

‘An investigation into the use of rubric-based self-assessment and written feedback as an effective teaching tool for the enhancement of student learning in the practical element of a food science degree module’.

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## **Abstract**

This action research took place over ten weeks of laboratory practical work within a Food Microbiology module at Letterkenny Institute of Technology (LYIT). The customary method of assessing laboratory practical work is to mark the student's laboratory report after each laboratory practical without a transparent marking scheme. The purpose of this research is to investigate if the implementation of a criteria based marking scheme, in the form of a rubric, together with student self-assessment and lecturer feedback, is an effective teaching tool for the enhancement of student learning in the practical element of a Level 7, Food Science degree module.

A mixed methods approach was used in this research. Literature themes researched included, rubric-assessment, self-assessment, feedback and assessing laboratory practicals. Data collection methods used included student rubric-based self-assessment sheets, assessment feedback sheets from the lecturer, fourteen questionnaires and three semi structured interviews. Student self-assessment marks were compared with those from the lecturer to plot changes over time. The findings suggest that by repeated use of the rubric, students' judgements of their marks do converge with the lecturer's marks. However, the overestimating of marks by students with respect to their achieved laboratory practical marks is remarkable. A significant correlation was found between continuous use of the self-assessment rubric and the marks achieved for their laboratory practical write-up. In future, these findings may be enhanced by supporting the student more rigorously during the self-assessment process with exemplars and training in the use of rubrics, self-assessment and feedback. In addition, self-assessment rubrics supported with written lecturer feedback should be considered as an assessment strategy for laboratory based subjects by LYIT.

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## **Section One: Rationale and Introduction**

This research will investigate if the use of rubric based self-assessment and written feedback is an effective teaching tool for the enhancement of student learning in the practical element of a food science module on an undergraduate degree, Level 7 programme.

Grades given to students and the decisions made by the lecturer about whether a student passes or fails continuous assessment and examinations are at the heart of academic standards (Bloxham et al., 2011). The assessment strategy of a particular course can have a major impact on a students' approach to their learning and whether they grasp the understanding of the key concepts of a subject area (Bloxham and Boyd, 2007).

Internationally higher education institutions and educators have become increasingly committed to making assessment and grading more effective in promoting student learning and to making less mysterious, more open and more explicit the grounds upon which student assessments are graded (Sadler, 2005). This is also a driver in the Irish landscape of higher education with student learning as the focus of one of six high level system objectives that are now the basis of financial metrics for third level institutes (Hunt, 2011). This has resulted in the introduction of grading criteria such as rubrics (Sadler, 2005). A rubric based marking scheme will be used in this research focusing on the laboratory element of a food science module.

Assessment should be 'valid, transparent and transparent' as deemed best practice by Race (2009, p27). The customary method of assessing laboratory practical work, in Letterkenny Institute of Technology, LYIT, is to mark the student's practical laboratory write-up report after each laboratory practical without a detailed marking scheme. Brown et al. (2005) states that there can be a 25 per cent variation between sets of assessors that marked the same laboratory notebooks. In order to ensure reliability and reduce such variability Brown et al. (2005) suggests one of the strategies to use is explicit marking criteria. This project investigates if the implementation of such marking criteria, in the form of a rubric, as defined in Section 2.2, together with student self-assessment and lecturer feedback, is an effective teaching tool for the enhancement of student learning in the practical element of a food science degree module.

The use of a rubric-based self-assessment for assessing laboratory practical work is not common practice in food science modules in Letterkenny Institute of Technology (LYIT) and has been identified, by the researcher, as an area for assessment research. Indeed, the use of rubrics in any practical element whether science or engineering is not reported within peer reviewed literature. Continuous use of this method of assessment over an academic semester within a food science laboratory practical has been identified as the research area for this study. This form of assessment coupled with lecturer feedback on the same rubric system will expand rubric research into an area that has yet to be studied.

Self-assessment and feedback is viewed by some researchers, such as Bloxham and Boyd (2007) as learning. In order for this learning to take place three factors have to be present: students should know what standard they are aiming for; the student should be provided with feedback so they know their position in relation to the standard set and the student must take action to reduce this gap between the first two, Bloxham and Boyd (2007) citing Sadler (1989). Evidence presented by Falchikov (2005) proves that in self-assessment the greater the degree of consensus between student and lecturer scores occurred with more detailed criteria based assessment, such as an assessment rubric. This will be investigated further in this research study.

LYIT (2015a), have implemented a Quality Assurance Handbook, which is the backbone on which all programmes are developed in terms of how they are designed, validated, monitored, assessed and how learner feedback is facilitated. In Section 6, Procedure and Guidelines for Assessment Planning, in relation to feedback it states ‘Learners should be given individual and timely feedback on assessment and it should be evident to the student why they obtained the mark they did’(LYIT, 2015a).

Students targeted for this research were enrolled in an undergraduate Food Science and Nutrition Degree Course, level 7, at LYIT. The cohort of sixteen students who volunteered for this study must complete 30 credits, which comprises two ten credit and two five credit modules as part of their first semester of third year. The Food Microbiology Module within which this study was conducted has a ten credit weighting.

The practical laboratory work, accounts for forty per cent of the overall module marks. The remaining marks are made up from continuous assessment at ten per cent and final written summative exam at fifty per cent. The food science student must pass both the practical

element and the final exam to pass and complete the module. The area of focus for this research is the practical laboratory element, in particular the assessment of the laboratory practical write-up.

All students will be asked to self-assess and grade their own laboratory practical write-up using a rubric marking scheme over a ten week period, and submit this with the weekly laboratory practical write-up. The rubric assessment as can be seen in Appendix 1, was designed by the researcher, who is also the lecturer, cognisant of the module learning outcomes for Food Microbiology. Upon receipt of this submission the researcher will use the same rubric to assess and grade the work and supplement this with additional written feedback within seven days of receipt. This will assist the student to transparently see where marks are awarded and if on focusing their effort correctly they are enabled to achieve their maximum potential with respect to marks. This helps in the process of self-regulation by improving their understanding of what they are aiming for (Bloxham and Boyd, 2007) with respect to the laboratory practical element within a science based module. In addition, to benefiting the students in the enhancement of their learning, the implementation of self-assessment also benefits the needs of the LYIT. It fulfils one of the LYIT's objectives as outlined in the Institute's Strategic Plan which encourages 'students to take greater responsibility for their own learning, and preparing students for a lifetime of learning'(LYIT, 2014).

The research to be carried out in this study is also timely as the National Forum for Teaching and Learning have announced their new enhancement theme for 2016/2018 'Assessment'. This pilot study will add to and supplement other research carried out under this initiative.

## **Section Two: Literature Review and Critique**

### **2.1 Introduction**

This literature review and critique will focus on specific areas related to the research questions. The main theme of the research questions is to investigate if the use of rubric based self-assessment and written feedback can enhance student learning in the practical element of a food science module on an undergraduate degree, Level 7. While this research study is focused on the laboratory practical element, this literature review and critique will not be limited to this area only. It will examine self-assessment with particular emphasis on the use of rubric-based self-assessment to enhance learning. This will be followed by exploring the various definitions, understandings and concepts of feedback and how, in combination with rubric-based self-assessment it can promote learning in the student.

In relation to assessment, Race (2009p 27) suggests that assessment should be valid, reliable, consistent and transparent ‘so that the students know where the goalposts are’. He suggests that, in order to promote deep learning and enhance students’ learning, assessment should also be more diverse, to ensure all types of learners are covered, manageable both for students and the lecturer, and beneficial in terms of feedback. Sadler (2005) also writes about assessment promoting student learning by making it clearer for the student to be aware of the grading scheme. This has resulted in a strong interest in criteria based assessment such as rubric assessment.

### **2.2 Rubric Assessment**

A rubric is a document that lists criteria for an assignment and describes various levels of quality, from excellent to poor (Andrade and Du, 2005). Barney et al. (2012) defined a rubric as a set of criteria against which a score can be allocated. Barney et al. (2012) conducted a study to evaluate if using a rubric based self-assessment and oral feedback improved learning against a set of learning outcomes. In the study, soft-ware engineering students were asked to present their work for assessment but were then allowed to update and resubmit having self-assessed their work against a developed rubric. Oral feedback was given and students were allowed to resubmit their work based on the feedback. A response of 4.7, from a five-point Likert scale (5= strongly agree), was obtained when the students were asked if the rubric-based assessment helped improve their assignment. Although this finding was clear it did not

translate into improvement in meeting the learning outcomes. One of the main findings of the study from the implementation of these interventions was an increase in student understanding of teachers' expectations. This led to fewer complaints about grades given to the student from the lecturer. However, the study had several limitations such as the small number of students in the study, only forty, and the short length of time in which the study was conducted, over one semester. In addition, the study fails to identify if the student needs to know more than what is requested in the assessment rubric (Barney et al., 2012).

In comparison, Xiaohua and Canty (2012) found that a rubric-referenced self-assessment enhanced student performance. Their study was conducted with two groups of chiropractic students. Only one group was asked to self-assess their anatomy assignment against a provided rubric. Feedback was provided to both groups. The result revealed that the groups that completed the self-assessment using the rubric, statistically scored higher in the assignments than those that did not. In comparison to the study by Barney et al. (2012), the intervention included more students, one hundred and thirty per group but again it too was conducted over one term only. Xiaohua and Canty (2012) cautioned that while rubric-based self-assessment aided learning, the students may concentrate on what they need to achieve from the rubric to get the higher grades and may not extend their learning outside what is requested on the rubric.

The promotion of learning by use of a scoring rubric was also studied by Jonsson and Svingby (2007) who concluded that the main reason such scoring rubric promoted learning, was the fact that the rubrics clearly laid out the expectations and criteria for the student, which also simplifies feedback and self-assessment. However, the authors did stress that training was needed to ensure reliability of the scoring. Andrade and Du (2005) also argue that the use of rubric based self-assessment promotes higher quality work with a better grade. The authors suggest that the rubrics helped focus the students' efforts. An investigation by Andrade and Du (2005) into students' perspectives on rubric referenced assessment finds that rubrics can be used in teaching in addition to evaluating. This reinforced the findings of a previous study by Andrade (2000) whereby he writes that rubrics are effective teaching tools. The author suggests that rubrics can be used to promote student learning and the development of 'sophisticated' thinking skills.

While Andrade has conducted several studies on rubric-based self-assessments and the promotion of learning, the studies have been qualitative, small numbers over a short period, a more in depth longitudinal study is required. Andrade and Du (2005) suggest further research

into students approach and interpretation of rubric based self-assessment would be beneficial. This is an area where Eshun undertook research (Eshun, 2011, Eshun and Osei-Poku, 2013).

Eshun (2011) like Andrade and Du (2005) argued that a clearly defined, criterion-based assessment approach enables assessment to play a lead role in the learning process. In a later study, Eshun and Osei-Poku (2013), used questionnaires to evaluate the use of assessment rubrics with their design students. Over one hundred and eight students completed the questionnaires. Eighty six percent of these students found that it helped them in their learning but it was surprising to find that forty-six percent of the students needed training in the assessment rubric. This point was not discussed in the studies mentioned previously which could possibly have a bearing on the results of their findings. The study did discover that the students had a positive learning experience and had a positive attitude towards the use of rubric-based assessment (Eshun and Osei-Poku, 2013).

As illustrated above, rubric assessments have been found to be positive in relation to informing the student of the expectations of learning from the lecturer's point of view. This research also validates the rubric as a legitimate tool for self-assessment.

### **2.3 Self-Assessment**

Self-assessment is a process of self-directed assessment by learners with the ability of providing their own feedback because they understand the academic standard they are aiming for, and can judge and change their own performance in relation to that standard (Bloxham and Boyd, 2007, Galbraith et al., 2008). Bloxham and Boyd (2007) view this assessment as learning and that improvement involves three elements: students should know what standard they are aiming for; the student should be provided with feedback so they know their current achievement and the student must take action to reduce this gap between the first two. Evidence presented by Falchikov (2005) proves that the greatest degree of agreement between student and lecturer scores in self-assessment occurred with more detailed criteria based assessment details such as a rubric.

Self-assessment, feedback and reflexivity are some of the methods that Boud and Falchikov (2005) suggest that encourage learning beyond higher education. Lynch et al. (2012) investigated the use of self and peer assessment with feedback to promote deep learning with student teachers. The authors found that by promoting self and peer assessment and feedback,

their pre-service teacher students were shown how to develop their critical thinking skills which resulted in higher quality learning outcomes.

Boud et al. (2013) investigated if student engagement in self-assessment attuned their own judgement of assessment over a time period and did it align with the learning outcomes expected by the lecturer. The study involved design students self-assessing their own work on a criteria-based assessment system (ReView) that was web based. Both the tutor and the student could complete the criteria-based assessment on the web based system. Once completed the computer program revealed any variation between the two, the student and the tutor. The tutor was able to examine where the difference in perception was on a particular criteria and provide immediate feedback to the student where improvement could be made. The research indicated that there was a significant difference between the student and the tutor at the first task, with students rating themselves higher than the tutors but this reduced by task two and three. The study suggested that students struggle to accurately self-assess initially whether it is a new task or new subject but the students appear to redefine their judgement over time. The study also revealed that over the study, that low achievement students over-estimated their performance, high achievers underestimated their performance while mid achievement students were the most able of the groups to develop their self-assessment skills to agree with the tutor. In addition, in relation to performance over time, the students were grouped into estimators with the mid achieving group showing the highest performance. There was no improvement with the over-estimators an explanation of which was outside the scope of the study. The study highlighted the role of criteria based assessment, feedback and students judgement, in student performance. A wider study across different discipline areas would validate this study. This study was limited as only students that volunteered were included in the metric and it relied on the good will of tutors to use the web based system.

There are many voices of relevant researchers in the area of self-assessment such as Bloxham and Boyd (2007), Boud (2013), Boud and Falchikov (1989), Falchikov (2005), Gibbs (2010) and Sadler (1989) together with the papers already mentioned, have informed my research and its parameters. Boud et al. (2013) research work is the corner stone research on which my own is based, though the possibility of results being skewed by participation of only highly self-motivated students and tutors possibly engaged in this study is not without consideration.

A gap in the literature has been identified in the area of the use of a rubric based self-assessment approach in relation to food science laboratory practical assessments. In this study food science



students will be asked to self-assess and score their own laboratory practical write up using a criteria based marking system, the rubric. The lecturer, in this case the researcher, will also use the same rubric to assess the practical write up but in addition, will provide written feedback to the student on this assessment rubric. Feedback is fundamental to student learning as highlighted in the LYIT's Quality Assurance Handbook (LYIT, 2015a).

## **2.4 Feedback**

There is a large volume of published studies questioning the area of how well the student can interpret and process feedback from the teacher (Orsmond and Merry, 2013, Price et al., 2010, Race, 2009, Gibbs, 2010, Nicol and Macfarlane-Dick, 2006, Taras, 2003, Black and Wiliam, 1998). Overall from analysis of the research undertaken in the papers listed above, the author/researcher, has found that feedback is imperative to progress student learning and this fact is evidenced by the research papers of the above authors. While Barney et al. (2012) used oral feedback and found that it enabled the student to perform well, he highlighted that the success of his research was based on the quality of the rubric and not specifically the teachers oral feedback.

In a similar point, Lynch et al. (2012), discovered that feedback was essential to the success of the student and suggested that both recipients and providers of feedback be acquainted with the feedback process. Lynch et al. (2012) investigated the promotion of deep learning through self and peer assessment and feedback on a teacher education programme. The researchers included a control group in their study. Both groups participated in a problem based learning scenario and were asked to engage with an e-portfolio system. Both groups were given feedback from the lecturer but only the main group was given peer feedback also. All students were asked to self-assess by completing an on line survey. Students that engaged with the e-portfolio system and peer feedback achieved better grades by forty percent than those that did not. In comparison to other studies, this particular group of students were training to become teachers and were well versed in Blooms Taxonomy, but like other studies the students need to be familiar with the feedback process and quality time needs to be taken with the student to provide the feedback clearly(Lynch et al., 2012). The LYIT assessment policy 2015, states 'timely feedback' is imperative, however it can be difficult to deliver and several researchers, as discussed below, wonder if the commitment of time to feedback is reflected in the results obtained by the student.

Barney et al. (2012) questioned whether the investment in time involved with oral feedback both by the teacher and the student justified the end result, which was not reflected in an improvement in learning outcomes but an increase in students' understanding of the teacher's expectations. The effort that is involved in feedback and whether it was worth it or not was studied by Price et al. (2010). Price et al, 2010, undertook a quantitative study over three years with business students in three partner universities and he argues that a disproportionate amount of effort is put into providing feedback in comparison to examining its effectiveness. As in the other studies (Barney et al., 2012, Lynch et al., 2012) it reinforces the fact that students want feedback but do not necessarily engage with it and often do not read all of it or clearly understand what it is trying to reinforce and highlight. In Price et al. (2010) seminal work the research undertaken had divergent reflections from the point of view of staff and students. The findings from a student's perspective alluded to negative tones used by the staff, illegible handwriting, clarity and timing of the feedback. From a staff's perspective, some focused on quantity of feedback rather than quality, rarely asking students how they applied feedback to future work. Students were not clear about the purpose of the feedback they received and they viewed the feedback as a justification of a grade received rather than a learning development tool (Price et al., 2010). Both Price et al. (2010) and Barney et al. (2012) raise the concern of resources and question if they are available to provide effective feedback. In higher education feedback is aimed at long term development of the student being able to self-assess and move their academic achievement forward in a positive fashion. The effectiveness of feedback as a tool for student academic development is difficult to measure (Price et al., 2010).

The above researchers discuss the fact that feedback is only effective if the learner is clear on what the feedback means and is willing to act on it. Feedback is a two way system as referred to by Taras (2002), while the teacher may provide feedback, the student must take some responsibility of participating in the process by taking on the feedback and using this to improve, to meet and fill the gap. With this point in mind, it questions whether the students involved in Barney et al. (2012) study took on this responsibility of 'filling the gap' as there was no significant grade improvement in the students summative examination.

Literature available on discipline specific, i.e. science feedback is very limited. The research study will be undertaken in this discipline area but support for the criteria based self-assessment has mainly been found in the areas of software and design. Science as a discipline has many inherent different forms of learning including theoretical and practical.

Gibbs et al. (2003) surveyed two Universities focusing on their Science programmes, physics, chemistry and biochemistry. Teachers at University A provided written feedback to the students while teachers at University B provided oral feedback to their students. The study revealed that from a teacher's perspective that oral feedback was easier to do as it was less time consuming than written feedback. However, the study highlighted that often the students did not write down oral feedback and so could not refer back to it. In fact, similar to the findings of Price et al. (2010) the study emphasised the point that there can be a difference in perception as to what feedback is or should be between that of the teacher and the student. The teachers thought they were providing feedback consistently through lectures, laboratories, workshops and informally, while the students did not see this information as feedback (Gibbs et al., 2003).

Feedback is a well-established research area, however, research in the science discipline is limited. The research focused on above, provides interesting parameters for consideration prior to undertaking the rubric based self-assessment within food science.

## **2.5 Rubric-based self-assessment and feedback in the practical element of a Food Science Module**

Literature on the teaching of Food Science and in particular the practical element of a Food Microbiology Module, reveals few studies on rubric-based self-assessment. Brown et al. (2005p 103) suggests that students carrying out laboratory practical work can get a better understanding of what they do and why, by using self-assessment procedures. The researchers above suggest in order to save time and increase reliability for marking the lab report, a standard laboratory report marking sheet should be used which should be given to the student and returned with their practical report. This system makes no mention as to how such a system could be implemented and does not refer to feedback. Boud et al. (1986) reported that failure of the student to meet any of the laboratory-based criteria gives very specific indications of what the student needs to do to become successful. In addition, Boud et al. (1986p 81) writes that providing immediate feedback, when teaching laboratory practicals and report writing, is very effective in promoting learning. Again there is no clear indication of how such a system could be effectively implemented into the teaching of a practical element of a food science module.

## **2.6 Conclusion**

The literature review verified that the use of rubric-based self-assessment combined with feedback can be used to enhance and promote student learning. However, one of the gaps exposed is that, much of the literature has been conducted in disciplines such as teaching, design, business, computers and engineering, there is very little in the area of teaching in food science, in particular within the laboratory practical element in higher education in Ireland.

From researching the literature another area that was exposed was the frequency of use of a rubric based self-assessment. Most studies used it once, (Barney et al) and analysed the results from this. Issues arise on whether the students engaged with the rubric and were able to enhance their learning from this intervention. This research will use the identical rubric on a weekly basis over ten weeks. It is expected that this will reinforce knowledge of the rubric with the student and as such ensure familiarity with the learning concept being measured.

Oral feedback has been used previously by Barney et al. (2012) and it is questioned whether retention of the key points being delivered by the lecturer is actually successful. The research to be undertaken in this study will encompass written feedback as a means to overcome this gap.

This research study will investigate if introducing a rubric based self-assessment with written feedback is an effective teaching tool for the enhancement of student learning in the practical element of food science degree module. From this research, it will evaluate the students understanding of rubric-based self-assessment, assess if written feedback from the lecturer in the form of the same rubric, enables the student to improve their marks and investigate if the use of rubric assessment is an effective tool for student engagement in laboratory practical report writing.

## **Section Three: Implementation and Evaluation**

### **3.1 Research Aim and Questions**

The purpose of this research, was to work within an action research framework and to ascertain if using a rubric based self-assessment, together with a lecturer assessed rubric with written feedback, was an effective teaching tool for the enhancement of student learning in the practical element of a food science degree module at an undergraduate level.

The research will endeavour to answer the following research questions:

1. Is the use of a rubric-based self-assessment, an effective tool for student engagement in laboratory practical write ups?
2. What is the students' understanding of a rubric-based self-assessment?
3. Can student self-assessments agree with lecturer assessments over a given time period?
4. Does the same assessment rubric, when supplemented by written feedback from the lecturer, enable the student to improve their mark?

#### **3.1.1 Enhancement of student learning**

The cohort of students that join the Food Science and Nutrition Degree course are made up of a mix of students from traditional entry students to mature students that enter through Springboard. Springboard is an initiative in Irish higher education whereby courses are offered free to long term unemployed people to achieve certificate, degree and masters level qualifications in areas where there are employment opportunities in the economy (Springboard, 2016). In LYIT a mature student is considered one who if applying for first year, will be twenty three years of age (or older) by the 1st January in the proposed year of entry (LYIT, 2016c). In the learning cohort that was examined as part of this research, sixty-one and a half per cent qualify as mature students. Race (2009, p 27) suggests that assessment processes should be more diverse to ensure all types of learners are catered for.

Experiential reflection of the researcher in delivering the practical elements of science modules indicate that the mature student appears more apprehensive in comparison to other students of the summative assessment, the exam paper. The mature cohort as a means to overcome this apprehension place a lot of emphasis on formative work and continuous assessment, in this case the laboratory practical element. The mature student has developed a strategy that permits

them to have obtained a reserve of marks prior to the summative exam. This in itself, is a learning strategy that mature learners have evolved to sustain their participation in higher education. Therefore, it is important that support systems are put in place to enable the student to achieve the maximum mark from their laboratory practical work, as this is the element where they apply most of their learning effort. Such a support system was trialled by this research work which focused on enhancing student learning in a laboratory practical element. All students irrespective of their learning style or age, have been asked to self-assess and grade their own laboratory practical write-up using a rubric, a criteria based marking scheme and to submit this with the laboratory practical write-up. Upon receipt of this submission the researcher, who is also the lecturer, will use the same rubric to assess and grade the work and supplement this assessment with written feedback. This will assist the student to see whether they are focusing their efforts correctly and as such are enabled to achieve their maximum potential with respect to marks. This helps in the process of self-regulation by improving their understanding of what they are aiming for (Bloxham and Boyd, 2007) with respect to the laboratory practical element within a science based module.

The ten credit Food Microbiology module in which this research has been undertaken consists of three one hour lectures and four hours of practical laboratory work weekly. A weekly laboratory practical is held over two, two hour sessions. One two hour practical is at the start of the week and the other two hour practical at the end of the week, which is held as best practice for practical study for microbiology at LYIT. The academic semester at LYIT consists of fifteen weeks, thirteen weeks are for academic delivery of content while the remaining two weeks are for summative assessment. The practicals start on week one of the semester and run until week ten. The students are required to write a weekly laboratory practical report based on their practical work performed and their findings from the full week's laboratory practical. To date, as part of their previous academic training in Year one and Year two, the structure of the laboratory practical write-up is reflective of previous practical science modules they have undertaken. On week one of the academic semester, the structure and format of the laboratory practical write up is reintroduced and revised with the student and a copy of this is included in the laboratory practical manual that is provided for this module.

For this research study, the student was provided by the researcher, the lecturer, with an assessment rubric of how the laboratory practical write up for this module, Food Microbiology, would be assessed, see Appendix 1. The lecturer demonstrated to the students how to use the

rubric (which was designed using the Microsoft Excel package) to self-assess their own practical write up by going through each section of the rubric on the computer in the laboratory. To ensure the students understood how to complete the rubric further, three students were asked to demonstrate how to complete the rubric to their peers using the computer in the laboratory. The students submit this rubric assessment with their laboratory practical write up as explained in section 3.2.

By carrying out such research, it is hoped the student will engage and reflect on their laboratory practical write-up in light of their self-assessment rubric and their lecturer's assessment of same. It is anticipated that the student will adjust their laboratory write up report over time and it will eventually concur with the lecturer's assessment. This teaching and learning intervention, will assess if this learning has been achieved by the student and if it has helped improve their grades. It is expected that the student will become more engaged in their laboratory practical report write up. This self-assessment should enable students to reflect and self-regulate and as such enable the student to identify and focus on the most important aspects of their work that they need to improve. This learning, self-reflection and regulation, will build the skills the students will need in any other work area following graduation (Boud et al., 2013). In addition to the enhancement of student learning, the implementation of self-assessment also meets an institutional need by fulfilling one of the objectives of the LYIT's Strategic Plan which encourages 'students to take greater responsibility for their own learning, and preparing students for a lifetime of learning' (LYIT, 2014).

### **3.1.2 Meeting the Institutional Need**

From an institutional point of view, assessment has been driven by policy, quality assurance procedures and the LYIT's strategic plan. At the heart of each quality assurance approach is the constructive alignment between the learning outcomes and assessment practices for each module (Kennedy, 2006p 77). The assessment practice should effectively measure the learning outcomes of the module in a reliable, valid and transparent way (Bloxham and Boyd, 2007p 5). Section 2.2.6 of the 'Assessment and Standards' Policies as laid down by Quality and Qualifications Council, QQI (2013), states that 'the provider should have fair and consistent systems and published criteria for grading assessment tasks'. The research undertaken in this study will provide the student with the exact criteria expected for a laboratory practical write up in the form of a rubric spreadsheet.

LYIT's Quality Assurance Handbook, suggests that each school should develop their own assessment criteria (LYIT, 2015a). It also encourages the development of assessment criteria for assessments which are worth more than twenty per cent of a module. Such assessment criteria does not exist for the laboratory practical element in the BSc in Food Science and Nutrition although there is a forty per cent weighting on the continuous assessment and a fifty per cent weighting on the final summative exam. Thus, there is an opportunity, to extend this pilot study across the other food science modules that have a practical element involved. The development of an assessment criteria in the form of an assessment rubric as undertaken in this research could be trialled across the discipline of Food Science and further extended into the other sciences within the school.

The students will be asked to engage with the rubric-based self-assessment on their own laboratory practical write up together with the lecturer's feedback and assessment. The student will have the opportunity to achieve an improved mark for the next laboratory practical write up by taking on the responsibility of participating in the process of feedback and using this information to reflect and empower them for future work (Taras, 2002).

### **3.1.3 Rubric Development**

Fiona O'Riordan, the Head of Faculty in Training and Education, at Griffin College, introduced the use of the rubric as an assessment and feedback tool, when delivering on the Masters in Teaching and Learning Course in LYIT in February 2015 (O'Riordan, 2015). This rubric was developed from a business assessment criteria grid that originated with Margaret Price and Chris Rust (Price and Rust, 2004). O'Riordan's rubric was adapted for this particular piece of research by changing some of the business language into relevant food science laboratory language, targeting students at level 7. The assessment rubric was designed to ensure the assessment would be valid, fair, transparent and by incorporating such things as 'include food product details', linking it to the real world (Race, 2016). Rubrics studied by the researcher and mentioned in section 2.2 were based on the Structure of Observed Learning Outcomes (SOLO) taxonomy (Barney et al., 2012), the cognitive domain of Bloom's Taxonomy (Lynch et al., 2012) and a computer web based marking system, ReView (Boud et al., 2013). The adapted rubric used in this research derived from the researcher's investigations of HETAC standards for Level 7 in Science and Blooms Taxonomy (Bloom and Krathwohl, 1956). The rubric that was developed for this research is cognisant that the learning population are students at Level 7 on the QQI framework (NFQ, 2015). Subject area, Food Microbiology, was also considered



for design of the rubric in question. The assessment rubric used for this research can be found in Appendix 1.

### **3.2 Ethical Approval**

Atkins and Wallace (2014), write about taking an ethical approach throughout the whole study, when doing educational research, as opposed to just meeting the need to cover anonymity or consent. The authors advise the researcher to stop and question whether their actions are ethical at each stage of the research, an approach that was followed in this research.

Consideration and respect must be given to both the research site as well as the participants. At Letterkenny Institute of Technology, Ethics Policy and Procedures are clearly documented on the LYIT website (LYIT, 2015b) . The LYIT ethics Policy and Procedures have developed a detailed ethics approval system based on the Declaration of Helsinki and EU Directive 2001/20EC on Clinical Trials. Researchers are expected to conduct their research in line with best ethical practice.

A consent form was issued before any part of the research commenced as without this, it takes away the right of the participant not to participate (Robson, 2011). A consent form was designed as part of the research. To accompany this, an information sheet was developed informing the participants of the research involved. A copy of both the consent form and information sheet have been included in Appendices 4 and 5 respectively.

There are no vulnerable groups such as persons under 18, gatekeepers, sensitive topics or financial inducements, however there are human participants and data of a confidential nature involved. The student cohort that were invited to take part in the research are from the researcher's own teaching class. They were explicitly informed, in the consent form and information sheet, that participation was not mandatory and that their choice would not impinge on any marks achieved in assessments that may be carried out by the researcher within the assigned module. The participants were informed in the same consent form and information sheet, that any data collected from both questionnaires and interviews, would be held securely and confidentially by the researcher. In addition, this data has been anonymised for use in the research findings and is viewed by others in this format.

There is a potential conflict of interest in this study as the participants involved are the researcher's own students. The consent form and information sheet were designed such that the participant can withdraw at any stage from the study without it impacting upon the power imbalance in the lecturer/research-student relationship. These forms also contained information to ensure that the student did not feel as if they were obliged to participate in case it may impact on their future relationship, for example, if a student wanted a reference. To mitigate some of these worries, details of the project supervisor were included on the information sheet and how to withdraw was clearly communicated to the student.

Saunders et al. (2011) also write about considering ethical issues throughout the research. In addition, they refer to the storage of data which is addressed in the LYIT ethics application form. In this particular piece of research all data gathered is stored securely so that data cannot be accessed, altered, disclosed or destroyed by unauthorised persons, in accordance with the 'LYIT Guidelines for Electronic Data Storage' (LYIT, 2015b). The data is maintained on the researcher's computer which has a password protected screen saver. The computer software is updated regularly and it contains antivirus software which is set for daily automatic updating. A firewall also runs on the computer. All documents are password protected. Following best practice in line with LYIT's ethical approval, the data will be retained anonymously for five years after completion of the study and then destroyed (LYIT, 2015b).

Ethical clearance was issued by the Ethical Committee at Letterkenny Institute of Technology before starting the project.

### **3.3 Implementation**

For this research, sixteen Level 7, Food Science and Nutrition students, were asked to engage in self-assessment of their Food Microbiology laboratory practical write ups. The self-assessments were completed using the rubric described in section 3.1.4. A demonstration and explanation of how the rubric system worked was delivered to the students prior to the commencement of the laboratory practical element.

The research study undertook to track the similarities and differences of these sixteen student self-assessments of their own laboratory practical write ups and that undertaken by the researcher, who is also the lecturer and laboratory practical demonstrator for the module in question. The student was asked to self-assess each weekly laboratory practical write up using

the rubric over the complete academic semester that consisted of ten weeks of practical work. The rubric made explicit the criteria needed to obtain marks for each section within the laboratory practical write and as such facilitated the opportunity to achieve maximum results. A copy of the rubric can be found in Appendix 1.

During the ten weeks, students engaged voluntarily with the rubric and using such, graded their own laboratory practical write ups. These self-assessment rubrics and the laboratory practical write up were uploaded onto LYIT’s virtual learning environment platform (VLE), Blackboard, after an interval of seven days upon completion of the weekly laboratory practical. The researcher used the same rubric assessment criteria spreadsheet to assess the uploaded laboratory practical write up, see Appendix 2. The submission and feedback cycle for the laboratory practical write up assessed in this research are outlined in Figure 3.1. The researcher’s feedback, for each individual student, using the same rubric assessment supplemented with written comments were uploaded onto Blackboard within a seven day period upon receipt of the students’ work. The student could engage with and reflect on the researcher’s feedback and assessment of their submitted work prior to submission of the next laboratory practical write up. This gave the student the opportunity to learn from their feedback and as such make adjustments to their report write up, in relation to this knowledge, before submitting the next laboratory practical write up.

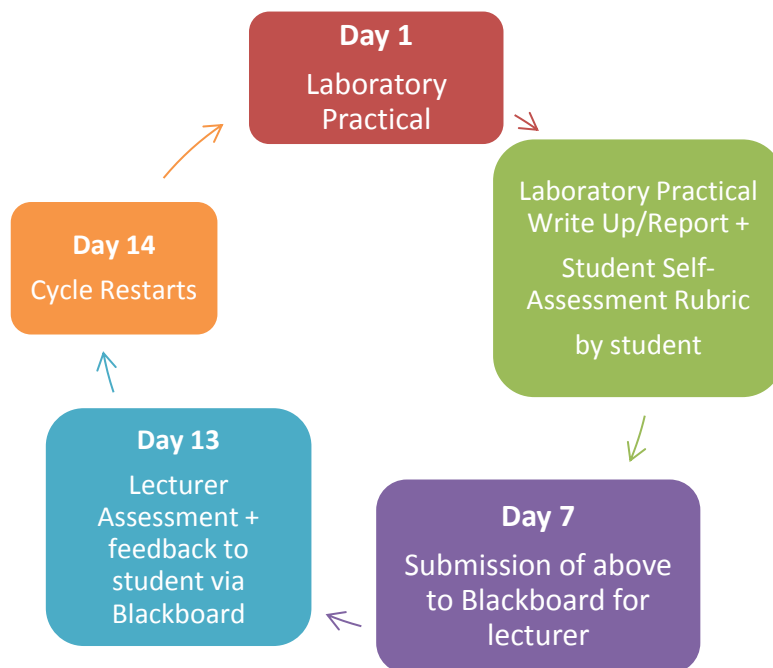


Figure 3.1: Laboratory Practical Write-Up Submission and Feedback Cycle

A mixed methods research was conducted to investigate the research questions further and on week thirteen, the final week of academic delivery of the Food Microbiology Module, after the completion of the practical work, the students were asked to complete a questionnaire and a follow up semi-structured interview. Both the questionnaire and interview were voluntary. Thirteen of the sixteen students in the cohort completed the questionnaire while three agreed to partake in the interview. The students received a copy of the interview questions beforehand to help put them at ease and aid with structuring their thoughts before the interview.

### 3.4 Research Methodology

#### 3.4.1 Research Philosophy

Research philosophy adopted relates to how the researcher views the world. Parahoo (2006), asserts that research is a scientific process that consists of formulating questions or hypotheses, collecting data using research methods such as observations, interviews or questionnaires and analysing the data. If one assumes that research is primarily concerned with the generation of, and testing of knowledge, then understanding the various research paradigms becomes an integral element of successful research.

In this research study, Saunders et al. (2011) research ‘onion’, see Figure 3.2, was used to understand the stages to pass through when formulating an effective methodology.

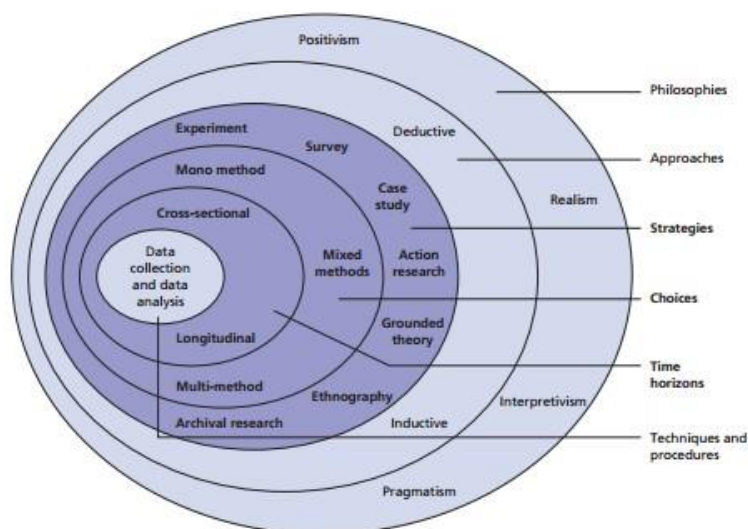


Figure 3.2: The research ‘onion’ (Saunders et al., 2011)

The outer layer of the ‘onion’ lists the scientific paradigms into four categories: positivism, realism, interpretivism and pragmatism. Healy and Perry (2000), refer to the latter two as: critical theory and constructivism, each with the three elements: ontology, epistemology and methodology. “Ontology is the “reality” that the researchers investigate, epistemology is the relationship between that reality and the researcher, and methodology is the technique used by the researcher to investigate that reality” (Healy and Perry, 2000). Table 3.1 has been adapted from Healy and Perry (2000) amending and applying it for this particular research.

Table 3.1: Scientific paradigm and the elements; adapted from Healy and Perry (2000)

Paradigm	
Elements	Realism
Ontology	Reality is “real” but only imperfectly and probabilistically apprehensible
Epistemology	Modified objectivist: findings probably true
Common Methodologies	Case studies/convergent interviewing: triangulation, interpretation of research issues by qualitative and by some quantitative methods such as structural equation modelling

### 3.4.2 Research approach

In this piece of research, pre-existing theoretical ideas already exist, thus making it a deductive approach. As there are only sixteen students in the research cohort, qualitative methods of research were used. Qualitative methods irrespective of the cohort size were also used in the research by Barney et al. (2012), Andrade and Du (2005) and Boud et al. (2013), who also investigated the use of using rubric-based self-assessment.

### 3.4.3 Research strategy

While there are numerous research strategies as described in Saunders Research ‘Onion’, the method used in this research falls under the umbrella of action research. Robson (2011) writes that this approach is very popular in educational settings. The author suggests that central to action research is improvement and involvement. In relation to this particular study the

participants were involved in the research. The research looked for improvement in grades from the students' laboratory practical write ups, through their understanding of rubric assessment and feedback.

A mixed methods approach and cross-sectional time frame were adopted in this research as the research used two data collection techniques over a short time frame (Saunders et al., 2011). Cross-sectional refers to a 'snap shot' at one particular time. It captures information about how things are/were over a week or a few months rather than following changes over a long period of time (Denscombe, 2009). A section of the data for this research was collected October to December, over a ten week period, while the questionnaires and interviews, were collected over a two day period in the final teaching week of the winter semester.

Barney et al. (2012), used questionnaires in their study and suggested the use of interviews in addition to the questionnaires if they were to repeat their study. Other relevant papers reviewed such as Andrade and Du (2005), Lynch et al. (2012), Price et al. (2010) and Eshun and Osei-Poku (2013) have proven that questionnaires and interviews are robust data collection methods in the research area of rubric and self-assessment.

#### **3.4.3.1 Questionnaires**

A questionnaire seeks written answers to a pre-determined set of questions that may be in the format of open ended questions or scales such as the Likert scale. According to Parahoo (2006), it is the main source of information when collecting data on facts, knowledge, attitudes, beliefs and opinions. In this study, it was envisaged that the completed questionnaires would provide a focus for the questions at the semi-structured one to one interview stage. A questionnaire is generally reliable because it is anonymous, it encourages greater honesty and is more economical in terms of time and cost (Cohen and Manion, 1996).

The questionnaires were administered at the end of week thirteen, after the completion of all laboratory practical write ups and feedback. This allowed time for the student to be aware of the final grade they were awarded for laboratory practical element of the module. This assured the student participants that the practical mark awarded to them could not be affected by their participation in the final questionnaire and interview. It also ensured that this piece of research was not contaminated by students' belief that participation could increase their final laboratory practical mark and as such the validity of such research cannot be questioned.

The questionnaire was developed in line with the research questions undertaken for this research work. Data from the questionnaire was captured through open ended questions and the Likert scale similar to, Barney et al. (2012) Lynch et al. (2012) Andrade and Du (2005), Price et al. (2010) and Eshun and Osei-Poku (2013). A copy of the questionnaire and justification for each question can be found in the Appendices 6 and 7.

### **3.4.3.2 Piloting of questionnaire**

The questionnaire was pilot tested with two colleagues and four Level 8, Food Science and Nutrition students who were familiar with the laboratory practical element of the Food Microbiology Module as they completed this module previously. Minor clarification points were then addressed.

### **3.4.3.3 Interviews**

The questions asked in the interview were consistent with the research questions (Saunders et al., 2011). A copy of the interview questions and prep work sheet for the interviews can be found in the Appendices 8 and 9.

Interviews were held to ensure validity of the research work and as a means of triangulating the other data collected i.e. the questionnaires and the rubric-based self-assessments. While data from interviews can be further analysed by coding into themes or categories (Saunders et al., 2011), it was deemed unnecessary by the researcher in this case as the number who participated in the interview process did not provide a wide enough spectrum of opinions to allow coding into themes or categories, see Appendix 10.

The following Table 3.2, summarises the data collection methods for each of the three research questions.

Table 3.2: Data collection method matching each research questions

<b>Research Title</b>	An investigation into the use of rubric-based self-assessment and written feedback as an effective teaching tool for the enhancement of student learning in the practical element of a food science degree module.	
	<b>Research Questions</b>	<b>Data Collection Method</b>
<b>Question 1</b>	Is the use of a rubric-based self-assessment, an effective tool for student engagement in laboratory practical write ups?	<ul style="list-style-type: none"> <li>• Students’ rubric – based self-assessment</li> <li>• Lecturer’s rubric assessment &amp; written feedback</li> <li>• Questionnaire</li> <li>• Interview</li> </ul>
<b>Question 2</b>	What is the students’ understanding of a rubric-based self-assessment?	<ul style="list-style-type: none"> <li>• Questionnaire</li> <li>• Interview</li> </ul>
<b>Question 3</b>	Can student self-assessments agree with lecturer assessments over a given time period?	<ul style="list-style-type: none"> <li>• Questionnaire</li> <li>• Interview</li> </ul>
<b>Question 4</b>	Does the same assessment rubric, when supplemented by written feedback from the lecturer, enable the student to improve their mark?	<ul style="list-style-type: none"> <li>• Students’ rubric – based self-assessment</li> <li>• Lecturer’s rubric assessment &amp; written feedback</li> <li>• Questionnaire</li> </ul>

### 3.4.4 Data Analysis

#### 3.4.4.1 Validity and reliability

A triangulation approach was also used in this research to ensure consistency of the findings. Triangulation refers to the use of different data collection techniques within the one study to ensure that the data is telling you what you actually think it is telling you (Saunders et al., 2011). Using more than one source of data collection reduces bias and improves accuracy and validity within the research as outlined in Table 3.2 above. The assistance of the supervising tutor is also vital in ensuring reliability.



#### **3.4.4.2 Qualitative Analysis**

The scientific paradigm of realism as mentioned in Table 3.1 uses qualitative and some quantitative methods (Healy and Perry, 2000). For the research undertaken in this study, qualitative analysis with descriptive statistics for data analysis is used similarly to the research studies of Barney et al. (2012), Andrade and Du (2005) and Boud et al. (2013).

#### **3.4.5 Conclusion to research methodology**

A qualitative approach was deemed the most appropriate research methodology to investigate the research questions (Bell, 2014). The research tools employed were rubric-based self-assessment sheets from the students and feedback sheets from the lecturer/researcher, questionnaires and semi structured interviews.

### **3.5 Results and Evaluation**

This section of 'Results and Evaluation' will commence with evaluating the findings to each research question listed below. Each research question will be supported from data that was collected using various methodologies. The results will be interpreted and discussed using other studies that have been reported in the literature. A final overarching discussion on all the results found in this study will lead into a concluding statement.

Data collection methods used in this research, were rubric-based self-assessment sheets from the students and assessment feedback sheets from the lecturer researcher, questionnaires and semi structured interviews. The above data collection methods are not reviewed on an individual basis but are amalgamated to support the research questions.

The research was conducted with sixteen Level 7, Food Science and Nutrition students at LYIT. The research took place over the first thirteen academic teaching weeks of semester five during the laboratory practical element in a ten credit Food Microbiology module. Mature students made up sixty one and a half per cent of the student cohort (>23 years). The gender bias of the student cohort is made up of eleven female and five male. Of the sixteen students within the cohort, fourteen engaged with this research and completed the rubric-based self-assessment sheet. Thirteen students answered the questionnaire and three students volunteered for interviewed.

### **3.5.1 Research Question 1**

Is the use of a rubric-based self-assessment an effective tool for student engagement in laboratory practical write ups?

All information that was recorded by the student on their self-assessment rubric was analysed using Microsoft Office Excel spreadsheets. Data was also generated using this package for the lecturer assessment feedback. This data can be seen in Appendix 3.

The self-assessment rubrics indicated an average self-assessment rubric submission rate of seventy six per cent from the student cohort over the ten weeks of the research. From Figure 3.3 there is a clear trend of increasing submission rate of the self-assessment rubric until week seven of the academic term. The lowest rate of completing the self-assessment rubric was found on the first week of the research at sixty per cent. In response to the low submission rate on week two of this research, the lecturer took it upon themselves to reintroduce to the students the self-assessment rubric and repeat the induction of the use of same. The reintroduction was rewarded with an increase of eleven per cent. The submission rate peaked on week 6 at ninety two per cent. A mid-term reading week where students were not instructed in academic subjects or laboratory practicals occurred at this juncture. It is possible that this submission rate was affected by this occurrence as the submission rate steadily declined until week ten of the research. There was a reduction in the response rate by two per cent week on week until week 9. This is in agreement with Boud et al. (2013) who also found it took students some time to readjust to self-assessing after a break, in this case, it was moving from one module to another.

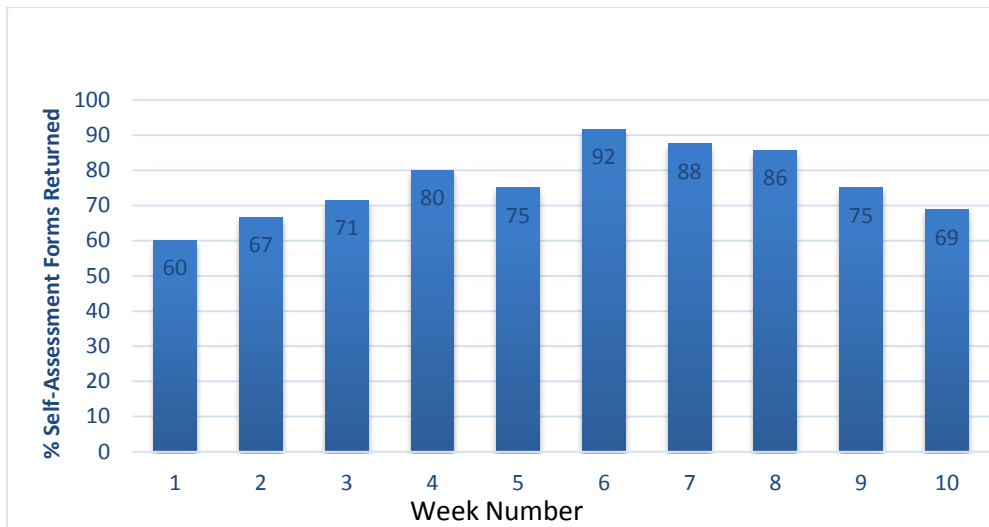


Figure 3.3: Student self-assessment rubric response rate over 10 weeks of laboratory practical work

The lowest submission rate was recorded as sixty nine per cent on week ten of the intervention, the final week. Week 10 of the academic semester is found to be challenging for students as the deadline for the majority of formative assessment is during this period. This assessment bottleneck is often cited by students as a reason for late submission of laboratory practical write ups. Coursework from other modules was cited by Barney (2012) as one of the contributing factors for decrease engagement with a rubric-based self-assessment intervention.

The lecturer is also cognisant that the student cohort undertake part-time seasonal work at this juncture in the semester, between weeks seven and thirteen, students especially mature, partake in outside employment for the Christmas season as a means to support their upkeep for college.

A questionnaire was used to supplement findings from the rubric intervention. When students were asked on the questionnaire how often they completed the self-assessment, over sixty two per cent said they completed the self-assessment after each practical, while fifteen per cent said they never completed it at all. This is in contradiction to the submission rates as evidenced in Figure 3.3 where an average submission rate of seventy six per cent was found. This is higher than the students perceived their completion rate. A similar question asked how often they read the feedback rubric from the lecturer. It was interesting to see the variation found in this answer. Thirty one per cent of students reported that they read the feedback after practical one, twenty three per cent after practical 2, eight per cent after practicals 3-6, while fifteen per cent of students stated they never read any aspect of the lecturer's feedback.

Fifty percent of the students that did not engage with the research, in that they did not complete the self-assessment rubric or engaged with the lecturer's feedback over the ten weeks, stated they did not have the time to do so. The other fifty percent that did not engage with the research said they forgot.

Student engagement with the rubric was further illustrated during the interviews. Interviewee 1 reflected a positive stance from their engagement with the process:

*"I used it to see where I could improve and to stop myself making common mistakes".*

(Interviewee 1)

A copy of the interview transcripts are located in Appendix 10. In addition, interviewee 1 showed that the research instructed their learning as they used the criteria given in the rubric to inform the practice of their writing skills within their laboratory practical write up.

*'I followed the 70-80% criteria and tried to include all the points that were listed.'*

(Interviewee 1)

Interviewee 2 also engaged with the self-assessment rubric to try and improve their mark for the next laboratory practical submitted:

*"I would look at where I fell in marks and try and improve those marks in my next write up".*

(Interviewee 2)

Andrade and Du (2005) discovered that some students admitted that, although they used a rubric to plan an assignment they rarely read every level or graduation within the rubric. The research undertaken here found that some students were using the rubric as a metric to increase their grades. Andrade and Du (2005) showed how students within their research review the scores from the lecturer and used this as a point to reflect on what the scores meant regarding the quality of their submitted work. They also reported that rubrics were thought as a fair way to grade by the participant of their research.

As can be seen in Figure 3.4 there is a direct correlation between student engagement with the self-assessment rubric and the laboratory practical mark achieved by each student. The bar chart in Figure 3.4 illustrates that students who engaged one hundred percent with the research process (submitted a self-assessment rubric for each practical) for example student 10, achieved a high practical mark. Also evident on this graph is the two students number 15 and 16, who did not engage with the research and obtained low marks with respect to others that did engage in the process. The Pearson  $r$  correlation was used to describe the relationship between these two variables (Thomas et al., 2015). In this case the variables were, student engagement with the rubric-based self-assessment and the student's practical mark. Pearson's  $r = 0.88$ , which demonstrated a very high correlation between both parameters can be considered a large effect. If Pearson's  $r = +/- 0.5$ , it is considered a large correlation,  $+/- 0.3$  it is medium, and  $+/- 0.1$  it is small (Thomas et al., 2015).

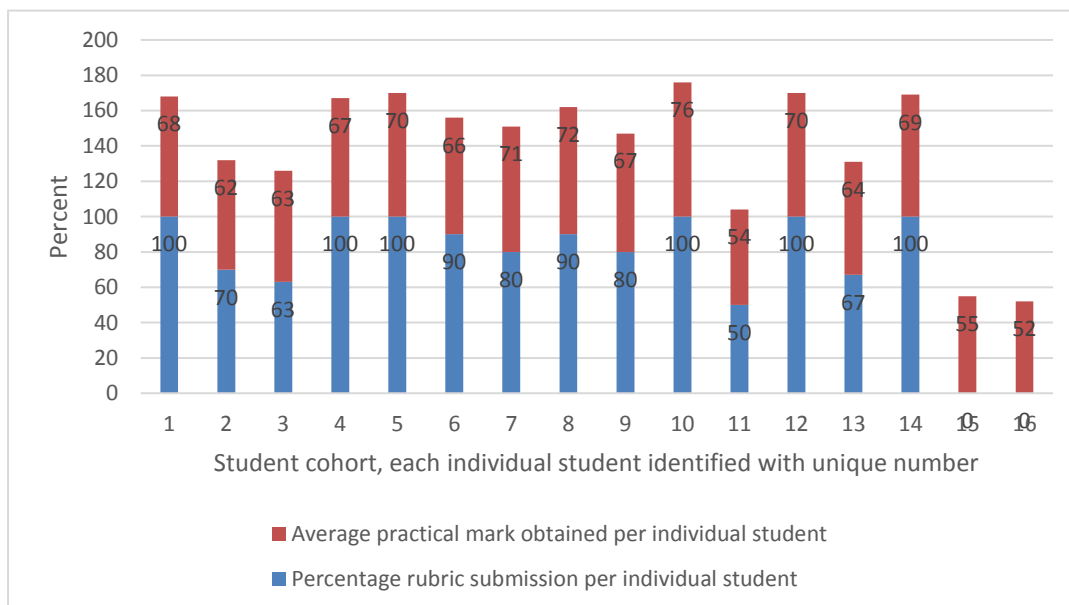


Figure 3.4: Bar chart showing correlation between individual student engagement with rubric and their achieved practical marks.

From the data shown in Figure 3.4 it can be seen that student engagement with the research process yielded a positive reward reflected in the marks achieved by the student. It is obvious that students 15 and 16 did not benefit from this intervention and also student number 11 who only submitted fifty per cent of the time, had a lower mark than those who submitted the self-assessment rubric at a higher rate.

### 3.5.2 Research Question 2

What is the student's understanding of a rubric-based self-assessment?

Overall the students' comments regarding the use of rubric-based self-assessments were consistently positive which is reinforced in the research by Andrade and Du (2005) and Eshun and Osei-Poku (2013). Interviewee 1 spoke positively when asked about engaging with the self-assessment rubric and feedback sheet:

*“if I hadn't been doing them I would have had the same mark that I got in the first one ....first mark was 69% and the last mark was 85%”.*

(Interviewee 1)

Students were asked in the questionnaire if they had ever encountered self-assessment over their academic studies, all students answered no. When asked in the interview if they understood what self-assessment was, they all answered similarly. These questions explored what was the students' perception of their own understanding of self-assessment. Interviewee 3 stated:

*“to assess how you do yourself”.*

(Interviewee 3)

Interviewee 2 was very positive about the self-assessment saying it was a “good idea” and it showed you:

*“where you stood with marks and where your lecturer thought you were at”.*

(Interviewee 2)

In the questionnaire students were asked to rate their understanding of the following:

A: Self-assessment using a rubric marking scheme

B: Written feedback using the same rubric marking system

C: The marking scheme for laboratory practical write ups

the results of which are tabulated in Table 3.3.

Table 3.3: Students rating of their understanding of the self-assessment using rubric (A), written feedback using rubric (B), marking scheme used in laboratory practical write-ups (C)

	None	Very little	Moderate amount	A lot	Quite a lot	A very great deal
A	8%	23%	0	23%	23%	23%
B	15%	8%	8%	23%	15%	38%
C	8%	0	15%	31%	8%	31%

From Table 3.3, the understanding of self-assessment using a rubric marking system varied from eight per cent of the students at ‘none’ to twenty three per cent knowing ‘a very great deal’. In question B, which checked for understanding of the feedback rubric, fifteen per cent of students said ‘none’ while thirty eight per cent said ‘a very great deal’. However, this fifteen per cent of students may be the same fifteen per cent that never engaged with the self-assessment or feedback during this research. Thirty one per cent of the students surveyed in the questionnaire understood a ‘very great deal’ about knowing the marking scheme for the laboratory practical write up used in this research. This was also substantiated by students in their interviews:

*“Like you’re missing things in some practicals and not knowing why you’re missing it, but when you were told this is why you got marked in that section, because you didn’t have that or you didn’t talk about this enough, and it was just on this one spreadsheet and wasn’t all these red marks all down the side of your report and everything in it”.*

(Interviewee 3)

In relation to engagement with the self-assessment rubric and written feedback, as Interviewee 3 put it:

*‘wish I had done so sooner’.*

(Interviewee 3)

### 3.5.3 Research Question 3

Can student self-assessments agree with lecturer assessments over a given time period?

The students’ self-assessment mark together with the lecturer’s assessment marks for each laboratory practical write up were recorded on an excel spreadsheet. A copy of this can be found in Appendix 3. The difference between the average students’ mark and the corresponding lecturer’s marks were calculated for each practical submission. An overall average of the differences for each practical was graphed and is shown in Figure 3.5.

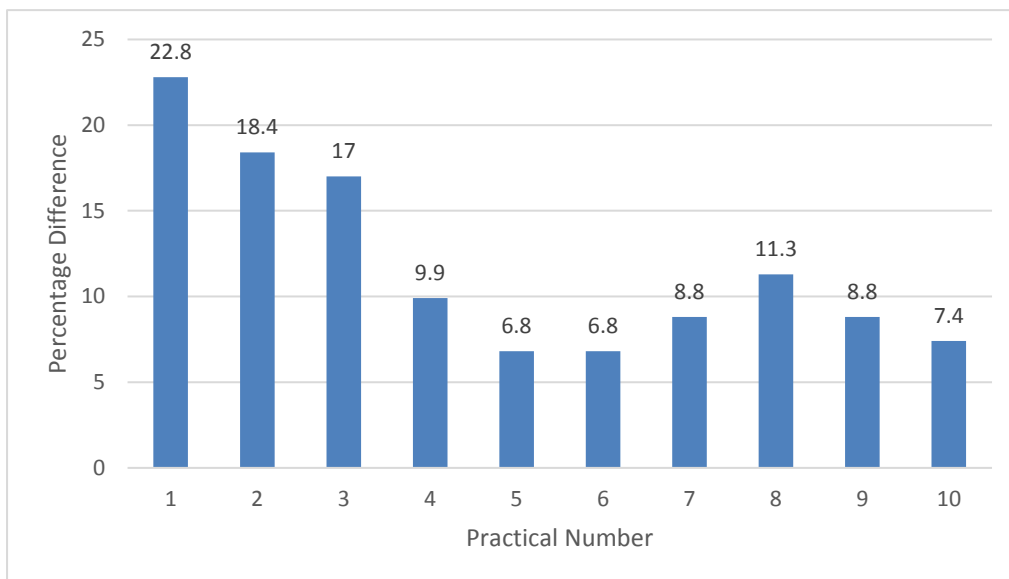


Figure 3.5: The average difference between the marks awarded by the lecturer and the marks awarded by the student from the self-assessment over the 10 week research period



It is apparent from Figure 3.5, that there was a decrease in the average difference between the students' self-assessment score and the lecturer's assessment scores for the same laboratory practical write up over the ten weeks of self-assessments. There was a significant difference found between the student and the lecturer after practical one, the difference being twenty two point eight per cent. After practical 2, this difference dropped by four point four per cent and by week 5 and 6 it dropped to its lowest at six point eight per cent. These findings suggest that the students struggled with self-assessment initially but once feedback was received the differences in the scores between self-assessment and lecturer reduced. These results reflect those observed in a study by Boud et al. (2013) who suggested that the combination of time and benchmarks scores from the tutor appeared to improve accuracy. This was further supported by Lynch et al. (2012) research that also found that once the students had received lecturer feedback and consequently they were familiar with what was required of them, the students were better equipped to assess their own work.

By practical 10, the difference was reduced to seven point four per cent. Practical 7 saw a small increase of two per cent to eight point eight per cent. Practical 7 was submitted after the mid-term reading week. A possible explanation for this difference may be similar to what Boud et al. (2013) found that when students have a period where engagement is broken, their next assessment can be at odds with the lecturer's marks but the positive correlation between their own self- assessment rubric marking and that of the lecturer is more rapid. Week 10 at seven point four per cent was slightly higher than week 6 and 7 which reflects Boud (2013) findings. The standard deviation of the averages percentage decreases as illustrated in Figure 3.7, was also calculated but is not shown. Over the ten weeks of practicals a standard deviation of 16.6 for practical 1 was recorded and this reduced to 7.72 at practical 10.

While the above results, in relation to the students' marks, show convergence over time, that of the lecturer's are reflective of Boud et al. (2013) research. They do not, however support Boud et al. (2013) findings on students' estimation of their own marks. Boud et al. (2013) found that students who partook in his research underestimated their marks, this is in complete contrast to the students engaged in this research.

Figure 3.6 illustrates the students' estimation of their marks in respect to that of the lecturer. While Figure 3.5 demonstrates convergence of marks between the student and the lecturer over a period of time, the actual expectation of marks that should be awarded remained elevated. In Figure 3.8, an average of eighty six per cent of participating students overestimated the marks

they achieved while only two per cent underestimated these marks. For the purpose of illustration, if the mark fell within plus or minus one percent of the lecturer’s mark, this was recorded as being the same. Over the ten practicals submissions, an average of eleven per cent of students using the self-assessment rubric marked themselves the same as the lecturer. Although these findings contradict Boud et al. (2013) they may reflect Barney et al. (2012) research in that the results shown above suggest that the lecturer may be a tough assessor. Barney et al. (2012) also refer to a gap in perception of what the students feel they deserve and what the lecturer accredits to them.

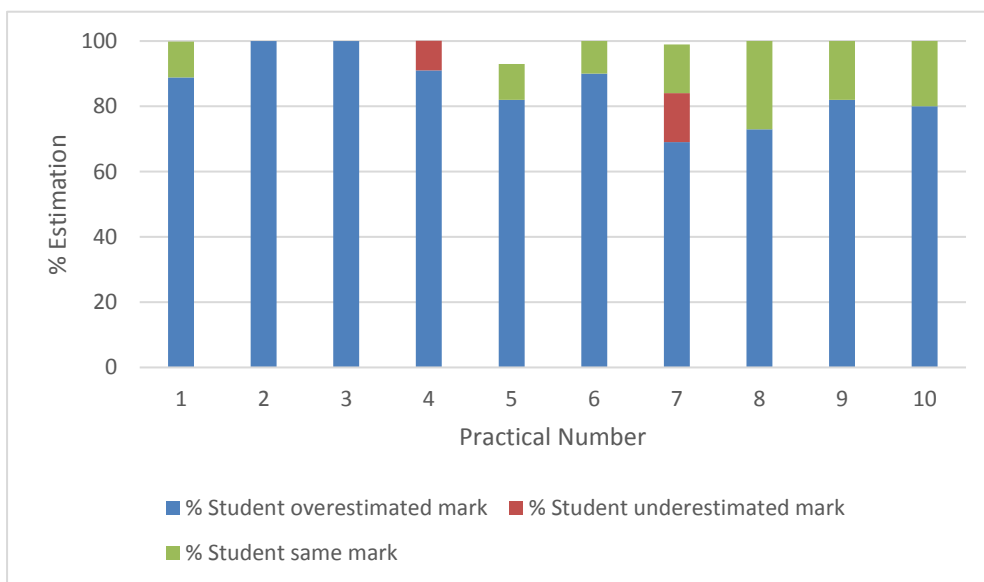


Figure 3.6: The estimation of students’ marks from their self-assessment rubric versus the lecturer marks

Another possible explanation for this overestimation of marks is that the students were new to self-assessment and the use of rubrics. This finding is supported by question three on the questionnaire which enquired if the student had encountered self-assessment previously, all respondents answered ‘no’. More effective training in the area of self-assessment and the use of rubrics may facilitate a better appreciation and understanding of the assessment process which is supported by Eshun and Osei-Poku (2013). Jonsson and Svingby (2007) suggest that lecturers should include practice sessions to familiarise the student with the process of assessment.

One of the most surprising aspects of this data is the number of students who awarded themselves high marks. On their first attempt of self-assessment after practical one fifty six per cent of the students self-assessed their mark using the self -assessment rubric as greater than ninety five per cent. In comparison the lecturer's awarding of marks was substantially lower averaging between sixty to sixty five per cent.

#### **3.5.4 Research Question 4**

Does the same assessment rubric, when supplemented by written feedback from the lecturer, enable the student to improve their mark?

Andrade and Du (2005) found when using a rubric to assess students, that once the student knew what to do this helped focus their effort and identify their strength and weakness within their work. This skill was ascertained when feedback was given which helped to improve their mark and their understating of the fairness of the received grade. The lecturer/researcher results supports Andrade and Du (2005) findings.

The lecturer used a question in the interview to ascertain if the students perceived if their practical marks had improved over the research period.

Interviewee 1 said it:

*“improved constantly by about 2% every week”.*

(Interviewee 1)

However, sometimes the marks did not show an improvement as was explained by interviewee two's answer to question four;

*“other weeks when I was rushing, I didn't take on board the comments made”.*

(Interviewee 2)

When asked another question in the interview if the same rubric supplemented by written feedback from the lecturer helped, interviewee 3 commented:

*“this term all along we knew what was dragging us down, what areas of our report was dragging us down, and I just thought the feedback was a very good idea”.*

(Interviewee 3)

The student cohort is ever changing. Reliance on part-time work and other commitments appear to be turning the students into very strategic learners, unwilling to devote effort to study which does not contribute to summative assessment (Bloxham and Boyd, 2007). As the research cohort included mature students study-life balance may encourage strategic learning. Using a rubric such as the one used in this research could easily form a strategy for students learning. It may develop into ‘give the teacher what they want’ (Andrade and Du, 2005) and selective learning only from the rubric being used. Xiaohua and Canty (2012) cautioned that while rubric-based self-assessment rubrics aided learning, the student may concentrate solely on what is in the rubric and not extend their learning outside the rubric. This may be advantageous for science students’ laboratory practical write up assessments, as the students are asked to submit their practical write up in a very strict controlled format that is reflective of industrial standard operating procedures.

To investigate the research question further, the self-assessment marks for the individual student for each practical were plotted on a line graph together with the assessment marks from the lecturer. Figure 3.7, illustrates a sample of the findings for students that took part in the research. All participant data for this graph has been plotted and is included in Appendix 11. This research found that although the students’ self-assessment mark was varied the lecturer’s assessment marks improved over the period. This increase in mark from the lecturer is attributed to use of the written feedback that was combined with the lecturer’s assessment rubrics.

In Figure 3.7, student 1 is an example of a student who engaged one hundred per cent with the self-assessment rubric and feedback system. While the student over-estimated their mark when self-assessing over all ten practicals, awarding themselves one hundred per cent for the first self-assessment, their reflective mark from the lecturer was lower but increased over the period. However, this trend was contradicted over the last two weeks when the lecturer assessment

marks reduced. Student one's standard deviation, between self-assessment mark and awarded mark, dropped from a high of 23.3 on week 1 to 6.4 in week 10, indicating that the students marks have improved over the ten weeks of the research period. This supports the research question above and also substantiates research question number 3. Student 4, fully engaged with the assessment and saw an increase in lecturer's marks over the ten weeks of practicals. The student overestimated their mark initially but converged with the lecturer marks which increased. Their standard deviation dropped from 14.1 after practical one to 3.5 after practical ten suggesting that if the self-assessment continued, the marks between the student and the lecturer may completely converge.

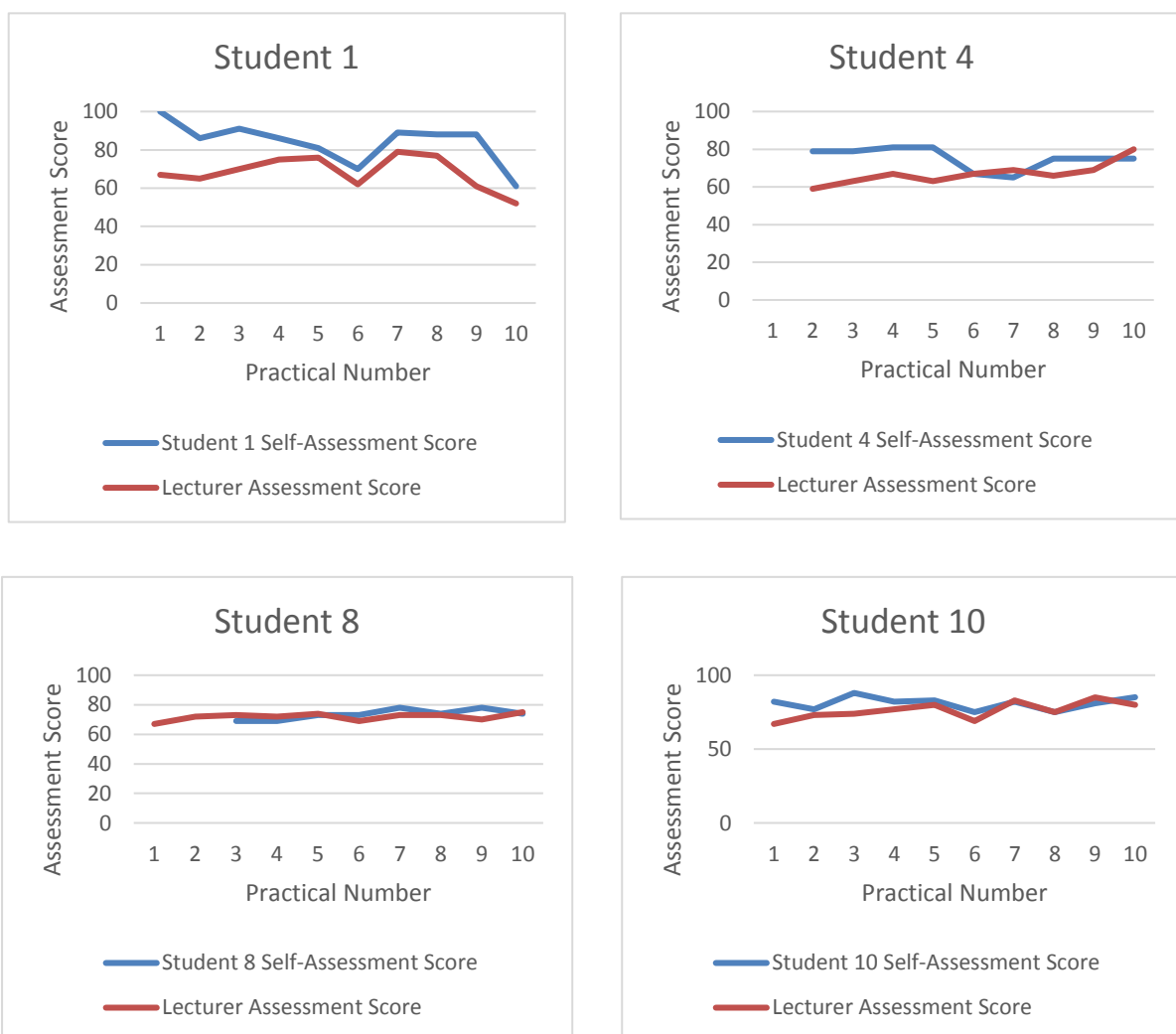


Figure 3.7: Individual student self-assessment marks and the corresponding lecturer assessment marks over the ten week laboratory practical period

Student 8, assessments marks matched the lecturer's marks on four occasions with a very low average standard deviation of 2. Student 8, was able to judge from the beginning where their marks corresponded in relation to each segment of the assessment rubric and was able to make judgements and demonstrate by such that their meta-cognitive skills were high. There was a steady increase in scores throughout the ten practicals for this particular student. These findings for student eight agree with Boud et al. (2013) who claimed that students who were accurate at estimating their assessment score, showed an increase in marks also.

Student 10 graded highest in class. The student overestimated their grade in the beginning with a standard deviation of 10.6 which dropped immediately to 2.8 once the first feedback sheet was given. For eight of the practicals the standard deviation remained below 4.2, dropping to 0 after practical eight. Jonsson and Svingby (2007) reported that self-assessment together with the rubric marking scheme indicates that learning is promoted by the meta-cognitive processes involved in this type of assessment. The self-assessment encouraged reflective practice and self-regulation (Lynch et al., 2012) which is apparent in the results achieved by all students and illustrated by students 4, 8 and 10 above. Student 1 whose marks did increase initially but showed decrease in the last two weeks possibly may not have had the time commitment to invest in their practical write up at this juncture. Barney et al. (2012) found similar results. Other factors, as suggested by Barney et al (2012), include students citing other courses and personal reasons as factors limiting their ability to take full opportunity of the feedback.

This research question was also addressed at the interview, when students were asked if the feedback helped with improving grades; Interviewee 1 stated:

*“Definitely, because I would have kept making the same mistakes if it hadn't been highlighted where I was going wrong”.*

(Interviewee 1)

Interviewee 3 also reflected the opinion of Interviewee one however, they said that while they had read through the feedback comments, when it came to writing up the next laboratory practical:

*“I had forgotten”.*

(Interviewee 3)

While in the case above, the student forgot what was written in the feedback, some situations occur that the student does not take the time to read the feedback and this finding was supported in studies by Barney (2012) and Lynch (2012). Both of these authors commented that the students want feedback but do not necessarily engage with it and often do not read all of it and clearly understand what it is trying to reinforce and highlight.

The student answers to the questionnaire raised some interesting points. When asked what helped them improve their grade, forty six per cent 'agreed' that the assessment rubric helped explain the marking system more clearly; sixty two per cent 'agreed' the self-assessment rubric made them engage better with the practical write up; fifty four per cent 'agreed' that the assessment rubric enhanced their learning experience of the laboratory practical work and fifty four per cent 'agreed' that the assessment rubric helped them reflect on their course work and become a more independent learner. While these findings are very positive this may have been a result of the students 'ticking the box' as this was the last question on the questionnaire and these results are not substantiated or reflective of the marks achieved.

Other results that came through the questionnaire were quite interesting. Students were asked to 'list three things you learned from using the rubric self-assessment for your practical work'. The students' answers fitted into the following seven broad themes and the percentage of the students who answered in each theme is noted in parentheses : one: gaining an understanding of where things went wrong, where marks were lost in the practical write up (fifteen per cent); two: understanding how to structure a practical well to gain most marks (forty four per cent); three: learning what the value for each section of the practical write up (twenty six per cent); four: gaining a better understanding of the lab work (four per cent), five: it helped with improving referencing (four per cent), six: it gave me confidence for the next practical and seven: it helped improve my own self-assessment (four per cent). It is interesting to note that the first three points raised are very student 'grade' focused. These are the main points that the students want to address to gain most marks. The latter four points, from a lecturer's perspective, reflect more on the learning process and what the lecturer would like the student to focus on. The student focus themes were also observed by Andrade and Du (2005) whose research suggested that the students used the self-assessment and rubrics to improve their work and grades. In the same study, Andrade and Du (2005) remarks that his students mentioned they were less anxious knowing what they were aiming for, using the rubric made it easier and improved the students' confidence.

### 3.6 Discussion

Research question number one showed very interesting data in that the timing of the study has an effect on student engagement as can be seen in Figure 3.4 and the related discussion. This finding could inform future studies to be cognisant of the placement and timing of their teaching tool and assessments within an academic semester. Unique findings for use of a self-assessment rubric with a science laboratory practical are illustrated in Figure 3.4. It can be clearly seen that there is a significant correlation between students that have used the self-assessment rubric on a weekly basis and the marks they obtained for this element of their module. This is a very encouraging find as it clearly shows that the rubric has enhanced the learning for the student as is reflected by the increased marks and as such is a very useful tool for the practical element of a food science module.

Research question number two illustrated that although students had never used self-assessment or a rubric marking scheme previously, they found undertaking this research a positive experience. When asked to rate their understanding of the research they had participated in, certain aspects were perceived as being understood better than others by the cohort. In relation to understanding of self-assessment using rubric thirty one per cent of the students had a negative perception (none – very little) while sixty nine per cent had a positive perception (moderate – a very great deal). Their understanding of written feedback using the same rubric marking scheme showed a decrease in the negative perception, twenty three per cent with seventy seven per cent being positive. The biggest differentiation on perceived understanding was in relation to the marking scheme for the laboratory practical write ups. Only eight per cent of students had a negative perception while ninety two per cent was positive. It is interesting to find that students rated their understanding of the marking scheme as highest in comparison to their understanding of the rubric. Clarity around mark distribution for the laboratory practical write up may enhance student engagement with this assessment process.

Research question number three did show that there was convergence between the students' self-assessment and the lecturer's assessments. A continuous period of engagement of the student with the self-assessment rubric showed substantial convergence of their marking and that of the lecturer, decreasing to six point eight per cent from an initial twenty two point eight per cent difference. This data supports the continuous use of this self-assessment rubric over an academic semester rather than at intervals as breaking the cycle of use affects the positive



outcome of convergence. This unexpected finding of overestimation of worth from students with respect to their laboratory practical marks is quite alarming. It could be due to the fact that they are novices in the area of self-reflection and as such self-assessment. This finding may be addressed by supporting the student more rigorously throughout this research process. It may suggest that intervention during the research process may be needed. This intervention may be supported with verbal feedback and illustrations of where the differences between marks awarded is occurring. In addition to the above suggested supports, a case could be put forward for a programme based strategy of assessments that are applied across all laboratory practical elements of modules within an undergraduate science degree. This strategy is also highlighted within QFI's documentation on assessment and standards (QFI, 2013).

Research question number four demonstrated that in all cases where students engaged with the research process their marks improved. There was a notable drop in the standard deviation between the students' self-assessment mark and that given by the lecturer over the period of the research. This has been attributed to student assimilation of lecturer written feedback during this research. This finding is also supported by all research questions undertaken in this study.

## **Section Four: Recommendations and Conclusion**

Although the findings of this research have been very informative and in some aspects unique, there are some other factors that need to be considered. Eshun and Osei-Poku (2013) has highlighted that if the research undertaken is not assimilated by the student or the student is not provided with a future opportunity to use this knowledge then this new skillset of self-assessment and self-regulation becomes redundant. It is imperative that the students are given the opportunity to use this skill set again in other modules with laboratory based practicals. In future, from these research findings, self-assessment rubrics supported with written lecturer feedback should be considered as an assessment strategy for laboratory based subjects by LYIT. Engaging the students in the process of rubric design may deepen their understanding of the learning outcomes which are to be assessed and the process of assessment itself. Having the student involved in appropriate elements of their own assessment is encouraged by experts in the field of assessment such as Race (2009p 27).

To further facilitate the lecturer when assessing the laboratory practical write-up and to ensure continuous and timely feedback, a computer programme could be designed based on the rubric used in this research. Such a system could be structured that once the lecturer has assessed the practical, this would be immediately available to the student. This would be of benefit to both the lecturer and the student.

The skills that participating students learned and demonstrated in this research should strengthen their interaction with all laboratory practical write ups during their academic studies. This learning could be supported further by demonstration of exemplars and training in the use of rubric based assessment. Early introduction of the rubric is vital in higher education to build student competencies and confidence in using assessment rubrics. Student induction, to reflective processes, at an early stage in their academic career will also support self-assessment and in turn support self-assessment rubrics.

The research found that students who engaged, dramatically improved their mark in the component that was assessed during this research compared to non-engaged students. The self-assessment rubric and feedback allowed this to occur, this substantiates that rubrics are an effective teaching tool for the enhancement of student learning and should be used more often in practical laboratory elements.

This research not only allowed the students an opportunity to explore an alternate pedagogy than is currently offered in the food science modules in LYIT, but also encouraged their reflection, through self-assessment and ‘critical self-analysis of practice’ which aligns with the higher levels of Blooms Taxonomy for these Level 7 students.

The introduction of a rubric marking scheme in combination with self-assessment, as demonstrated by this research study, has proven to be a very successful teaching tool for the enhancement of student learning in the laboratory practical element of a food science and nutrition degree. Findings show that student engagement with the teaching tool that was trialled through the course of this research resulted in increased formative assessment marks. Students’ participation in and understanding of, a new pedagogical strategy is evident. The immersion of students in the self-assessment aspect of this research supports the LYIT strategic plan that encourages students to take greater responsibility for their own learning and to prepare students for a lifetime of learning (LYIT, 2014).

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## Appendices

## Appendix 1

### Student Self-Assessment Rubric

Date:

Student Name: \_\_\_\_\_

Practical Number:

Cover sheet should include Practical Subject and Number; Title of Practical; Date; Student Name and Number.

Marking Criteria	Practical Aim	Introduction	Method	Results	Discussion	Conclusion	Reflection	References	Grammar
	Why was the procedure carried out? What are you trying to investigate?	Describe the theory that supports the Science in the practical.	Summarise method used written in past tense and passive voice.	Describe your observations/findings.	Discuss your findings, why did you get these results? Could it be to do with the intrinsic properties of test product/media used?	What are your overall conclusions from the experiment?	Reflect on how the experiment went? What would you change, what improvements would you make so it would run better the next time you did it?	Harvard referencing used. Evidence of use of books, journals and lecture notes.	Grammar and spelling is correct
<b>Criteria</b>	<b>5%</b>	<b>20%</b>	<b>10%</b>	<b>20%</b>	<b>25%</b>	<b>5%</b>	<b>5%</b>	<b>5%</b>	<b>5%</b>
<b>70 - 100%</b>	Main aims of practical clearly laid out.	Reason for testing product discussed. Scientific details of the product included, what results are expected and why. References included. What other methods can be used to test this product for similar organisms?	Method written in past tense with any adjustments made to method during practical class included.	All results described. Tables clearly labelled. Photo included. Results graphed & clearly labelled. All calculations shown in full.	Results for product tested discussed including reasons for getting these results. Excellent references used to support argument. Results referenced against Reg 2073. Product details included.	Excellent, logical conclusion of the overall experiment	Reflected on how the experiment went. What went well and what did not go well. Suggested changes for improvement, if they were to do it again.	Excellent references in correct format, references cited well.	Excellent grammar & spelling.



<b>60 - 69%</b>	Main aims of practical are not clear.	Reason for testing product discussed. Scientific details of the product included, what results are expected and why. References included.	Method written in past tense straight from manual.	All results described. Tables clearly labelled. Photo included. Graphs not included. All calculations shown in full.	Results for product tested discussed including reasons for getting these results. References included to support argument are satisfactory. Results referenced against Reg 2073. Product details included.	Adequate logical conclusion of the overall experiment .	Reflected on how the experiment went. Suggested changes for improvement, if they were to do it again.	References satisfactory, use of citation.	Grammar & spelling satisfactory
<b>40 - 59%</b>	Main aims of practical not included.	Reason for testing product discussed. References included.	Method not written in past tense.	All results described. All results tabulated & tables clearly labelled. No graphs or photo.	Results for product tested discussed including reasons for getting these results. References included to support argument are adequate. No reference to Reg 2073. Product details included.	Satisfactory conclusion of the overall experiment .	Reflected on how the experiment went. No suggestions included for improvement.	Referencing not in correct format, poor citation of references.	Grammar poor & spelling satisfactory
<b>&gt;39%</b>	No aims included.	Reason for testing product discussed but references not included.	Method copied straight from manual.	Results described. Results not in table format with no graphs or photo.	Results discussed but little evidence included to support argument. No reference to Reg 2073. Product details included.	no conclusion reached	no reflection included	no references included.	Grammar & spelling poor
<b>Grade</b>									
	0	0	0	0	0	0	0	0	0

**Total Grade 0**

## Appendix 2

### Lecturer Practical Assessment Rubric and Feedback Sheet

Date:

Student Name: \_\_\_\_\_

Practical Number:

Cover sheet should include Practical Subject and Number; Title of Practical; Date; Student Name and Number.

Marking Criteria	Practical Aim	Introduction	Method	Results	Discussion	Conclusion	Reflection	References	Grammar
	Why was the procedure carried out? What are you trying to investigate?	Describe the theory that supports the Science in the practical.	Summarise method used written in past tense and passive voice.	Describe your observations/findings.	Discuss your findings, why did you get these results? Could it be to do with the intrinsic properties of test product/media used?	What are your overall conclusions from the experiment?	Reflect on how the experiment went? What would you change, what improvements would you make so it would run better the next time you did it?	Harvard referencing used. Evidence of use of books, journals and lecture notes.	Grammar and spelling is correct
<b>Criteria</b>	<b>5%</b>	<b>20%</b>	<b>10%</b>	<b>20%</b>	<b>25%</b>	<b>5%</b>	<b>5%</b>	<b>5%</b>	<b>5%</b>
<b>70 - 100%</b>	Main aims of practical clearly laid out.	Reason for testing product discussed. Scientific details of the product included, what results are expected and why. References included. What other methods can be used to test this product for similar organisms?	Method written in past tense with any adjustments made to method during practical class included.	All results described. Tables clearly labelled. Photo included. Results graphed & clearly labelled. All calculations shown in full.	Results for product tested discussed including reasons for getting these results. Excellent references used to support argument. Results referenced against Reg 2073. Product details included.	Excellent, logical conclusion of the overall experiment.	Reflected on how the experiment went. What went well and what did not go well. Suggested changes for improvement, if they were to do it again.	Excellent references in correct format, references cited well.	Excellent grammar & spelling.

<b>60 - 69%</b>	Main aims of practical are not clear.	Reason for testing product discussed. Scientific details of the product included, what results are expected and why. References included.	Method written in past tense straight from manual.	All results described. Tables clearly labelled. Photo included. Graphs not included. All calculations shown in full.	Results for product tested discussed including reasons for getting these results. References included to support argument are satisfactory. Results referenced against Reg 2073. Product details included.	Adequate logical conclusion of the overall experiment.	Reflected on how the experiment went. Suggested changes for improvement, if they were to do it again.	References satisfactory, use of citation.	Grammar & spelling satisfactory
<b>40 - 59%</b>	Main aims of practical not included.	Reason for testing product discussed. References included.	Method not written in past tense.	All results described. All results tabulated & tables clearly labelled. No graphs or photo.	Results for product tested discussed including reasons for getting these results. References included to support argument are adequate. No reference to Reg 2073. Product details included.	Satisfactory conclusion of the overall experiment.	Reflected on how the experiment went. No suggestions included for improvement.	Referencing not in correct format, poor citation of references.	Grammar poor & spelling satisfactory
<b>&gt;39%</b>	No aims included.	Reason for testing product discussed but references not included.	Method copied straight from manual.	Results described. Results not in table format with no graphs or photo.	Results discussed but little evidence included to support argument. No reference to Reg 2073. Product details included.	no conclusion reached	no reflection included	no references included.	Grammar & spelling poor
<b>Grade</b>									
	0	0	0	0	0	0	0	0	0

**Total Grade 0**

Lecturer Feedback
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### Appendix 3

Student Self Assessment Practical Results and Lecturer Assessment Practical Assessment Scores																																									
	1	SA	LA	Diff	2	SA	LA	Diff	3	SA	LA	Diff	4	SA	LA	Diff	5	SA	LA	Diff	6	SA	LA	Diff	7	SA	LA	Diff	8	SA	LA	Diff	9	SA	LA	Diff	10	SA	LA	Diff	Number SAs completed
Student 1	x	100	67	33	x	86	65	21	x	91	70	21	x	86	75	11	x	81	76	5	x	70	62	8	x	89	79	10	x	88	77	11	x	88	61	27	x	61	52	9	10
Student 2			57				62				53		x	36	65		x	17	63		x	10	61		x	35.3	60		x	22	62		x	35.5	62		x	22.1	71		7
Student 3			67		x	78	62	16	x	68	60	8	x	90	62	28	x	77	56	21	s	s			x	77.5	62	15.5		s				59				75		5	
Student 4			s		x	79	59	20	x	79	63	16	x	81	67	14	x	81	63	18	x	67	67	0	x	65	69	-4	x	75	66	9	x	75	69	6	x	75	80	-5	9
Student 5			52		x	88	63	25	x	87	64	23	x	88	74	14	x	84	72	12	x	81	70	11	x	81.2	75	6.15	x	82	76	6.2	x	86.8	72	14.8	x	85.3	78	7.3	9
Student 6	x	72.2	68	4.2	s	s	s		s	s	s		x	78	67	11	x	73.3	69	4.3	x	71	59	12	x	87.3	65	22.3	x	82	55	27	x	83.8	72	11.8	x	82	70	12	7
Student 7	x	74	67	7			71				68		x	78	68	10	x	77	64	13	x	73	68	5	x	80	74	6	x	80	72	8	x	80	81	-1	x	80	80	0	8
Student 8	x	68	67	1			72		x	69	73	-4	x	69	72	-3	x	73	74	-1	x	73	69	4	x	77.5	73	4.5	x	74	73	1	x	77.5	70	7.5	x	74	75	-1	9
Student 9	x	95	55	40	x	90	52	38	x	75	48	27			71			66		x	79	68	11	x	93.5	82	11.5	x	95	76	19	x	76	75	1	x	91.5	73	19	8	
Student 10	x	82	67	15	x	77	73	4	x	88	74	14	x	82	77	5	x	83	80	3	x	75	69	6	x	82	83	-1	x	75	75	0	x	81	85	-4	x	85	80	5	10
Student 11			50		x	83	64	19	x	76	47	29		s				49			s			x	84	48	36	x	79	56	23			55				65		4	
Student 12	x	95	68	27	x	86	65	21	x	80	67	13	x	76	72	4	x	80	77	3	x	72	63	9	x	65.8	66	-0.3	s	s		x	97	78	19	x	93.5	77	17	9	
Student 13	x	100	53	47	x	76	63	13			67		x	70	67	3	x	63	63	0	s	s		x	58.8	61	-2.3	x	71	70	0.5	x	70.5	68	2.5			67		6	
Student 14	x	96	65	31	x	89	64	25	x	90	67	23	x	90	68	22	x	84	81	3	x	75	66	8.5	x	85	75	10	x	83	73	10	x	78.5	66	12.5	x	79	67	12	10
Student 15			51				57			s					59				62			s				48				53				55					53		0
Student 16			39				45				38				44				49			33				65				70				66					71		0

Key: SA= Student Self-Assessment  
 LA: Lecturer Assessment  
 Diff: The different between the students' assessment score and the lecturer's  
 s: Student was sick and did not attend practical  
 x: rubric-based self-assessment submitted

## Appendix 4

### Consent Form

**Project Title:** Can a rubric be used as an effective teaching tool for the practical element of a food science degree module?

**Principal Researcher:** Cathy Hannigan

**Participants:** Third Year Food Science and Nutrition Students

The aim of this proposed research is to investigate whether or not a rubric can be used as an effective teaching tool in the practical element of a science module. There are ten practicals as part of the Food Microbiology Module. You will be asked to self-assess the 10 Food Microbiological practical reports using a rubric that I will provide. This self-assessment is part of a teaching and learning exercise to investigate the above question. You may be asked to be interviewed at the end of the 10 weeks, this is also voluntary. You can withdraw from this research at any time by sending me an e-mail to [cathy.hannigan@lyit.ie](mailto:cathy.hannigan@lyit.ie). This self-assessment mark will not impact upon the marks for the report. All data gathered will be stored securely and accessed only by myself and my supervisor.

Participant Declaration: \_\_\_\_\_, acknowledges that:

- I have been informed about the research and have the opportunity to ask questions
- I consent to the use of the data from my self-assessment rubric
- My participation is voluntary
- I can withdraw at any time by sending an e-mail to [cathy.hannigan@lyit.ie](mailto:cathy.hannigan@lyit.ie)
- I am aware that if I withdraw my consent that it will not affect my practical marks
- I give consent to the publication of the results; the identity of participants will remain anonymous
- I give my consent to be interviewed, if requested.
- I give my consent to be surveyed, if requested.

Participant's Name: \_\_\_\_\_

Student Number: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

I, the researcher, have stated the purpose and procedure involved in this piece of research. I have answered any questions that the participant had in relation to the study and I am satisfied. I believe the participant has understood my explanation and purpose of this study and has given me informed consent.

Researcher's signature: \_\_\_\_\_ Date: \_\_\_\_\_

## Appendix 5

### Information Sheet

As part of a teaching and learning exercise you will be asked to self-assess your weekly Food Microbiology lab report using a rubric marking system that I have developed. There are 10 practical reports in total. The rubric marking system will be clearly explained before the self-assessment commences.

I wish to investigate whether or not a rubric can be used as a teaching tool for the practical element of this module. I will also complete the same rubric marking system and provide weekly feedback. You will be able to compare marking sheets, i.e. your own self-assessment sheet as well as mine and hopefully gain a better understanding of where marks are awarded or deducted when writing a lab report.

The self-assessment sheet that you complete will be held securely on a password protected file on my computer that has a password protected screen saver. All data presented in the project will be presented in the research work anonymously.

Participation is voluntary and you can withdraw at any time by sending me an e-mail to [cathy.hannigan@lyit.ie](mailto:cathy.hannigan@lyit.ie). Withdrawing your consent or not taking part in the research will not affect your mark for your practical report.

At the end of the ten weeks I will ask a few people to volunteer to be interviewed as part of this learning exercise. A class survey may also take place. Anyone that may become distressed by an interview will not be asked to partake, it will be voluntary only. This will be carried out after all the practical reports have been submitted and marked, thus it will not have any impact on your practical marks.

Any questions regarding this teaching and learning exercise can be asked at any stage.

I can be contacted on extension 6054, [cathy.hannigan@lyit.ie](mailto:cathy.hannigan@lyit.ie) or Deirdre McClay on extension 6232, [Deirdre.McClay@lyit.ie](mailto:Deirdre.McClay@lyit.ie)

## Appendix 6

### MALT Questionnaire

1. Please circle your gender: Male / Female

2. Please place a tick in the box for what age group you are in:

19-22	23 – 25	26 – 28	29 – 31	32 – 35	>35
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. Did you do any kind of self-assessment on practical write-ups before encountering it on this course?  
Please circle: Yes/No

4. List 3 things you learned from using the rubric self-assessment for your own practical write ups

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

5. This question relates to the frequency of using the rubric-based self-assessment and written feedback for practicals number 1 to 10. Please tick the appropriate box.

- 1 = After every practical; 2 = After practical number 1 - 2; 3 = After practical number 3 - 4;  
4 = After practical number 5 - 6; 5 = After practical number 7 - 8; 6 = After practical number 9 – 10;  
7 = Never

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>
A How often did you complete the rubric self-assessment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B How often did you read the feedback rubric?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If you answered, Never, to A or B in question 5, please complete question 6, if not go to question 7.

6. On a scale of 1- 4 please rate the following, 1 being the most relevant;

- A. I did not understand the rubric
- B. I did not have time
- C. I do not have the confidence to complete a self-assessment
- D. Other – please comment in box provided

1. To what extent do you think the following helped improve your practical grade? Please tick the appropriate box.

1 = none;                      2 = very little;                      3 = moderate amount;  
 4 = a lot;                      5 = quite a lot;                      6 = a very great deal

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
A Self-assessment of my own practical write up using the rubric marking system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B Written feedback using the same rubric marking system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C Knowing the rubric marking system for practical write ups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

2. This question relates to your own learning experience when using the rubric; Please tick the appropriate box.

1 = strongly disagree;      2 = disagree;      3 = neutral;      4 = agree;      5 = strongly agree

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
A The assessment rubric helped explain the marking system more clearly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
B Using the self- assessment rubric made me more engaged with practical write ups	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
C Using the assessment rubric enhanced my learning experience of lab practical work	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D Using the assessment rubric helped me to reflect on my course work and become a more independent learner	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Thank you for your participation and cooperation in this research. Your responses will be kept confidential. Please scan your answers and complete any questions that you may have left out. I will present an overview of the results of this study to inform you about some of the findings.



## Appendix 7

Questionnaire and justification for each question:

<b>Research Title</b>	An investigation into the use of rubric-based self-assessment and written feedback as an effective teaching tool for the enhancement of student learning in the practical element of a food science degree module.	
	<b>Research Questions</b>	<b>Data Collection Method</b>
<b>Question 1</b>	Is the use of a rubric-based self-assessment, an effective tool for student engagement in laboratory practical write ups?	<ul style="list-style-type: none"> <li>• Students' rubric – based self-assessment</li> <li>• Lecturer's rubric assessment &amp; written feedback</li> <li>• Questionnaire</li> <li>• Interview</li> </ul>
<b>Question 2</b>	What is the students' understanding of a rubric-based self-assessment?	<ul style="list-style-type: none"> <li>• Questionnaire</li> <li>• Interview</li> </ul>
<b>Question 3</b>	Can student self-assessments agree with lecturer assessments over a given time period?	<ul style="list-style-type: none"> <li>• Questionnaire</li> <li>• Interview</li> </ul>
<b>Question 4</b>	Does the same assessment rubric, when supplemented by written feedback from the lecturer, enable the student to improve their mark?	<ul style="list-style-type: none"> <li>• Students' rubric – based self-assessment</li> <li>• Lecturer's rubric assessment &amp; written feedback</li> <li>• Questionnaire</li> </ul>

The questionnaire was built to meet the research questions as outlined in column three. The research questions were arrived at from the references quoted as well as from information gathered from the rubric.

<b>Question</b>	<b>Reference - validation Adapted from papers/rubric</b>	<b>Reason – which Research Objective (RO) does it met?</b>
1		Establish gender
2		Establish age
3	(Andrade and Du, 2005)	Self-assessment (RQ 1and RQ 3)
4		Use of rubric (RQ 1)

5 & 6	Derived from use of the rubric	Engagement with rubric & feedback (RQ 1, RQ 3 and RQ 4)
7	(Andrade and Du, 2005, Eshun and Osei-Poku, 2013, Lynch et al., 2012, Price et al., 2010)	All 3 Research questions
8	(Andrade and Du, 2005, Barney et al., 2012)	RQ 2 RQ 3 RQ 4
9	(Eshun and Osei-Poku, 2013)	RQ 3 RQ 4

## Appendix 8

### INTERVIEW QUESTIONS

1. What is your understanding of self-assessment?
2. What did you think when you were asked to self-assess your own practical write up?
3. How did you use the rubric assessment criteria to complete your practical write up?
4. Did your practical grade improve over the weeks?
5. If it did can you explain:  

If the self-assessment helped improve your practical grade?

What about the written feedback, do you think it helped improve your practical grade?
6. Did you find the use of the self-assessment and the written feedback helped you engage more with the practical work on an ongoing basis?
7. For future practical write ups would you recommend  

Completing a rubric-based self-assessment for each practical? (or for some)

Why?

Receiving written feedback for every practical in a rubric assessment criteria? (or for some)

Why?

## Appendix 9

### Interview Prep Worksheet

		Tick	Comment
1	Thanking interviewee		
2	Explaining purpose of research (again), confidentiality and anonymity		
3	Explaining that the interview can be stopped at any time if the interviewee wishes		
4	What will happen the data		
5	Request to record the interview electronically		
6	Amount of time		

### Interview

		Tick	Comment
1	Location of interview		
2	Date and time		
3	Setting		
4	Background of participant		
5	Immediate impression following interview on how it went		

## **Appendix 10**

### **Interviews Transcripts**

#### **Interview One**

What is your understanding of self-assessment?

So I just use it to see where I could improve and to stop myself making common mistakes that where ....

What did you think when you were asked to self-assess your own practical write up?

Never done it before but found it good and the reason I thought I was being asked to do was so that I could see where I was going wrong for myself and then doing so I would be able to improve my mark.

Though that came from yourself?

Yeah

Very good

How did you use the rubric assessment criteria to complete your practical write up?

I followed the 70 -100% criteria and tried to include all the points that were listed.

So you went straight for ?

The highest one

Oh very good

Did your practical grade improve over the weeks?

It improved constantly by about 2% every week except for one week where it was lower, but that was because I didn't do a good one that week.

If it did can you explain:

If the self-assessment helped improve your practical grade?

Definitely because I would of kept making the same mistakes if it hadn't been highlighted where I was going wrong.

What about the written feedback, do you think it helped improve your practical grade?

Yeah because I used to read that and then if I wasn't including a graph or if I was saying stuff not including you know like figures cfu/ml and stuff I was losing my marks. So I would read that and see that I was doing that more see where I was going wrong.

Did you find the use of the self-assessment and the written feedback helped you engage more with the practical work on an ongoing basis?

Yeah because well, I had to, I had to keep making sure that I was including all the right stuff so I would use the rubric thing to make sure I was doing that and then that's what was improving me then. You kind of always had to keep referencing that too so sort a so then

For future practical write ups would you recommend, completing a rubric-based self-assessment for each practical? (or for some)

I think so yeah because if I hadn't been doing them it I would have had the same mark that I got in the first one, I wouldn't have gotten, I wouldn't have improved

Why?

I would just do it for all of them because it doesn't take long.

Receiving written feedback for every practical in a rubric assessment criteria? (or for some)

Why?

I just think every practical because I am used to doing it now, so I would just do for all of them  
So was it a good experience, a learning experience, how would you see it overall?

Aye well the first mark I got was 69 and the last mark I got was 85, so definitely do it like.

## Interview Two

What is your understanding of self-assessment?

My understanding of self-assessment is that you go down through your own report individual areas of it and give yourself a mark out of a number such as 5, 10, 15 on what you think it should be

On your own work

On your own work

What did you think when you were asked to self-assess your own practical write up?

I thought it was a good idea in a sense that it would show you where you stood at marks and where your lecturer thought you were, what level your lecturer thought you were

And were you frightened or anything like that

Yeah I was frightened

But you did it .... I do think that it was a good idea

How did you use the rubric assessment criteria to complete your practical write up?

I would from the first report back I got, I would look at where I fell in marks and try and improve those marks in my next write up

Did your practical grade improve over the weeks?

It did in certain ones that I really used the assessment for but then other weeks I was rushing so I didn't fully take on board the comments made

If it did can you explain, if the self-assessment helped improve your practical grade?

It did help, 1 week that I did use it and I used I improved on the comments that were made where I fell, I did improve my mark did improve but then other weeks I just read through the comments but I didn't actually put them in place in the next write up, I had forgotten

What about the written feedback, do you think it helped improve your practical grade?

Did you find the use of the self-assessment and the written feedback helped you engage more with the practical work on an ongoing basis?

Yes, definitely, yeah

For future practical write ups would you recommend, completing a rubric-based self-assessment for each practical? (or for some)

Why?

Yeah, I would definitely recommend it because it doesn't take that long to do (ok) and it does help you for your next write up

Receiving written feedback for every practical in a rubric assessment criteria? (or for some)

Why?

I think at the start I think starting off every practical, because I'd prefer there's other modules that we do write ups for, and we don't know where we are falling down whereas at least this term all along we knew what was dragging us down what areas of our report was dragging us down and I just thought the feedback was a very good idea and I would maybe until a person gets use to it then maybe only have to do it for a few

So was it a good experience, a learning experience, how would you see it overall?

No that's everything just that it's a good idea



### Interview three

What is your understanding of self-assessment?

To assess how you do yourself, how you think you do whenever you are doing stuff

What do you mean by stuff?

Practical work, reports

That's about it really, I never thought any more of it

What did you think when you were asked to self-assess your own practical write up?

Oh god no, it was like really do you have to evaluate what I've written along with writing it when I thought about it then after I suppose after the first couple it was ok, you really had to look at what you were doing rather than just doing and handing it in

1<sup>st</sup> one 2<sup>nd</sup> one until you get into it properly you had to was ok rather than just doing it and then handing it in

ok

The 1<sup>st</sup> one to get into it properly

How did you use the rubric assessment criteria to complete your practical write up?

At the start not the best, I know it the wee spreadsheet I was reading through then to see exactly what was meant to fall into each compartment, into each area so with that it was far better then when you went back when you actually went back and checked to make sure you had everything put into it

Why?

Well the very first one I looked at it briefly and then I went and done my report and then I was like ok well I missing this or that or I didn't speak enough about certain things in this area like the results discussion or whatever. At the very start, the aim I think I was actually falling down on.

When you checked against the rubric yeah the spreadsheet. When I looked through it to check if all my stuff was right it was much better, it was far better

Did your practical grade improve over the weeks?

It did, well the first couple of weeks were ok, it rise a bit then dropped was the I hadn't done enough work on it. It rise a bit and then dropped but then I knew I had excluded stuff that I needed in it and then when I went back and went through it then it rose went up again

How did you know you had missed?

Well I thought I hadn't enough data on it but then when I went and I knew I missed one of the Reg stuff I forgot about it and then I went down but it was written in it

If I had not rushed as much it would have been better, I noticed it went up again because it was written in it.

If I checked through it and did not rush.

If it did can you explain, if the self-assessment helped improve your practical grade?

What about the written feedback, do you think it helped improve your practical grade?

To be honest I only saw one of the proper written feedbacks it was just then going through and then assessing what my grade was doing.

Obviously if I am getting this at the bottom of the spreadsheet, like I seen some of the written feedback, like I knew the arrows were going it and clicking

When i look back I wasn't fully sure. It was then going through some of the feedback that I wasn't fully sure whether I was about highlighting on the doc it was cause I didn't include these things when I look back

Did you find the use of the self-assessment and the written feedback helped you engage more with the practical work on an ongoing basis?

Yes definitely towards the last couple, yeah oh yeah, I think definitely in the last few that I done I did far better

You did better in the last few?

Because I engaged with it, looked through what I had it down and that my aims were going properly with my conclusions. All the stuff that was in each part was in it.

For future practical write ups would you recommend, completing a rubric-based self-assessment for each practical? (or for some)

Why?

For each for each, for each definitely because as I said there's parts like when you do it at the start and then you kind of slip away, forget I was meant to put this in because it's in it and it tells you the whole time

Its telling you why you fell away in this section. If you follow it the whole way through then you obviously will do a whole lot better. So if you did it one or two but you need to keep an eye on it for every practical, I think so yeah.

Receiving written feedback for every practical in a rubric assessment criteria? (or for some)

Why?

I suppose if you are falling down on some things yeah written feedback would be good, but at the same time, the way it was set up was good to see, where the different sections the different percentages the different sections you were getting this here for this section

Because you were reading each section. Actual comments were ok but at the same time because you were reading each section you knew then what you needed to include properly rather than the wee feedback things at the bottom. I read the marks at the bottom of the rubric, so you read the marks at the bottom of the rubric and then used these, I found that far better than just the wee comments. You were reading each section then you could see down on thing I suppose, but the way it was set up it was good. Actual comments were ok That's why I went with that oh yeah definitely, you are reading each section 2073, it's the only one i remember, the marks at the bottom of the rubric briefly you read the marks at the bottom of the rubric, that's why I went with that

Any further comments?

I actually found it good, it was an eye opener,

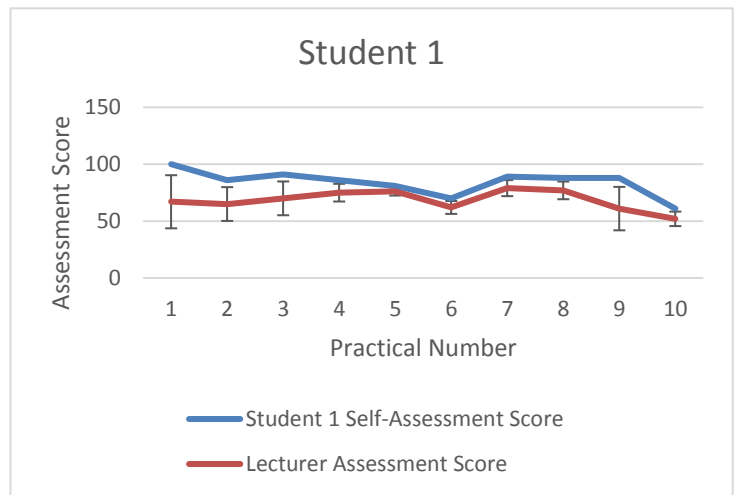
Good?

Good I had never being asked assess what way you are going to look at how you were progressing through it was just a case of put this together and away you go, and you were missing see things in practicals and not knowing why it was just on this one spreadsheet it was. Put this together. When you aware told. It was just on this one spreadsheet it didn't have all these red marks down the side report and everything in it. This is why you got marker in this section. If only they would all do it. If they all set them up. Creating things they want. It would be better knowing the way they want their practical set, it would be easier.

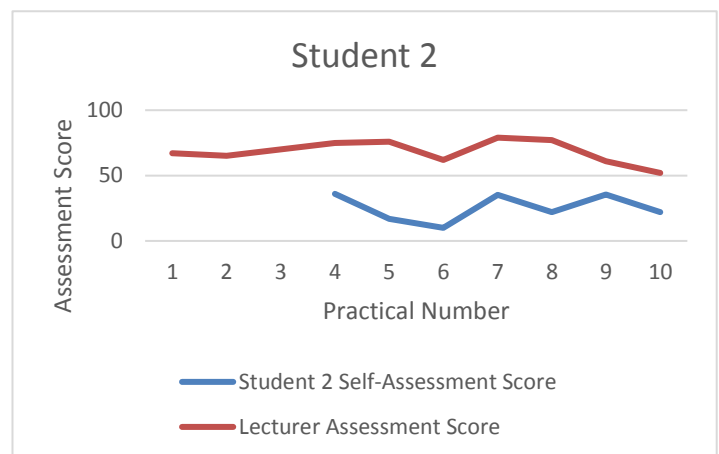
## Appendix 11

### Individual Student Self-Assessment Marks and Lecturer Marks

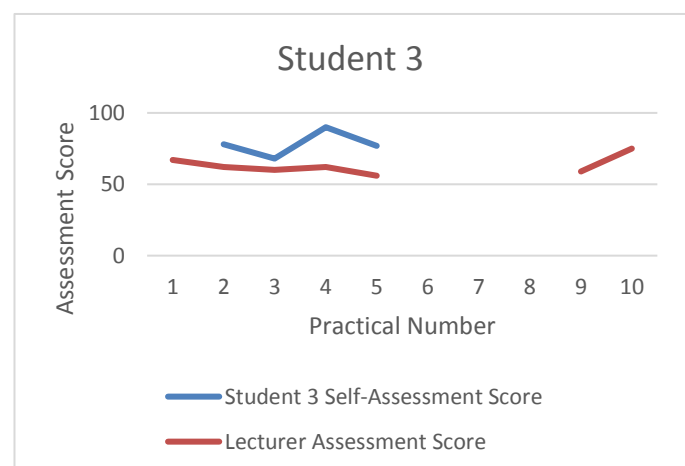
	Student 1 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1	100	67	23.3
2	86	65	14.8
3	91	70	14.8
4	86	75	7.8
5	81	76	3.5
6	70	62	5.7
7	89	79	7.1
8	88	77	7.8
9	88	61	19.1
10	61	52	6.4
Avg	84	68	11



	Student 2 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1		67	
2		65	
3		70	
4	36	75	27.6
5	17	76	41.7
6	10	62	36.8
7	35.3	79	30.9
8	22	77	38.9
9	35.5	61	18.0
10	22.1	52	21.1
Avg	25	68	31

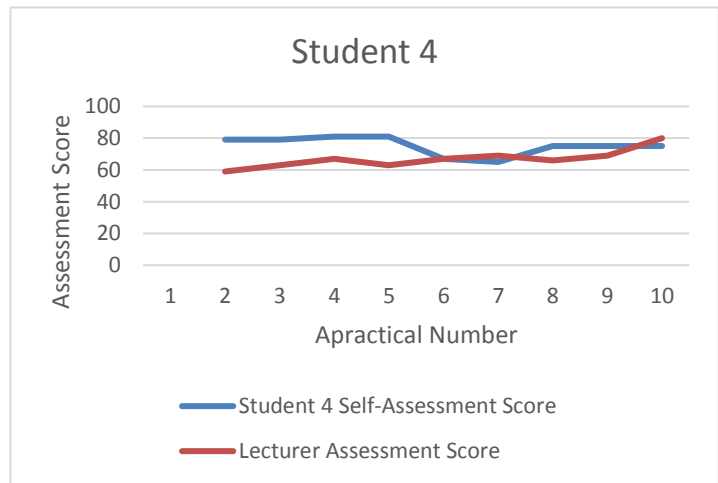


	Student 3 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1		67	
2	78	62	11.3
3	68	60	5.7
4	90	62	19.8
5	77	56	14.8
6			
7	77.5	62	11.0
8			

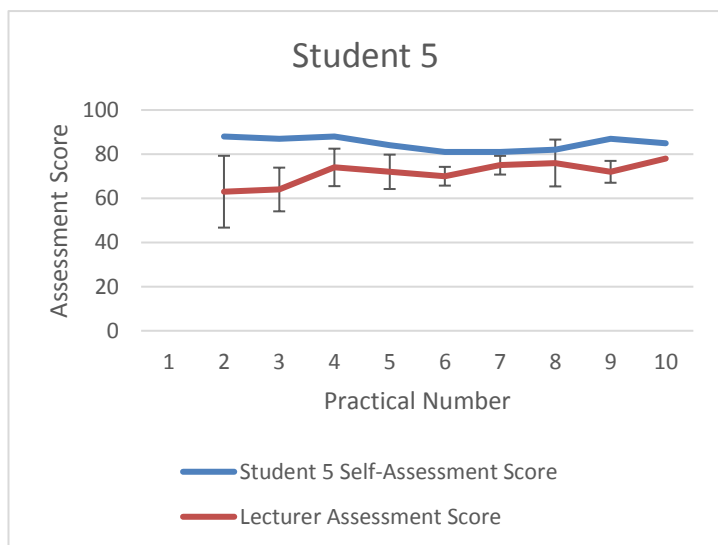


9		59	
10		75	
Avg	78	63	13

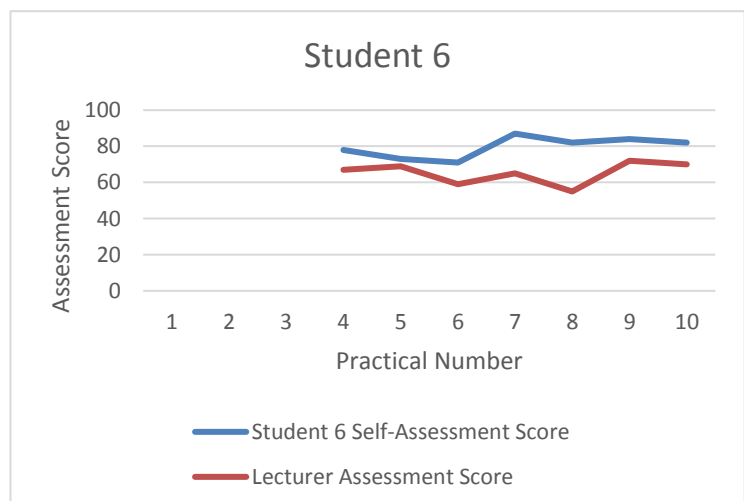
	Student 4 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1			
2	79	59	14.1
3	79	63	11.3
4	81	67	9.9
5	81	63	12.7
6	67	67	0.0
7	65	69	2.8
8	75	66	6.4
9	75	69	4.2
10	75	80	3.5
Avg	75	67	7



	Student 5 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1			
2	88	63	17.7
3	87	64	16.3
4	88	74	9.9
5	84	72	8.5
6	81	70	7.8
7	81	75	4.2
8	82	76	4.2
9	87	72	10.6
10	85	78	4.9
Avg	85	72	9

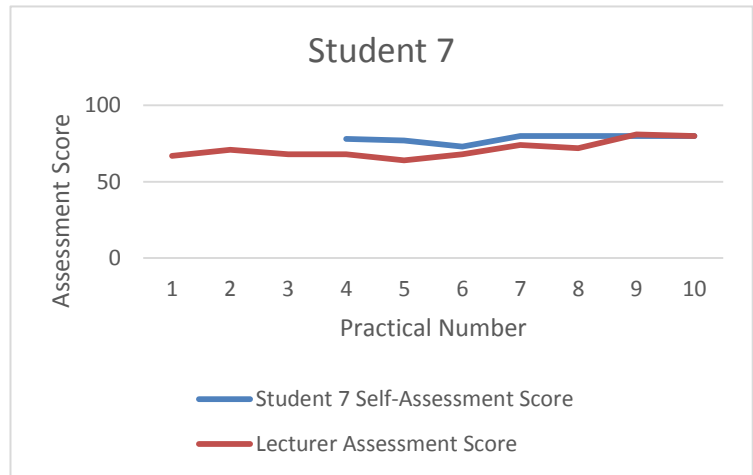


	Student 6 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1	72	68	
2			
3			
4	78	67	7.8
5	73	69	2.8
6	71	59	8.5
7	87	65	15.6

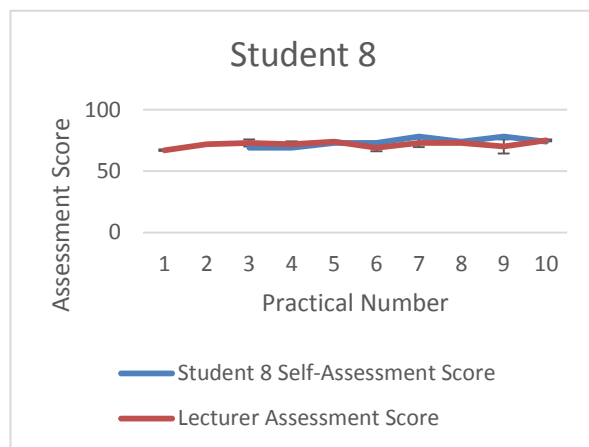


8	82	55	19.1
9	84	72	8.5
10	82	70	8.5
Avg	79	66	10

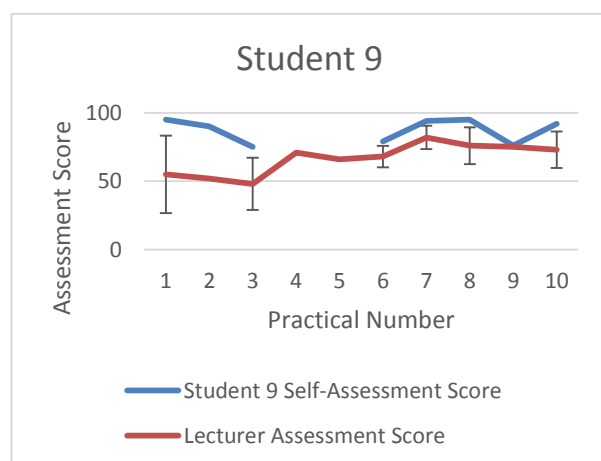
	Student 7 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1	74	67	4.9
2		71	
3		68	
4	78	68	7.1
5	77	64	9.2
6	73	68	3.5
7	80	74	4.2
8	80	72	5.7
9	80	81	0.7
10	80	80	0.0
Avg	78	71	4



	Student 8 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1	68	67	0.7
2		72	
3	69	73	2.8
4	69	72	2.1
5	73	74	0.7
6	73	69	2.8
7	78	73	3.5
8	74	73	0.7
9	78	70	5.7
10	74	75	0.7
Avg	73	72	2



	Student 9 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1	95	55	28.3
2	90	52	
3	75	48	19.1
4		71	
5		66	
6	79	68	7.8

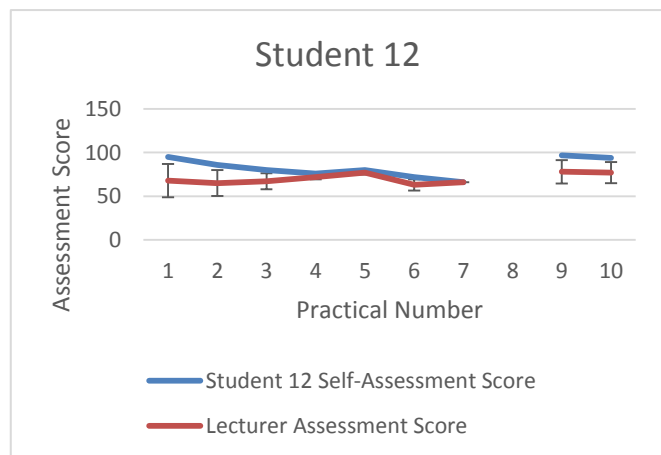
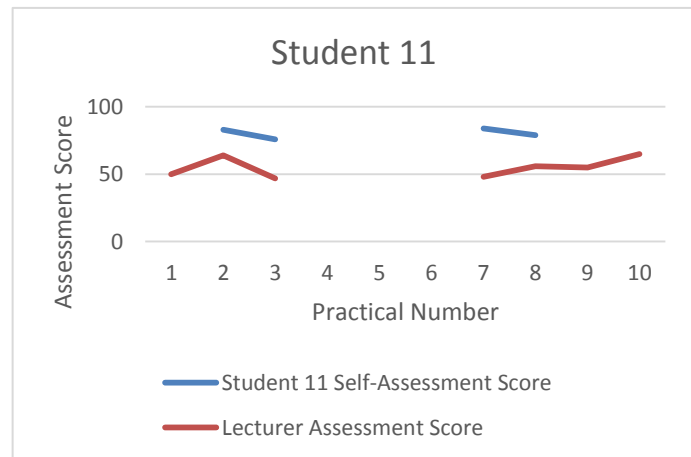
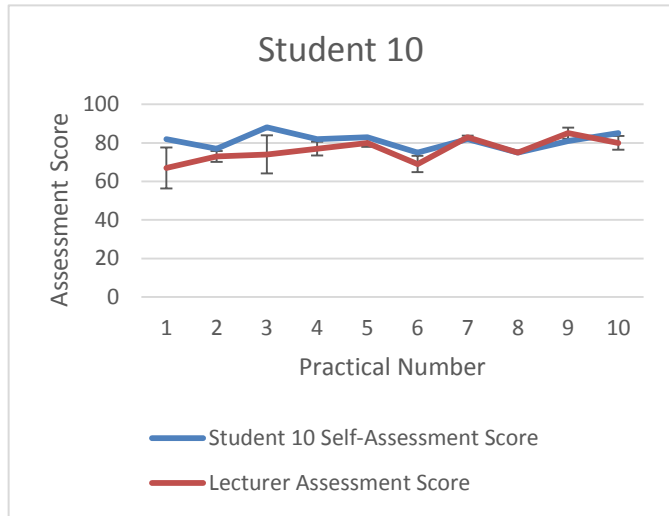


7	94	82	8.5
8	95	76	13.4
9	76	75	0.7
10	92	73	13.4
AVg	87	67	13

	Student 10 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1	82	67	10.6
2	77	73	2.8
3	88	74	9.9
4	82	77	3.5
5	83	80	2.1
6	75	69	4.2
7	82	83	0.7
8	75	75	0.0
9	81	85	2.8
10	85	80	3.5
AVg	81	76	4

	Student 11 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1		50	
2	83	64	13.4
3	76	47	20.5
4			
5		49	
6			
7	84	48	25.5
8	79	56	16.3
9		55	
10		65	
AVg	81	54	19

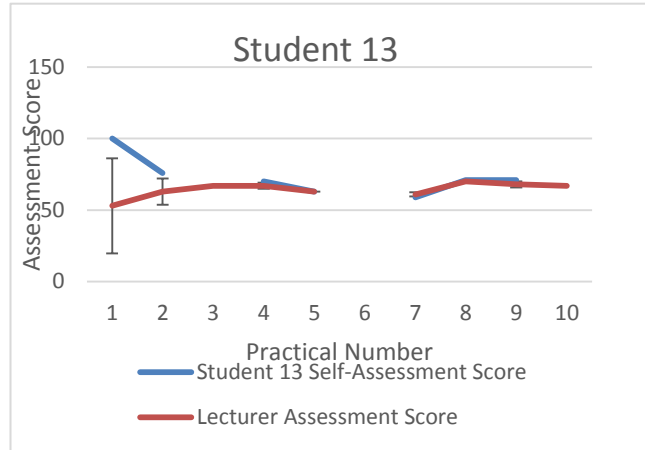
	Student 12 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1	95	68	19.1
2	86	65	14.8
3	80	67	9.2
4	76	72	2.8
5	80	77	2.1



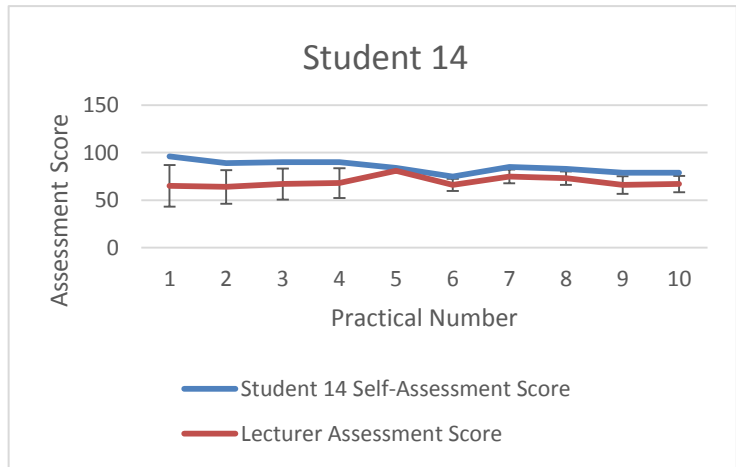


6	72	63	6.4
7	66	66	0.0
8			
9	97	78	13.4
10	94	77	12.0
AVg	83	70	9

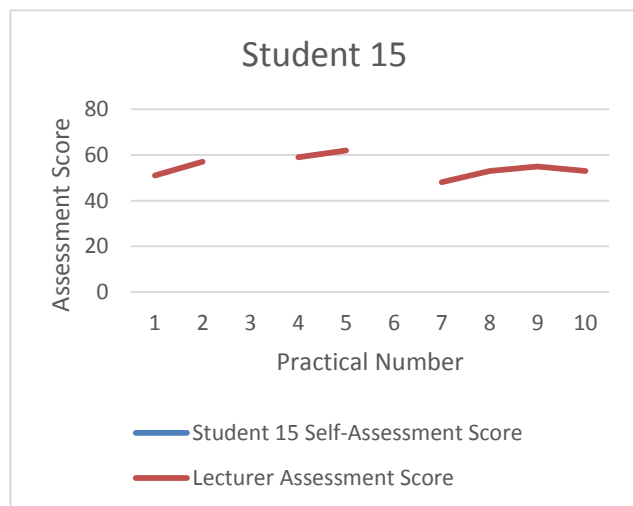
	Student 13 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1	100	53	33.2
2	76	63	9.2
3		67	
4	70	67	2.1
5	63	63	0.0
6			
7	59	61	1.4
8	71	70	0.7
9	71	68	2.1
10		67	
AVg	73	64	7



	Student 14 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1	96	65	21.9
2	89	64	17.7
3	90	67	16.3
4	90	68	15.6
5	84	81	2.1
6	75	66	6.4
7	85	75	7.1
8	83	73	7.1
9	79	66	9.2
10	79	67	8.5
AVg	85	69	11



	Student 15 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1		51	
2		57	
3			



4		59	
5		62	
6			
7		48	
8		53	
9		55	
10		53	
Avg		55	

	Student 16 Self-Assessment Score	Lecturer Assessment Score	Standard Dev
1		39	
2		45	
3		38	
4		44	
5		49	
6		33	
7		65	
8		70	
9		66	
10		71	
Avg		52	

