Education Assessment Mechanisms: Developing a Handbook

Aoife Hawthorne

Integrated Science Program, Class of 2023, McMaster University

SUMMARY

Assessment-based teaching methods in higher education do not accurately reflect student understanding (Gernsbacher, Soicher, and Becker-Blease, 2020). Instructors often have little freedom in how they teach, face issues such as large class sizes, and have few allocated resources. In turn, students face ineffective and inaccurate assessments, such as time- limited and standardized tests that depend on rote memorization and fail to promote active learning. Drawing from literature and personal anecdotes, this research aims to answer: What practices and assessment schemes promote accurate assessment of student understanding? This research is designed to provide realistic examples for instructors to allow them to take control over their classrooms and provide their students with more valuable and effective learning experiences. My findings indicate that these methods will not only give instructors more control over what they teach, but students will also become engaged, active, and inspired interdisciplinary learners.

Gernsbacher, Soicher, and Becker-Blease, 2020. Four empirically-based reasons not to administer time-limited tests, *Translational Issues in Psychological Science*. 6(2) pp. 175-190. 10.1037/tps0000232

Received: 04/29/2022 **Accepted:** 01/30/2023 **Published:** 03/03/2024

Keywords: assessments, inquiry, research, rubrics, reflective, university, reflective learning, problem based, research based

INTRODUCTION

Integral to education, student learning has long been a central topic in literature, however, how student learning is assessed has come to the forefront over the past two decades (Geis, 1984). Charles Goodhart's (1975) sentiment rings true: "When a measure becomes a target, it ceases to be a good measure". Targets lose their validity when behaviours can be adjusted to "game" this target. This principle is seen in the context of education in which instructors and students alike face disparities in assessment methods and marking schemes. This research aims to answer the question: What practices and

assessment schemes promote the accurate assessment of student understanding? I analyzed the following: learning mechanisms, assessment schemes, and rubrics to understand how they may be implemented to provide students and instructors with more flexible teaching and learning avenues.

MATERIALS AND METHODS

Pertinent to the scope of this research is the identification of issues faced by instructors and students. Using online journal articles from 1984 to present-day, I was able to analyze these issues and then decide which pedagogical practices would be most effective at aiding them. Determining which methods to include was not a strict process due to the preference of giving a broader scope of as many teaching and learning methods as possible.

Problems Faced by Instructors

Inequitable assessment schemes and methods pose problems for both instructors and students. This section highlights those issues as they inform the aims of this project. Instructors find it difficult to assess subjective questions and specific topics as it is difficult to be tested accurately or fairly through a multiple-choice (MC) item or timed assessment. Furthermore, some students may be able to correctly guess an MC without actually knowing the answer to the question being asked (Siegfried and Wuttke, 2019). Instructors may not be aware that the student happened to choose the correct answer as opposed to utilizing skills to reach the answer (Bush, 2001). Literature indicates that male students tend to outperform on MC items than females as they are more competitive and are more likely to guess as opposed to leaving the question blank (Arthur and Everaert, 2012; Siegfried and Wuttke, 2019). This leads to disparities in student learning as there is no way for instructors to know if or how their students know and understand the material.

MC item format is also quite restrictive for instructors to interact with. In larger class sizes, particularly common in higher education settings, MCs are often the go-to method of assessment due to their "automatic and thus economic and objective" abilities (Siegfried and Wuttke, 2019). MC tests are the most commonly used assessment method in science classrooms in higher education (Stanger-Hall, 2017) as they act as quick and easy ways to assess students' recall of a particular topic, but guaranteeing solidified knowledge is difficult. Further, these tests comprise the bulk of students' course marks, so MCs may contribute to artificially inflated or depressed marks due to the abilities of the students at the particular time they are written (Brown and Abdulnabi, 2017).

These tests are also difficult to write. Instructors find it challenging to write high volumes of unique and effective MC items (Rauschert, Yang, and Pigg, 2019). Further, curriculum standards may not translate to the learning objectives required to write effective MC items, leading to questions that require a student to regurgitate information as opposed to showing a full understanding of it (Rauschert, Yang, and Pigg, 2019). It is suggested that instructors be provided with the proper resources to create effective questions, such as learning the structure of an MC item (see Figure 1).

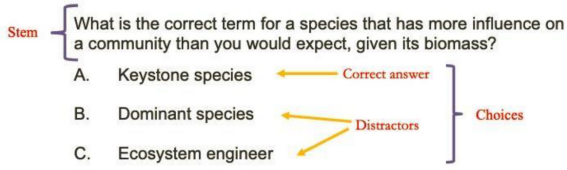

Figure 1: Anatomy of a multiple-choice question. The stem is the base question or phrase, and the choices are constituted of one correct answer and two distracting answers (Rauschert, Yang, and Pigg, 2019, p.3).

Instructors utilize constructed response (CR) items to assess in-depth topics. These include application-based questions that ask students to draw on multiple topics to answer an open-ended question. A drawback is that they require more time to

assess and provide adequate feedback (Arthur and Everaert, 2012; Yeong, 2015).

Instructors also feel immense pressure to teach content specific to reflect curriculum standards. University-level courses have less strict standards to adhere to, so there is greater variation in testing styles and content. Colloquially referred to as "teaching to the test", the process entails instructors teaching students the right content to satisfy testing standards and is purposely done to ensure that students receive top marks. Copp's 2016 study found that teaching to the test revealed two aspects of consideration: grade level taught and perceived pressure. Instructors of higher grade levels face more pressure when preparing their students for "high stakes" exit exams to meet provincial standards and graduation requirements (Copp, 2016). Further, these instructors will structure assessments in such a way that the marks earned will affect students' overall academic standing and ability to graduate.

Problems Faced by Students

Students' individual abilities outside of content understanding and knowledge, such as reflective and inquiry skills are often ignored on timed assessments and standardized tests due to their rigid structures and lack of flexibility. In particular, students face the pressure of limited time. Some students may work quickly and complete an assessment within the allotted time, however, they will perform poorly or not demonstrate an in-depth understanding of the material. Further, other students will struggle to complete the timed assessment but will demonstrate a thorough understanding of the material in the portions they do completely. (Bhattacharyya, Junot, and Clark, 2013). One such counterargument is that students should practice their time management skills and "learn how to take tests", however, this discourages students from truly learning and engaging with the material. Conversely, time management skills are poorly understood as traditional assessments tend to place students in high-pressure situations. This so-called "trade off" is not worth missing out on the deeper learning and interaction with course content.

The format of timed assessments often paints an inaccurate picture of student knowledge. If tests are designed to evaluate student learning and thus provide them feedback for improving their knowledge, introducing time constraints and potentially poorly-written questions can depress scores artificially (Brown and Abdulnabi, 2017). In contrast, students who guess the correct answers on MC items are rewarded for the knowledge they do not possess (Bush, 2001). Their final scores will reflect that of a student who supposedly has a great understanding of the material, but they will not be accurate nor reliable.

Timed and MC assessments tend not to take into account variables that impact student performance, such as emotional, mental, and physical conditions (Boser, 2000). The only way to ensure validity in MC tests is to create consistent testing conditions (Bhattacharyya, Junot, and Clark, 2013), though this is not possible with students as personal factors are dynamic and inexorable. Students' poor performance on one assessment can often significantly depress their course mark greatly. This leaves students feeling as though they were not able to demonstrate their knowledge and understanding of course material, and instructors are left wondering if they taught the material effectively.

RESEARCH

This handbook compiles the multitude of solutions to the problems outlined for students and instructors. These solutions allow instructors to take control over their classrooms and offer students more enriching learning experiences.

Inquiry-Based Learning

Inquiry-based learning (IBL) is defined as a student-centered approach that allows students to develop their understanding through asking questions about particular subjects (Attard, Berger, and Mackenzie, 2021). Through IBL, students are

encouraged to explore the world around them, engaging with different materials, asking big and small questions, and having discussions to share ideas (Attard, Berger, and Mackenzie, 2021). The goal is to make students excited about education and enjoy what they're learning. Instructors should focus less on content consumption and more on the interdisciplinary nature of science and the various ways of communicating it and accessing it.

IBL sounds promising, but some scholars argue that it is not the most effective pedagogical practice (Quigley et al., 2012). Instructors may find it difficult to implement if they are not familiar with the practice. They may have already established a course outline that is not subject to change. Further, IBL appears unrealistic given the larger class sizes in higher education settings. While a move to IBL may be difficult and unrealistic to complete instantaneously, this research will outline some more feasible transitions.

One quick method to integrate within course content is relating it to locality. For example, ecology students may study a species native to their university. They could use the university grounds as a study space. Geology students may study rock formations in their city and access archives to learn more about their locality and its development. These activities personalise scientific learning and allow students to connect their education to where they live and work. Another module instructors can develop for students is an inquiry into local industries. Have students research industries in the area and ask representatives of those institutions about their fields. An option might be to have those representatives come in as guest speakers to give a seminar on their field and offer more insight to students. Not only does this support authentic learning experiences, it also drives the "real world" connection to students, and inspires them to pursue their goals (van Driel et al., 2018).
Students want to feel as though they are being heard, that they are making a difference, and that they are progressing. IBL methods have the potential to support student engagement and help students discover their identities as learners (Attard, Berger, and Mackenzie, 2021).

Problem-Based Learning

Problem-based learning (PBL) is a student-centered approach that was first propagated in 1969 by Howard S. Burrows at McMaster University (Da Silva et al., 2018). Learning occurs because a problem is identified (Yew and Goh, 2016), and as students work to solve problems, they identify their strengths and weaknesses as learners, collaborators, and researchers. PBL also increases student engagement through the use of critical thinking, creative solution development, and self-directed learning (Luy-Montejo, 2019). An example of PBL is having students form groups to investigate a problem and determine a feasible solution to it.

As innovative as it sounds, it has its challenges when it comes to implementation. One key factor is population. Higher education settings tend to have large student populations, which makes specialised learning strategies such as PBL quite difficult to implement due to the emphasis on small-group learning (Albuali and Khan, 2017). Further, it is reported that not all students have the same foundational skills, such as communication and problem solving, and awareness of PBL to succeed. Therefore, it is recommended that students undergo a two- to three-month preparatory course (Albuali and Khan, 2017). Da Silva et al. (2018) claim that it can be implemented simply, with instructors facilitating discussions and formatting their curriculum into "thematic blocks", which are specific topics studied over a set time period. Finally, due to the complexity of PBL, many higher education faculty feel as though they are not equipped to conduct it (Ribeiro, 2011). Formal pedagogical training in PBL could be beneficial for instructors wishing to use it, which acts as a potential drawback.

Integrating PBL is a slow, but feasible process. As the large class size continues to be a limiting factor for the implementation

of PBL, it is suggested that this be done gradually, such as beginning with implementation at the tutorial level, where class sizes are approximately 30 students (Albuali and Khan, 2017). The time period varies based on class size and content, so it is up to the descretion of the instructor (Albuali and Khan, 2017). The authors also suggest that if a course currently has eight teaching assistants (TAs) that each take one group, four TAs could take two groups at once, thus reducing the need for increased instructional space. Individuals can also work through problems alone and brainstorm ideas before sharing their ideas with the rest of their class in lecture. This allows students to form their own opinions and exercise their critical thinking and problem solving skills before engaging with other students to "reveal the answer". This approach highlights the importance of the journey to the answer, allowing students to appreciate the research process, and instructors to identify gaps in knowledge and address them.

Research-Based Learning

Research-based learning (RBL) is a learning approach that places research at the heart of the learning experience (Noguez and Neri, 2019). Its goals are to emphasise research as a transferable skill and to provide students with a more comprehensive education (Noguez and Neri, 2019). Students learn the process of completing a research project both in group and individual settings (Granjeiro, 2019).

Like IBL and PBL, RBL faces challenges in its implementation. The primary challenge is resource allocation as conducting and synthesising research requires lab space and other technologies (Susiani et al., 2018). One other important factor to consider when implementing RBL is students' competencies at the beginning of the course. Not all students will have completed their own research, nor might they understand the process in its entirety, which can make the early stages of implementation quite difficult (Noguez and Neri, 2019).

Implementing the RBL model starts when students enter a higher education institution. In the first year of their program, students should develop research skills as they become more aware of the societal issues around them (Noguez and Neri, 2019). As students develop their research interests, they can interact with researchers at their universities to begin tackling research in their areas of interest (Noguez and Neri, 2019). As students go about their research, they will gain experience reading literature, developing their own theories and hypotheses, collecting data, and drawing conclusions (Susiani et al., 2018). The RBL approach not only means students build their problem-solving and critical thinking skills, but they are equipped with the tools to solve them (Susiani et al., 2018).

Immediate Feedback Assessment Technique

The IF-AT technique allows students to be aware of the accuracy of their answers upon completion. In providing students with immediate feedback, students have higher retention rates of the learned material (Epstein et al., 2002). Further, IF-AT combines the style and ease of MCs with the problem-solving processes of CRs (Arthur and Everaert, 2012). Students practice self-regulation as they recognize their mistakes and correct them, which facilitates learning while they complete the assessment (Epstein et al., 2002).

One variation of the IF-AT system is the bingo-style scratch card system, shown in Figure 2. The IF-AT system is beneficial for instructors as it provides a more nuanced view of student knowledge and understanding. Instead of assuming that the student lacks knowledge of a topic due to an incorrect answer, it may instead have been the second option the student chose as they worked out the answer (Maurer and Kropp, 2015). This system rewards students who are willing to acknowledge mistakes they have made and re-work possible solutions to reach the correct answer. In particular, science students can re-work solutions and use

one answer for the next "step" of the question, allowing them to build upon concepts and solve multi-step problems (Epstein et al., 2002).

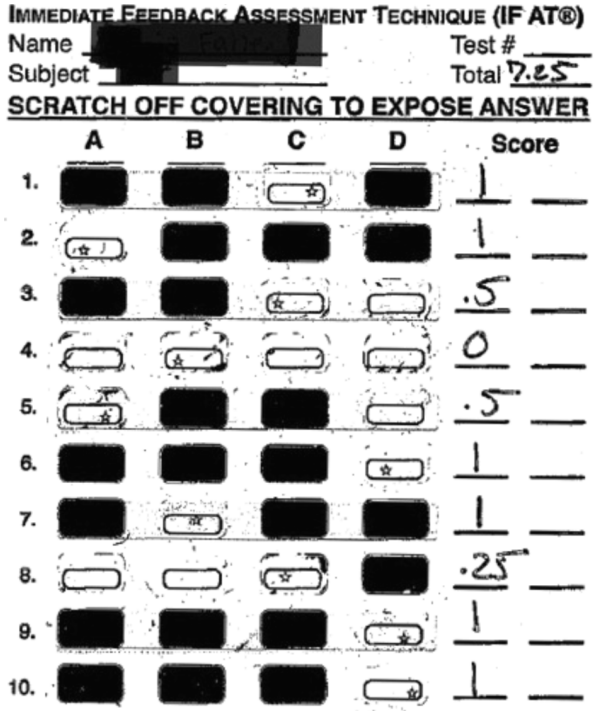

Figure 2: Lottery scratch card variation of the Immediate Feedback Assessment Technique. When the star is the only box scratched off, the student gets one point. When two boxes are scratched off, the student gets half of a point. When three boxes are scratched off, the student gets a quarter of a point (Calimeris and Kosack, 2020).

Student-Developed Multiple Choice Questions

Generating large volumes of effective MCs is difficult for instructors (Rauschert, Yang, and Pigg, 2019). A pragmatic alternative to this issue includes involving the students in MC development. For students to create MCs, they are exercising deeper levels of understanding (Galloway and Burns, 2015). When students develop MCs, they are working with the anatomy of a question and understanding how it works. Figure 1 shows the anatomy of an MC. Students will develop questions with clear, thorough stems, complete with thoughtful distracting answers. In creating questions, students will effectively view the questions from an examiner's standpoint, understanding how erroneous answers are developed, as well as the thought processes required to reach the correct answer (Galloway and Burns, 2015; Skillings and Ferrell, 2000).

For this technique, have each student develop several MCs and submit them, and then instructors choose the "best" ones to be included on the assessment. Instructors should be clear about what effective MCs are and how to construct them.

Essay-Style Questions

Essay-style questions are a form of CR that allows students to develop argument-building skills through written work (Ferretti and Graham, 2019). Students can respond to questions posed in lectures or literature by developing a thesis, substantiating it, and researching their field of interest.

These skills can be developed throughout the course through workshops or seminars that focus on how to write a thesis statement, how to support it with effective arguments, and how to navigate databases and libraries to discover references. These sorts of skills are transferable, and students can understand the power of an effective argument in the context of scientific research (Driscoll and Wells, 2012).

Potential drawbacks include perception and marking. Including an essay component may shift students' attitudes about the course due to their own attitudes and emotions towards writing (Bulqiyah, Mahbub, and Nugraheni, 2021; Driscoll and Wells, 2012). Further, assessing the essays may be time-consuming and developing an assessment scheme or rubric for these essays may be difficult. The Rubrics section may offer some alternative rubrics for consideration.

Essay questions should enable students to utilize course concepts to construct a response to an overarching question or set

of questions. There may be one singular question or the choice out of two or three questions. These questions should be broad enough that the instructor can anticipate several different responses due to their students' interests and experiences, but specific enough that students have a direction (Driscoll and Wells, 2012). One example of a prompt might be "The role of physics in sustainable development". Students understand that they will all discuss physics and sustainability in their essays, though they still have the freedom to research the specific physics concepts and their implications. Instead of regurgitating answers for their essays, students will use their research and communication skills to develop concise, well-explained, and defined answers (Driscoll and Wells, 2012; Hift, 2014). As they comb through literature, they will read information that may spark interest or lead them in a different direction. They will spend more time writing the essay and researching a specific topic than regurgitating facts about it, which makes for a more valuable educational experience (Driscoll and Wells, 2012).

Reflective Learning

Reflective learning is another form of CR that focuses less on argument construction and more on the empowerment of the student and their perceptions of their abilities (Colomer et al., 2020). Because learning is such a personal and individual process, it is beneficial for students to reflect on and examine their experiences (Bulqiyah, Mahbub, and Nugraheni, 2021; Colomer et al., 2020). Instructors can develop reflective learning assessments that allow students to expand upon their understanding, evaluate their attitudes and skills, and construct new ideas and perspectives (Colmer et al., 2020).

As with many CRs, reflective learning assessments may be more time-consuming for instructors to assess. Writing skills may take a lot of time to develop for students and are difficult for both native and second language students (Ferretti and Graham, 2019). As a result, mark allocation may be problematic and students may have difficulty meeting the instructor's expectations (Fraile, Panadero, and Pardo, 2017). The Rubrics section will offer more insight into this area.

When developing reflective learning questions, instructors should focus on keeping them open-ended as this allows students to utilise higher-order thinking skills, judgement, and reasoning (Çakır and Cengiz, 2016). In a two-question assessment, the first question should pertain to the topic of study and should encourage thinking about more advanced topics in society. For example, in an ecology class, a question may be: "How can we control climate change with demands of increasing food production and increasing energy use?" (Kramer et al., 2017). In this question, students will draw from material learned in lectures and discussions but also conduct their own research. The instructor may further request that different groups of students analyse different regions of the world to gain a better understanding of the world around them. The second question should prompt students to reflect on the skills they used to reach the answer(s) to the first question. Instructors should prompt students with substantive questions such as "What resources might be the best to conduct research in this area?", "Of the resources you analysed, which ones were strong? Which ones were weak? What would you change about them?", "If you had access to all resources, how would you investigate climate change with regards to food and energy consumption?" These sorts of questions allow students to exercise their critical thinking skills and they instill a sense of purpose within them as they complete their research (Driscoll and Wells, 2012).

Rubrics

Rubrics and assessment schemes are a form of communication between students and their instructors. As education became more important to faculties outside of education, the importance of the legibility and accessibility of the marking schemes followed suit (Schneider

and Hutt, 2013). But how much do rubrics really tell us? How accurately do assessment schemes reflect student understanding? This section will highlight some of the most practical rubrics for instructors so that they can develop a more thorough understanding of their students' capabilities; and for students so that they can take more control over their learning.

3-Bin Style

A three-bin marking scheme is a simple scheme for both instructors and students to understand. With a three-bin system, as seen in Table 1, it is a quick process for instructors to assign their students into bins based on the work their students provide (Miknis, Davies, and Johnson, 2020). These bins may exist at each level of the assessment, with instructors only providing constructive feedback at the very end of assessments (Miknis, Davies, and Johnson, 2020). A student may perform well to know the material enough to recall it, but they may not understand it or be able to communicate it. Detailing feedback in a few boxes provides a quick method for instructors to ensure that their students have a basic understanding of their marks.

Table 1: Three-bin marking scheme with numerical equivalent, in percent, and details about the mark.

Category	Numerical equivalent (%)	Details
Distinction	80+	Student demonstrates exemplary understanding of the topics covered
Pass	51-79.9	Student demonstrates a fair understanding of the topics covered
Fail	< 50.9	Student fails to demonstrate understanding of the topics covered

Three boxes may prove to be a more difficult sort of assessment for students as they may have difficulty "reading" their marks. For example, if a student were to receive a mark of "pass", they are left wondering if their 79 is comparable to a 51. Mathematically, these two students performed quite differently - with almost 30 percent between them, so it introduces questions around whether their instructor views both students' work similarly. Instructors could use this method as a base and then consult *Creating effective rubrics* for tips on how to increase accessibility and legibility.

5-Bin Scheme

A more traditional method of marking is the five-bin scheme, which features letters ranging from A to F attached to corresponding numerical marks. Detailed in Table 2, the five-bin scheme was the standard method of marking in the 1970s (Schneider and Hutt, 2013).

Table 2: Five-bin marking scheme with numerical equivalent.

Letter	A	B	C	D	F
Numerical equivalent (%)	80-100	70-80	60-70	50-60	0-49

The five-bin approach has been detailed to include variations of the letters to more accurately reflect their numerical equivalents. For example, an A+ may indicate a mark above 95%, and a D- may indicate a mark between 50 and 55% (Schneider and Hutt, 2013). With the letter variations taken into account, the five-bin approach becomes the 13- or 15-bin approach (depending on if F+ and F- are considered). While this may provide students with a seemingly more accurate representation of their mark, distinctions between bins are sometimes unclear when the meaning of each bin is not well defined. For example, what distinguishes an A from an A+? The answer lies in the construction of the rubrics themselves and how both instructors and students can get the maximum value out of them.

Checklists

Checklists are a great tool for students and instructors. For students, they can meet the expectations of the assignment by following a checklist. This may also guide their work and foster new creativity as they challenge themselves (Miknis, Davies, and Johnson, 2020). Further, a checklist offers a transparent dichotomy between meeting expectations and failing to do so (Geis, 1984). Instructors either check off "yes" or "no" on the checklist, meaning marking becomes a quicker process for large class sizes. In Figure 3, Geis (1984) highlights a form of checklist used by a History course at Murdoch University. This scale compares two qualities of work (Geis, 1984). It provides more detail to students as they navigate their mark by offering more of an explanation of their results.

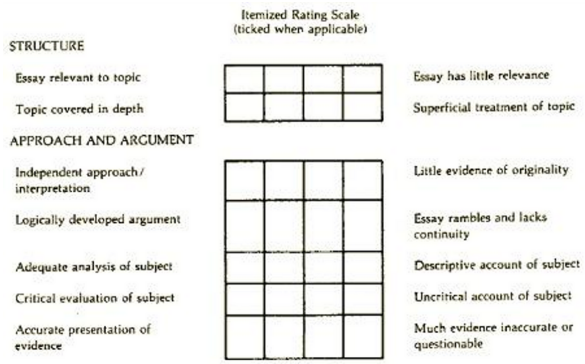

Figure 3: Checklist used by a history course at Murdoch University. This sort of checklist is also known as a rating form as two qualities are compared. Adapted from Geis, 1984, p.6.

Frequency Scales

Frequency scales highlight expectations of students, such as, "Regularly engages with the material", and often highlight observable behaviour (Brookhart, 2018). A frequency scale is more beneficial for a longer assessment, one that requires multiple weeks to complete, where behaviour can be assessed on the longitudinal scale and patterns can be observed. Depending on the outcomes to be assessed, instructors have a lot of freedom and flexibility when deciding what to include on a frequency scale (Menold and Bogner, 2016). Frequency scales that are item-specific are more valuable for student feedback and increase the quality of the assessment (Menold and Bogner, 2016). A student can read their scale and understand their mark as a reflection of their level of participation (Brookhart, 2018). They can use this feedback to understand that participating more next time may help them grow as a student. Further, instructors can gain a snapshot of current student participation or performance in a specific area and use it to structure their course and enhance instructional quality (Debets et al., 2020). For example, if participation is relatively low in the first term of the school year and most students participate about a third of the time, the instructor may choose to embed more discussion-based assessments in the curriculum and reassess participation in the next term. Frequency scales can provide a clear indication of behaviour and learning habits, which can help both instructors and students move forward and grow (Debets et al., 2020).

Rating Scales

Rating scales assign a point value (usually 1-5) to an item being assessed. For example, an instructor may rate a student's participation or number of keywords used in an answer. A rating question might appear as is shown in Table 3. Here, the instructor is assessing the use of scientific terminology in the students' responses. One particular student may use a lot of terminology but forget a few terms or concepts, so the rating is four out of five. These ratings are helpful for instructors to gain an understanding of the performance of their students in terms of values and they can create graphs to analyse patterns of student performance in certain areas (Brookhart, 2018). A drawback is the lack of context they provide if given without commentary (Ion, Sánchez-Martí, and Agud, 2018). This may be difficult in larger class sizes, where it may not be feasible to mark several hundreds of students with thorough written explanations.

Table 3: A sample rating question. The assessment is written clearly above a scale and the point allotted to that assessment is clearly indicated. Highlighted in yellow is the score the student receives for meeting this assessment.

The student used sufficient scientific terminology in their response.
1 2 3 **4** 5

Creating Effective Rubrics

One of the proponents of communication is the rubric. It is a dialogue between the instructor and the student, and, as Schneider and Hutt (2013) note, an "intimate communication tool" used to "inform" and "instruct". Knowing this, the goal becomes to accurately communicate student understanding to students. Some common guidelines may include checklists, frequency scales, and rating scales, but do not include descriptions of behaviours or guide students in their next steps of learning (Brookhart, 2018). Effective marking schemes may encompass all of the aforementioned. In order to do so effectively, it is pertinent to outline each form of so-called guideline. When providing students with a rubric such as Table 3, it is important to also provide them with enough feedback and context before and after the assessment (Geis, 1984). In the example above, a student is marked on how well they were able to present information. Beforehand, they should be given a checklist for what to include in their presentation and behaviours of strong presenters (projected voice, clear annunciation, rehearsed but well-paced, etc.) so this feedback is better understood (Geis, 1984).

Instructors should identify what they want to assess, how they want to assess it, and what the end goals are (Miknis, Davies, and Johnson, 2019). Emphasis should be placed on larger learning objectives and big-picture ideas to promote creativity (Vincent-Lancrin et al., 2019). Instructors should anticipate how the students will perform and understand why they may perform a certain way. A sample rubric has been developed in Table 1.

Student-Developed Rubrics

An important practice for students is to develop goals. This can be achieved by student-developed rubrics. Using this strategy, the instructor facilitates discussion about what qualities demonstrate proficiency in an assessment (Allen and Tanner, 2017). To understand where their students' understandings lie, it is important to first start at a basic level and then transfer those skills (Allen and Tanner, 2017; Skillings and Ferrell, 2000). For example, ecology students may begin by considering ideal, passing, and failing ecosystems for an insect (Skillings and Ferrell, 2000). As these levels are distinguished, students find it easier to critique prospective ecosystems, and this building of metacognition can then be applied to critiquing their own work (Skillings and Ferrell, 2000). As students develop their own standards for their work, they improve their self-evaluation skills, self-regulation, and engagement (Becker, 2016).

CONCLUSION

Because learning is a longitudinal process, feedback and progress reviews are pertinent as they help inform the paths the students may take (Zhan, 2020). Allowing students to understand their strengths and weaknesses gives them more agency and responsibility for their learning as they strive to grow (Zhan, 2020). Self-assessment and reflection are both extremely valuable learning tools for studentsstudents, and they work as excellent tools for environments outside of the classroom (Ion, Sánchez-Martí, and Agud, 2018). Feedback not only works for students, but also instructors. When instructors assess their students, they are inadvertently assessing their course (Jiang, 2020). Specifically, they can identify patterns in student engagement, topic preferences, and understanding to improve their course(s) (Jiang, 2020). Both acts of giving and receiving feedback are

extremely beneficial for students as they build their metacognition skills, becoming more aware of their strengths and weaknesses, as well as how to spot them in their peers' work (Ion, Sánchez-Martí, and Agud, 2018). In summary, students benefit greatly from feedback and become more committed to their learning, ensuring that it is a lifelong process (Ion, Sánchez-Martí, and Agud, 2018).

Learning is a lifelong process. As students enter higher education settings, they become more responsible for their own learning and are expected to become independent learners (Worsley, Harrison, and Corcoran, 2021). Instructors also want their students to do well both academically and personally (Worsley, Harrison, and Corcoran, 2021). The assessment schemes and learning models outlined in this report aim to streamline this process and make it a more dynamic, engaging, and rewarding experience.

REFERENCES

Albulali, W. and Khan, A.S., 2018. Challenges facing the shift from the conventional to problem-based learning curriculum. *Higher Education Studies*. [e-journal] 8(1) 10.5539/hes.v8n1p36

Allen, D. and Tanner, K., 2017. Rubrics: Tools for making learning goals and evaluation criteria explicit for both teachers and learners. *CBE - Life Sciences Education* 5(3), pp. 197-295. https://doi.org/10.1187/cbe.06-06-0168

Arthur, N. and Everaert, P., 2010. Gender and performance in accounting examinations: Exploring the impact of examination format. *Accounting Education.* [e-journal] 21(5)pp. 471-487. https://doi.org/10.1080/09639284.2011.650447

Attard, C., Berger, N., and Mackenzie, E., 2021. The positive influence of inquiry-based learning teacher professional learning and industry partnerships on student engagement with STEM. *Frontiers in Education.* [e-journal] https://doi.org/10.3389/feduc.2021.693221

Becker, A., 2016. Student-generated scoring rubrics: Examining their formative value for improving ESL students' writing performance. *Assessing Writing*. [e-journal] 29, pp.15–24. 10.1016/j.asw.2016.05.002

Bhattacharyya, S., Junot, M., Clark, H., 2013. Can you hear us? Voices raised against standardized testing by novice teachers. *Creative Education* 4(10), pp. 633-639. DOI: 10.4236/ce.2013.410091

Boser, U., 2000. Teaching to the test? *Education Week*. 19, pp. 1-10.

Brookhart, S.M., 2018. Appropriate criteria: Key to effective rubrics. *Frontiers in Education.* [e-journal]. https://doi.org/10.3389/fpubh.2021.634285

Brown, G., Abdulnabi, H., 2017. Evaluating the quality of higher education instructor-constructed multiple-choice tests: impact on student grades. *Frontiers in Education.* DOI: 10.3389/feduc.2017.00024

Bulqiyah, S. Mahbub, M.A. & Nugraheni, D.A., 2021. Investigating writing difficulties in essay writing: Tertiary students' perspectives. *English Language Teaching Educational Journal*, [e-journal] 4(1), pp.61-73. 10.12928/eltej.v4i1.2371

Bush, M., 2001. A multiple choice test that rewards partial knowledge. *Journal of further and higher education* 25(2) pp. 157-1. DOI: 10.1080/03098770120050828

Copp, D., 2016. Teaching to the test: a mixed methods study of instructional change from large-scale testing in Canadian schools. *Assessment in Education: Principles, Policy & Practice*, (1), pp. 1–20. DOI: 10.1080/0969594x.2016.1244042

Calimeris, L. and Kosack, E., 2020. Immediate feedback assessment technique (IF-AT) quizzes and student performance in microeconomic principles courses. *Research in Economics Education*. [e-journal] 51(3-4), pp.211-226. https://doi.org/10.1080/00220485.2020.1804501

Çakır, H., and Cengiz, Ö., 2016. The use of open ended versus closed ended questions in Turkish classrooms. *Open Journal of Modern Linguistics,* [e-journal] 6, 60-70. 10.4236/ojml.2016.62006

Colomer, J., Serra, T., Cañabate, D., Bubnys, R., 2020. Reflective learning in higher education: Active methodologies for transformative practices. *Sustainability*. 12(9). https://doi.org/10.3390/su12093827

Da Silva, A.B., De Araújo Bispo, A.C.K., Rodriguez, D.G., and Vasquez, F.I.F., 2018. Problem-based learning: A proposal for structuring PBL and its implications for learning among students in an undergraduate management degree program. *Revista de Gestão.* [e-journal] 25(83). 10.1108/REGE-03-2018-030

Debets, M.P.M., Scheepers, R.A., Boerebach, B.C.M. Onyebuchi, A.A., Lombarts, K., 2020. Variability of residents' ratings of faculty's teaching performance measured by five- and seven-point response scales. *BMC Med Educ.* [e-journal] 20(325). https://doi.org/10.1186/s12909-020-02244-9

Driscoll, D.L. and Wells, J., 2012. Beyond knowledge and skills: Writing transfer and the role of student dispositions. *Composition Forum*, [e-journal] 26. http://compositionforum.com/issue/26/beyond-knowledge-skills.php

Epstein, M.L., Lazarus, A.D., Calvano, T.B., Matthews, K.A., Hendel, R.A., Epstein, B.B., Brosvic, G.M., 2002. Immediate feedback assessment technique promotes learning and corrects inaccurate first responses. *Psychol Rec.* [e-journal] 52, pp.187–201. https://doi.org/10.1007/BF03395423

Ferretti, R.P. and Graham, S., 2019. Argumentative writing: theory, assessment, and instruction. *Reading and Writing*. 32. pp.1345-1357. https://doi.org/10.1007/s11145-019-09950-x

Fraile, J., Panadero, E., and Pardo, R., 2017. Co-creating rubrics: The effect on self-regulated learning, self-efficacy, and performance of establishing assessment criteria with students. *Studies in Educational Evaluation.* [e-journal] 53.pp.69-76. 10.1016/j.stueduc.2017.03.003

Galloway, K.W., Burns, S., 2015. Doing it for themselves: Students creating a high quality peer-learning environment. *Chemistry Education Research Practice*. [e-journal] 16(1)pp.82–92. https://doi.org/10.1039/C4RP00209A

Geis, G.L., 1984. Checklisting. *Journal of Instructional Development*, 7(1), pp.2–9. 10.1007/bf02905585

Goodhart, C.A.E., 1975. Monetary relationships: A view from Threadneedle Street. *Papers in Monetary Economics*. 1. Australia: Reserve Bank of Australia.

Hift, R.J., 2014. Should essays and other "open-ended" -type questions retain a place in written summative assessment in clinical education? *BMC Medical Education.* [e-journal] 14(249). 10.1186/s12909-014-0249-2

Ion, G., Sánchez-Martí, A., and Agud, I., 2018. Giving or receiving feedback: which is more beneficial to student learning? *Assessment & Evaluation in Higher Education.* [e-journal]. 10.1080/02602938.2018.1484881

Jiang, Y., 2020. Teacher classroom questioning practice and assessment literacy: case studies of four English language teachers in Chinese universities. *Frontiers in Education.* [e-journal]. https://doi.org/10.3389/feduc.2020.00023

Kramer, D., Hartter, J., Boag, A.E., Jain, M., Stevens, K., Nicholas, K.A., McConnell, W.J., Liu, J., 2017. Top 40 questions in coupled human and natural systems (CHANS) research. *Ecology and Society* [e-journal] 22(2).pp.44.

Luy-Montejo, C., 2019. Problem based learning (PBL) in the development of emotional intelligence of university students. *Propósitos y Representaciones*, 7(2), 353-383. http://dx.doi.org/10.20511/pyr2019.v7n2.288

Maurer, T.W. and Kropp, J.J., 2015. The impact of the immediate feedback assessment technique on course evaluations. *Teaching and Learning Inquiry.* [e-journal] 3(1)pp.31-46. https://doi.org/10.20343/teachlearninqu.3.1.31

Menold, N. and Bogner, K., 2016. Design of rating scales in questionnaires. *GESIS Survey Guidelines*. Mannheim, Germany: GESIS – Leibniz Institute for the Social Sciences. 10.15465/gesis-sg_en_015

Miknis, M., Davies, R., Johnson, C.S., 2020. Using rubrics to improve the assessment lifecycle: a case study. *Higher Education Pedagogies*. 5(1). https://doi.org/10.1080/23752696.2020.1816843

Quigley, C., Marshall, J.C., Deaton, C., Cook, M.P., Padilla, M., 2011. Challenges to inquiry teaching and suggestions for how to solve them. *Science Educator*. [e-journal] 20(1). https://files.eric.ed.gov/fulltext/EJ940939.pdf

Rasuchert, E.S.J., Yang, S., and Pigg, R.M., 2019. Which of the following is true: We can write better multiple choice questions. *Bulletin of the Ecological Society of America*. [e-journal] 100(1)pp.1-7. https://www.jstor.org/stable/26554305

Rauschert, E., Yang, S., and Pigg, R., 2019. The anatomy of a multiple choice question. [Online Image]

Ribeiro, L.C., 2011. The pros and cons of problem-based learning from the teacher's standpoint. *Journal of University Teaching & Learning Practice*. 8(1), pp.34-51. https://doi.org/10.53761/1.8.1.4

Schneider, J. and Hutt, E., 2013. Making the grade: A history of the A-F marking scheme. *Journal of Curriculum Studies.* [e-journal] 46(2)pp.201-244. https://doi.org/10.1080/00220272.2013.790480

Siegfried, C. and Wuttke, E., 2019. Are multiple-choice items unfair? And if so, for whom? *Citizenship, Social, and Economics Education.* 18(3). https://doi.org/10.1177/2047173419892525

Skillings, M.J. and Ferrell, R., 2000. Student-generated rubrics: Bringing students into the assessment process. *The Reading Teacher*. [e-journal] 53(6)pp. 452-455. https://www.jstor.org/stable/20204821

Stanger-Hall, K., 2017. Multiple-choice exams: An obstacle for higher-level thinking in introductory science classes. *CBE - Life Sciences Education*, 11(3), pp. 201-332. DOI: 10.1187/cbe.11-11-0100

Van Driel, J.H., Vossen, T.E., Henze, I., de Vries, M.J., 2018. Delivering STEM education through school-industry partnerships: A focus on research and design. *Global Education in the 21st Century.* [e-journal] 2. pp. 31-44. https://doi.org/10.1163/9789004391413_003

Vincent-Lancrin, S., González-Sancho, C., Bouckaert, M., de Luca, F., Fernández-Barrerra, M., Jacotin, G., Urgel, J., and Vidal, Q., 2019. *Fostering students' creativity and critical thinking: What it means in school, educational research and innovation.* [e-book] Paris: OECD Publishing. Available through: https://doi.org/10.1787/62212c37-en [Accessed 21 March 2022].

Worsley, J.D., Harrison, P., and Corcoran, R., 2021. Bridging the gap: Exploring the unique transition from home, school, or college into university. *Frontiers in Public Health.* [e-journal]. https://doi.org/10.3389/fpubh.2021.634285

Yeong F., 2015. Use of constructed-response questions to support learning of cell biology during lectures. *Journal of Microbiology & Biology Education*, 16(1), pp. 87–89. DOI: 10.1128/jmbe.v16i1.890

Yew, E.H.J. and Goh, K., 2016. Problem-based learning: An overview of its process and impact on learning. *Health Professions Education.* [e-journal] 2(2)pp.75-79. https://doi.org/10.1016/j.hpe.2016.01.004

Zhan, P., 2020. Longitudinal learning diagnosis: minireview and future research directions. *Frontiers in Psychology.* [e-journal]. https://doi.org/10.3389/fpsyg.2020.01185