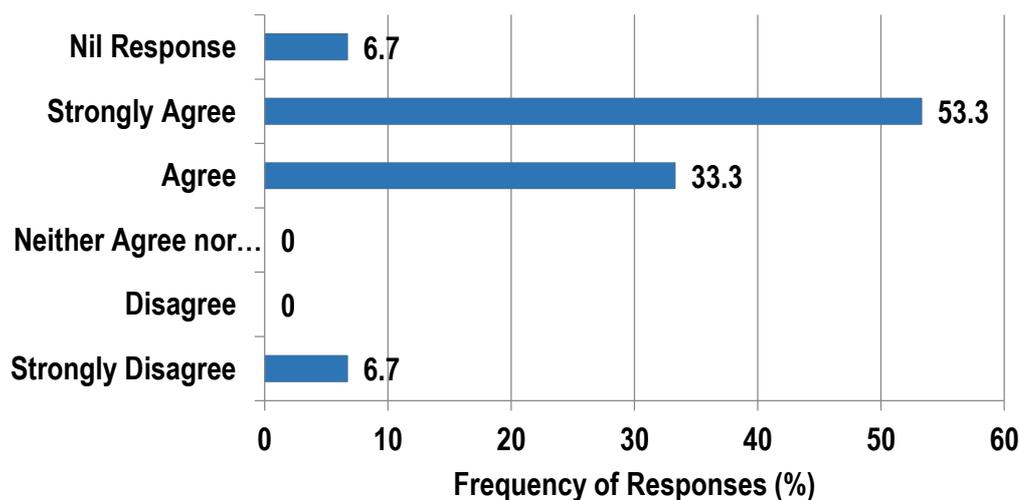


Figure 2: The rubric content supported the course learning outcomes

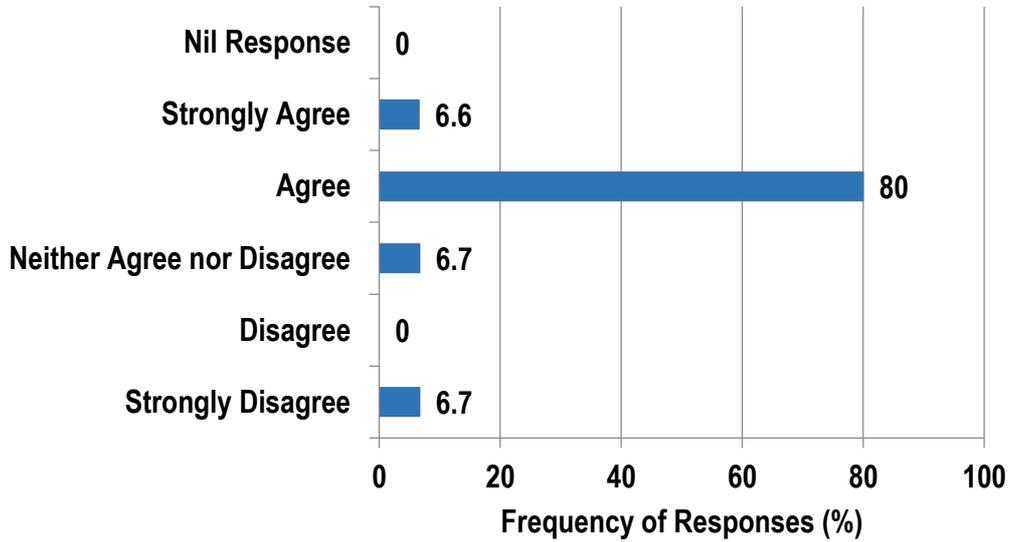


Figure 3: Feedback using rubric and supported students' progress

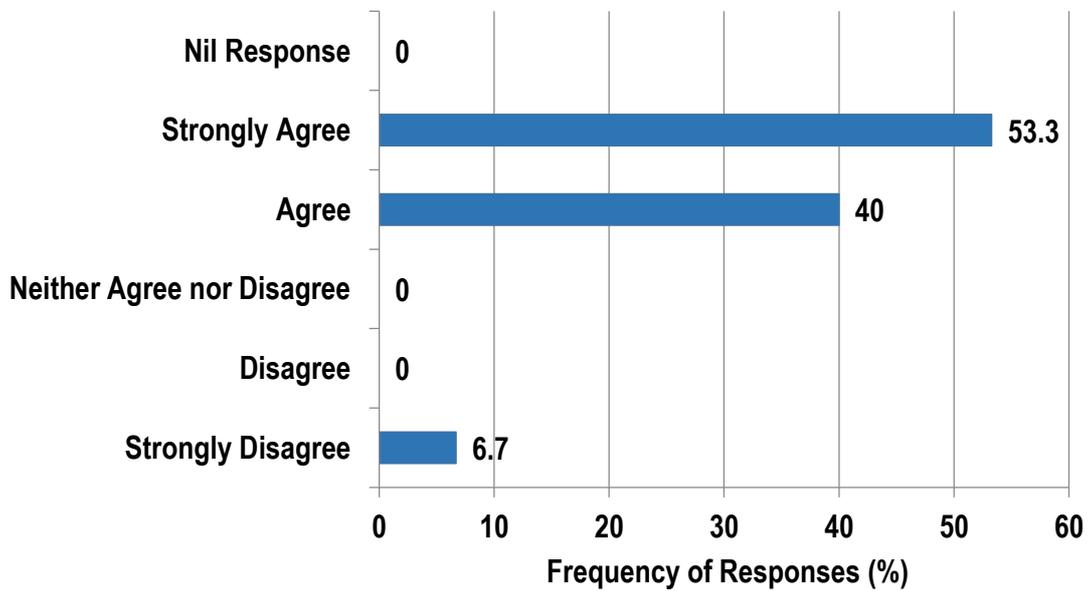


Figure 4: Student satisfaction with length of consultation times and reviewing of assessment drafts using the rubric

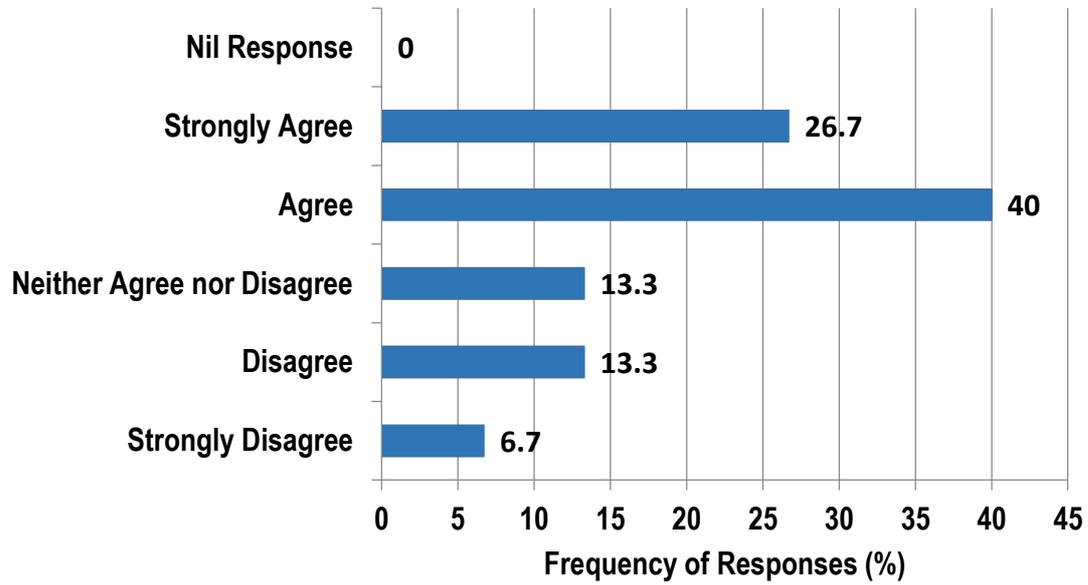
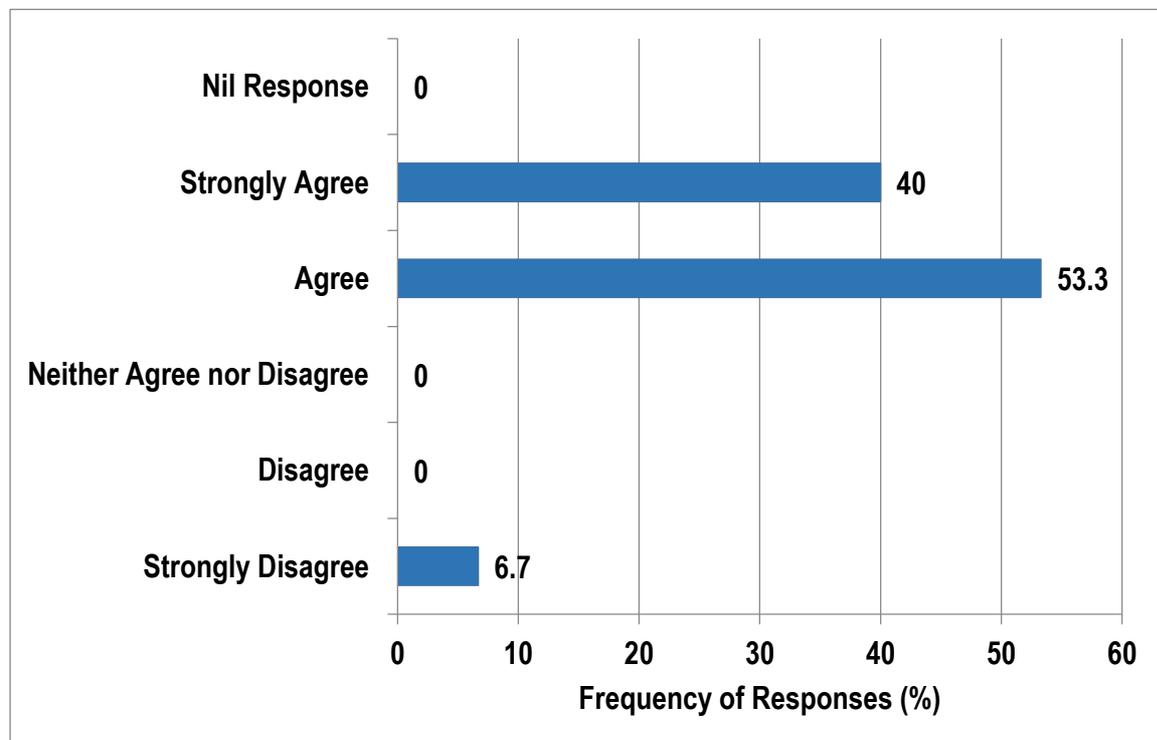


Figure 5: Feedback and final grading assisted student’s understanding to perform better



DISCUSSION:**Rubric helpful in preparation for proposal writing task:**

The majority (86.6%) of the students found the rubric to be very helpful in their preparation for the proposal writing task. The findings in this study are supported by a study by McCarthy [1] on students' learning experiences using three different feedback mechanisms and their assessment criteria. Any form of feedback mechanism should always be provided with an assessment rubric to assist students' understanding in preparation for any written task, and to further support students' in enhancing their learning in the specific assessment task.

Content and course learning outcome (CLO):

In terms of the alignment between the content and CLO, majority (80.0%) of the students responded positively that the content in the rubric supported the attainment of the CLO. This response is supported by Brown & Race [4] who noted seven key approaches that can save staff time when assessing, but tend to involve additional time and skill in the design process. One of these key approaches addresses the use of assignment return sheets with criteria, demonstrating the alignment between marks, content and learning outcome [4]. In support of Brown and Race's [4] statement, the researcher aligned the content

in the rubric criteria and CLO in reference with the UPNG Course Handbook [14].

Furthermore, the strong alignment between the content and the CLOs in the rubric reflects a constructivist approach in terms of emphasising student-centered, active learning strategies through project work, research-based learning, problem- and enquiry-based learning methods [15, 16]; and the integration of graduate attributes in terms of communication skills and critical thinking skills [17, 18]. Students were able to clearly link the content and the learning outcome with their marks, which provided a positive learning experience for them as a result.

Feedback using rubric and student progress:

The majority (93.3%) of the students were satisfied that feedback on their proposal drafts using the rubric provided them with information about their progress with respect to achieving CLOs. This positive response reflects the effectiveness of formative feedback by the academic to enhance students' learning as evidenced through higher education elsewhere [1-4, 8, 10]. Furthermore, students were provided timely feedback twice in a semester using the rubric for formative (draft revision) and summative (final grade) assessments. This approach in providing timely feedback using the rubric when the student needed it appears to have had positive impact on their experience.

Student consultation times and reviewing of assessment drafts using the rubric:

Students had varied reactions towards individual consultation times with the academic and the review of their assessment drafts using the rubric. Although, 66.7% of the students appreciated the time dedicated during individual consultation in using the rubric to review their proposal drafts, the others provided a negative response towards the consultation times.

Considering this response, the varying time frames associated with delivering timely feedback during individual consultation may not be applicable to these few students due to the teaching workload of staff [15, 19] and the students' enrolment in other courses within the program. Furthermore, some students may themselves have responded late to feedback from both the staff, and through their own self-reflection and self-assessment using the rubric [6]. Late responses to feedback by students may have a negative impact on their experience. However, it should be noted that the proposal writing task in the rubric was timed to ensure that there was an opportunity for students to benefit from the comments they receive; and that there was time within the semester to put their learning into practice in subsequent activities [1-4, 6].

Feedback and final grading assisted students' understanding to perform better:

At the end of the semester, most of the students were satisfied that feedback and final grading assisted their understanding to perform better. This final assessment process integrated summative assessments which were given to students at the end of a set time period, or at the end of the semester, to assess what has been learned and how well it was learned [1]. With respect to the assessment task being considered, the 93.3% of the students indicated that feedback and grading of their final research project proposal assisted their understanding of key concepts to perform better in future proposal writing tasks. This positive response reflects the commitment of staff towards utilising the assessment rubric during the marking and feedback stages, by following the same criteria students used to complete the project, leading to an objective final grade [1, 18].

Key advantages of the rubric and future resources to support students' learning in this course:

The key advantages of rubric use were related to the detailed format of the rubric in terms of the constructive alignment between the criteria, level of assessment, marks, CLOs, and the logical arrangement of each section and category of the proposal's subtitles, which enabled students to focus and improve in their proposal writing tasks. The positive response to the use of rubric reflects authentic assessment to promote student learning [4, 6, 9, 15, 20]. In

addition, a final key advantage related to timely feedback [1-4, 6] in terms of staff feedback, marks and highlighted areas, which assisted students' understanding of key concepts in research proposal writing tasks. The results of this study highlight significant advantages of rubric use and indicated that the detailed constructive alignment of content, CLO and grading in the assessment rubric, along with its timely delivery of feedback, can have a positive impact on students' experience within a course and their subsequent development as learners [1, 15].

Some students also suggested that past exemplars of proposals and rubrics should be provided in the future. This response is supported by Lipnevich et al. [8] who reported on the use of exemplars and detailed rubrics as formative assessment. Their results demonstrated that students who were provided with both rubrics and exemplars showed significant improvement in their writing performance. Considering this response, the authors aim to provide model answers which demonstrate good answers, and explain why they are good for the students [4]. It should also be noted that students were taught the concepts of proposal writing in class but were not formally instructed on the use of rubrics. Although, instructions were given to the students at the time of this study regarding the use of rubrics, they were not taught on how to use the different elements in a rubric

meticulously as it was a new learning assessment criteria tool; both for them as student and the researcher. Reflection on these assessment tasks over time and engaging further with the literature around marking tools/schemas will lead to the refinement of the existing rubric and the development of others.

CONCLUSION:

This study has demonstrated that the use of a rubric as a formative assessment tool has had a positive impact on MIS students' learning experience. In particular, the detailed format of the assessment rubric and the successful achievement of the learning outcomes with timely feedback have allowed students to have a positive learning experience in terms of improving their proposal writing task. In addition, most of the students were satisfied that feedback and final grading at the end of the semester assisted their understanding to perform better in this course.

Despite these positive learning experiences, the students had varied reactions towards consultation times with the staff in reviewing of their assessment drafts using the rubric. These varied reactions from the students may be due to other factors such as teaching workload of staff and the students' enrolment in other courses within the program, which are beyond the staff and the students' control.

Furthermore, although students emphasised the importance of using past exemplars of

proposals and rubrics, a comparative study in future could evaluate the effectiveness on students' performance by comparing those receiving rubrics and exemplars before working on their assignment to those who receive rubrics and exemplars after submitting revised versions of their draft. Reflection on the results of this study will lead to further refinement of the existing rubric and the development of others.

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REFERENCES:

1. McCarthy J. Evaluating written; audio and video feedback in higher education summative assessment tasks. *Issues in Ed Res.* 2015; 25 (2): 153-169. <http://www.iier25/mccarthy.html>.
2. Naylor R, Baik C, Asmar C, Watty K. Good feedback practices: prompts and guidelines for reviewing and enhancing feedback for students. Centre Study Higher Ed. The University of Melbourne. 2014:3-12. <http://www.cshe.unimelb.edu.au>.
3. Gibbs G, Simpson C. Conditions under which assessment supports students' learning. *Learn Teach Higher Ed.* 2004; 1 (1):3-31. http://www2.derby.ac.uk/ltanew/images/Documents/Assessment_for_learning/lathe_article_2004.pdf.
4. Brown S, Race P. Using effective assessment to promote learning. In Hunt L, Chalmers D, editors. *Textbook of University Teaching in Focus: A Learning-Centred Approach.* Camberwell, Victoria: ACER Press, 2012: 74-91.
5. Weaver MR. Do students value feedback? Student perceptions of tutors' written responses. *Assess Eval Higher Ed.* 2006; Vol.31(3):379-394. <http://dx.doi.org/10.1080/02602930500353061>.
6. Bearman M, Dawson P, Bond D, Hall M, Bennett S, Molloy E, Joughin G. Guide to the assessment design decisions framework.2014:1-8. <http://www.assessmentdecisions.org/guide>
7. Mueller J. Creating a rubric. 2017:1-8 <http://jonathan.mueller.faculty.noctrl.edu/toolbox/rubrics.htm>.
8. Lipnevich AA, McCallen LN, Miles KP, Smith JK. Mind the gap! Students' use of exemplars and detailed rubrics as formative assessment. *Instr Sci.* 2014; 42: 539-559.
9. Strangman L, Knowles E. Improving the development of student's research questions and hypotheses in an introductory business research methods course. *Intl J SOTL.* 2012; 6 (2): 24.
10. Osterbur ME, Hammer EY, Hammer E. Does mechanism matter? Student recall of electronic versus handwritten feedback. *Intl J SOTL.* 2015; 9 (1): 7.
11. Creswell JW. *Research Design: Qualitative, Quantitative and Mixed Method Approaches,* 4th ed. University of

- Nebraska-Lincoln. SAGE Publications, Inc: United States of America, 2014: 43-289.
12. Bowen GA. Document analysis as a qualitative research method. *Qual Res J.* 2009;9(2):27-40.
<https://doi.org/10.3316/QRJ0902027>.
 13. Spuur KM, Falconi CL, Cowling CM, Bowman CM, Maroney MA. Demographics of new undergraduate Medical Imaging and Medical Sonography degree students at CQUniversity, Australia. *Rad.* 2011; 18: 117-122.
 14. University of Papua New Guinea Course Handbook. Bachelor of Medical Imaging Science: 2.49901 Research Project. Public Relations and Marketing Unit. University Printery. Port Moresby: Papua New Guinea, 2009: 180-183.
 15. Biggs J. Constructive alignment in university teaching. *HERDSA Review HigherEd.*2014;1:5-22.www.herdsa.org.au.
 16. Stewart M. Understanding learning: theories and critique. In: Hunt L, Chalmers D, editors. *Textbook of University Teaching in Focus: A Learning-Centred Approach.* Camberwell, Victoria: ACER Press, 2012: 3-20.
 17. Chalmers D, Partridge L. Teaching graduate attributes and academic skills. In: Hunt L, Chalmers D, editors. *Textbook of University Teaching in Focus: A Learning-Centred Approach.* Camberwell, Victoria: ACER Press, 2012: 56-73.
 18. University of Papua New Guinea: Assessment and Accreditation Policy. University of Papua New Guinea. Port Moresby: Papua New Guinea, 2015: 9-44.
 19. Hil R. *Whackademia.* Sydney: New South Publishing, 2012.
 20. Herrington J, Herrington A. Authentic conditions for authentic assessment: aligning task and assessment. In: Herrington J, Herrington A, editors. *Critical visions. Proceedings of the 29th HERDSA Annual Conference, Western Australia, 2006:* 146-151.