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# Embedding reflection into the science curriculum in higher education

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## *Abstract*

Across traditional lab-based science subjects, including biological sciences, most learning is discipline-specific and focused on developing scientific skills and knowledge. However, graduate employers are increasingly demanding that employees have additional skills, including the ability to recognise their own strengths and limitations, a skill that can be structured around reflection. Reflective practice is standard practice in people-centred professions, but is seldom used in more lab-based subjects. To address this area for development, an undergraduate biology course at the University of Portsmouth, UK, trialled including the inclusion of reflection in assessment to encourage students to explore decision making and teamwork while working on a group assessment, and to support the conscious use of feedback as feed-forward. The reflective element supported a wider assessment strategy that included formative and summative elements, group work and peer marking of work that was discipline-specific (lab reports). While the current trial was small, this paper will reflect on the operations of the pilot, which showed promise in supporting a different type of thinking among students and could form the start of a wider programme of reflective development across a science degree, and thus may support employability in science graduates. This paper will share the practice of the intervention.

**Keywords**: higher education; reflection; employability.

## *Background*

In most science degrees, there is substantial focus on learning content and scientific writing, but few opportunities to turn the attention inwards and allow students to think about what they are doing, why they are doing it, and how they might do things differently. In more people-centred professions, such as social work or nursing, critical reflection is a major part of learning and assessment (Helyer, 2015). This is almost entirely lacking from the science curriculum (Hill et al., 2020). In fact, a great deal of training in science writing is focused on removing the self from the writing, and creating an impression of objectivity (Dobrin, 1985) and almost personal infallibility – if there is a problem, it is a scientific one. However, there are several key reasons that self-reflection is important not only in people-centred professions but also in science. These reasons span the scales from biases and social impacts through skills development of individual students and employability.

Firstly, we need to recognise that although scientific enquiry aims to be objective, it is designed and carried out by individuals who exist in a wider context of paradigms and biases. This can lead to scientific findings that, while appearing to be scientifically rigorous, are in fact strongly biased by the views or training or social context of the researcher. Examples of social biases in science include societal gender roles leading to skewed interpretations of sexual dimorphism and mate preference in animals (Rosenthal and Ryan, 2022). This, and other biases in society, based on gender roles and race in particular, have had long-lasting consequences for research in animal and human biology (Rose, 2009; Ogden, 2021). Additionally, colonial attitudes continue to be strongly ingrained in many scientific fields (Harrison, 2005), with an 'explorer' mentality which tends to ignore or underestimate the skills and knowledge of researchers from the countries in which their tropical research is based. These attitudes are not only central to a great deal of field-based research and overseas field trips (Eichhorn et al., 2020; Hart et al., 2021) but have been argued to be central to everything from curriculum to the system of publishing (Piron et al., 2017), and efforts to improve the situation are not always effective. For example, while the move to open-access publication makes literature more accessible to readers globally, it restricts publication to researchers with the resources to fund open-access fees, shifting rather than removing inequalities (Sengupta, 2021).

Within the scientific field, we regularly make assumptions and use methods that cannot be clearly and objectively described, based on experience and community. Dobrin (1985) uses the neat example of a radiographer who interprets X-rays based on experience but cannot clearly show a non-expert what they see; this illustrates the inherent problem with the assumption that scientific writing is objective. Without considering our own positionality and biases (Jafar, 2018), it is hard to see how these attitudes will change. In this paper, we argue that it is important for educators to encourage self-reflection in science students early on, to allow future graduates to challenge such biases.

On the level of individual students, science graduates will go on to have many different roles, from roles in lab-based research to marketing or industry to teaching (Jisc/AGCAS Prospects, 2021). These professions require a diversity of transferable skills, where training scientists purely in scientific methods and not in recognising their own skills development is therefore doing them a disservice, as these skills are invaluable whether a graduate remains in science or not. A key skill, whatever the job role, is to be able to recognise one's own strengths and limitations and ask for help when needed – reflective skills are considered crucial for any professional (Colomer et al., 2013).

Although transferable skills are seen as valuable by academics, little time is devoted to skills development or reflection during science courses (Hill et al., 2020), largely through fear of reduced time in the curriculum for disciplinary content (Sarkar et al., 2020). However, the content focus means students can struggle to understand why they lose marks for style or coherence, or how they can improve their work. From our own anecdotal experience, although assessment-driven (Holmes, 2018), students are also not always good at recognising either the strengths or limitations of their own work. In part, this might be through a lack of awareness of how other students are coping with different aspects of work, and the fact that there is seldom chance for self-reflection, self-evaluation or peer evaluation.

An interesting place to encourage both self and peer evaluation is in tasks that are carried out as a group. Group work is a space where students have a chance to see what others are doing, gain skills, and realise where their own work is limited. It also helps build collaborative working. In general, although students are often surprised by this, our team has observed that the standard of the work produced by a group of students is higher than the average standard of individual work. This has also been found in published studies (Mora et al., 2020).

## *Pilot in BSc (Hons) Biology*

In this paper, we discuss an assessment intervention trialled during the 2022/23 academic year at the University of Portsmouth, UK, in the School of Biological Sciences, Faculty of Science and Health. The assessment intervention aimed to introduce a reflective element to a summative assessment at Level 5 (second year undergraduate) on a 20-credit module called Animal Adaptations, available on the BSc Biology course and the BSc Marine Biology course. A total of 76 students were enrolled on the module and completed the assessment, which was worth 50% of the module mark. For BSc Biology, this was an optional module, while for BSc Marine Biology it was compulsory. We will discuss the specific reasons for the intervention, the original assessment, the modified assessment, and how the assessment went, before discussing ways that it could be modified and expanded in the future to broaden its scope.

This paper was written after the assessment was complete and as such ethical approval was not obtained; here we focus and reflect on our own experiences as educators to provide recommendations for similar contexts in the sector. No personal student data, grades or reflections are included, where this paper will instead focus on practice and recommendations. The rationale below highlights the situation of the intervention in higher education literature.

## *Rationale for intervention*

The intervention that will be discussed was developed to address four different issues:

### 1) Students do not always recognise their own skills, or know when to ask for help

This issue was recently raised in an employers' forum in our school, where local employers were asked which key skills they require in graduates but are not currently seeing. Employers identified specific scientific skills, such as environmental surveying knowledge, but also transferable skills, and perhaps most importantly, the ability for graduates to recognise their own limitations. These comments mirrored discussions with our own tutees who often struggle with job applications, and the growing importance of transferable skills to employers (Succi and Canovi, 2020). Critical self-awareness is important from the point of view of the employer because they need their employees to ask for help when needed, rather than halting progress or even causing damage by a lack of knowledge or skill. Students have to be prepared for self-management in employment, but these are skills they do not often explicitly develop in higher education (Miller and Konstantinou, 2022). However, they are skills that can be supported through reflection (Mello et al., 2021; Mello and Wattret, 2021).

### 2) Students do not always use feedback as feed-forward

The use of feedback is a continual issue when students do not see feedback as useful or know how to use it (Winstone et al., 2017). This limits skill development and restricts both formative and summative assessment into end-point assessments of current skills, wasting the time and effort that could have been used more effectively as a learning experience, missing opportunities for skill development and improvement. Part of the issue here is in the feedback given: if it is too generic, students do not understand how it applies to their work; if too specific, they do not necessarily know how to extrapolate that to future work and do not see how it is helpful. This might lead to students not engaging with feedback at all, focusing on the given mark but not taking the time to understand the reasoning behind the awarded mark.

### 3) Students are rarely given space to think about the context of their work on a personal and societal scale

In a science course, very little time is given to discussing wider contexts, although there is increasing focus on programmes of decolonising curricula at universities (Bhambra et al., 2018; Begum and Saini, 2019). This is not, however, currently widely adopted amongst academic staff, regardless of how important they view these steps, due to a lack of experience and training (Grinsted et al., 2024). While specific concerns about diversity and decolonisation are critical to overall understanding of a scientific topic, it is important to start with a questioning attitude to context and self, and for students to feel safe to question assumptions (Brookfield, 2012) before they can tackle topics that feel higher risk. Therefore, here we will start with a more basic interpretation of self-reflection and self-assessment, with the view that an improved self-awareness will help enable students to critically engage with the historical contexts and societal biases of science topics in future work.

### 4) A pre-existing assessment was available for improvement

In a pre-existing summative assessment, second-year biology and marine biology students were producing an individual abstract for a group-produced lab report. Both individual and group-produced parts (weighted 20% and 80% of the assessment mark, respectively) covered the same learning outcomes, both scientific (‘Discuss the effects of the environment on biological systems’, and ‘Analyse and evaluate experimental data in animal science’.), so the individual abstract’s only purpose was to provide a possibility for slight differentiation of marks amongst group members. Abstracts were difficult to assess because they were only 200 words, and students were frequently losing marks for missing a few key words. We saw two options: either focus more time on teaching students how to write abstracts, or use the opportunity to multitask and develop other skills. Abstract writing is a skill that is covered in other modules within the course, so we decided this was an opportunity to try and develop an assessment element which addressed the deficit in graduate employability skills noted by the employers.

Additionally, we had previously implemented a formative, peer-marked assessment prior to the summative lab report, which provided an excellent resource on which to build a reflective activity, replacing the original individual abstract. Together, this set of assessments had some real strengths, which could be built on to make an authentic and useful set. The version of the set of assessments which was used in the previous academic year (2021/22) followed four steps through the module:

#### *i. Individual formative lab report plan*

Students attended a computer-based lab using videos of a fruit fly experiment to obtain behavioural data. Students then used this data to write a plan for a lab report, highlighting the important information they would include, what figures they would use, and how they would introduce and discuss the data. They did not have to write this up as a full report, but instead submitted a short plan in bullet-point format. This formative assignment was meant to get students to think about the overall structure of lab reports, with headings and subheadings, and to think about what belongs in each section of the report.

### *ii. Peer feedback on lab report plan*

Students were then each randomly allocated two to three other reports to peer assess. They were also given the opportunity to assess their own report plan. They were asked to give a mark out of 10 for a number of different elements of the plan, and give constructive, written feedback using a clear and simple mark scheme for guidance. Each student, therefore, gave out and received several pieces of feedback from different students and engaged directly with the marking criteria. This activity was designed to help students i) understand how markers use marking criteria to assess their work, ii) gain an insight into how their peers approach lab report writing to encourage them to reflect on what works well and what works less well in report writing, iii) gain multiple lots of constructive feedback that they may engage with more actively because they actively produced feedback for others as well.

### *iii. Group practical and group lab report*

Later in the module, all students attended an in-person practical where they conducted an experiment investigating the metabolic rate of a marine invertebrate under different temperature conditions. They then wrote this up as a full lab report in groups of approximately four students. This part was worth 80% of the assessment mark.

### *iv. Individual abstract*

To give a place for individual input, to assess the individual understanding of the project, and to allow for slight differentiation of marks amongst group members, each student wrote their own 200-word abstract to be submitted alongside the group report. This was worth 20% of the assessment mark.

This overall assessment structure and the multiphase approach were working well from prior years' experience. The lab report approach is used frequently across the degree course to assess understanding of practical work and to train students to present experimental data in a way that is analogous to a scientific paper or report that would be produced in industry. In this way, it is an authentic assessment (Sokhanvar et al., 2021), particularly when written as a group, since scientific research is seldom conducted by individuals with no collaborators, although it does not assess laboratory skills directly (Veale et al., 2020). Learning to write as a part of a team is an important skill for both academic and industrial careers, although our students often complain about group work. Based on our anecdotal experience, students often say that they find group work difficult to organise and coordinate, and that they worry that their marks do not represent their own work or that they have to compensate for less engaged group members. Therefore, they do not always recognise the value that group working provides.

In this assessment, a combination of formative and summative assessment was already in place, using peer feedback, which has been demonstrated to improve content learning and develop scientific skills (Mora et al., 2020). We did not want to change the bulk of the assessment substantially, because we thought that the multi-part approach to assessment was appropriate and we were keen to support student engagement with the marking criteria and develop skills in both lab report writing specifically, and to reflect on work done by peers. According to Hortigüela Alcalá et al. (2019, p.934), ‘a truly formative assessment system must incorporate critical reflection and an active questioning on the part of the student’. Stronger students will use the peer assessment as a trigger to critically reflect on their own work, thereby recognising their own strengths and weaknesses and building their skills (Yan et al., 2022), but this is not explicit in the requirements. Therefore, we decided to build an explicitly reflective element into the assessment to encourage all students to actively question their own actions.

## *Details of intervention*

Our modification to the assessment was designed to replace the individually written abstract with an individually written commentary on the way that students worked in their groups and how they had used feedback from previous work to improve their group-produced summative lab report. Although students were encouraged to discuss comments specifically generated in the peer feedback activity, they were also able to choose feedback from elsewhere in their course to allow them to select comments they found most valuable. This activity was designed to encourage self-assessment and reflection, as well as encourage direct interaction with and application of feedback. Students were given the opportunity to form their own groups, but other than that, there was little choice in what they should write. There were also opportunities for reasonable adjustment for students who were not able to work in groups, with an option to focus their commentary on the report itself and their time management rather than the group work.

Presented below is the exact wording of the assessment task.

**Individually-written commentary**

Each group member needs to write a short 300-word commentary on the practical and lab report. This will count for 20% of your individual mark for this assignment. They should answer the following questions:

- How did you approach dividing the tasks up as a group and managing communication?
- How did you use earlier feedback to improve the report?
- How could you improve your report?
- What did you learn from this piece of work that you will take forward to future work?

This piece should be **reflective,** which is a bit different from the normal scientific writing you have been developing. This means that you should describe briefly what happened, but you should include your own thoughts and how you came to decisions, using evidence to back it up.

Since the commentary was short and only a small part of the overall assignment, we did not want to overwhelm the students with too many new concepts and therefore did not discuss a reflective model for the students to follow. Additional questions we considered adding (and may add in future years) were more structuring, following Gibbs' reflective framework (Gibbs, 1988), as used by Sekarwinahyu et al. (2019). We also designed a full mark scheme, but again did not want to include an overwhelming quantity of information, so settled on a briefer description of the key criteria used for assessing their commentary:

**Assessment criteria**

Commentary (Individual mark) Weight 20% of total lab report mark

- Shows evidence that you can work as a group, and analyse where things went well/wrong/how things could have been better and why.
- Identifies key areas of problems and chooses appropriate methods for their resolution.
- Demonstrates the impact of the past feedback and the resulting change in your own work.
- Shows insight in evaluating your own strengths and weaknesses.

The aims were to encourage students to reflect on their own learning as well as that of others. It combines peer assessment with self-assessment, which Stančić (2021) demonstrates is a valuable combination. It also provides a space for students to voice concerns about working with their group, and asks them to justify decisions and think about the process of group work.

Brookfield (2009) would likely argue that this assessment asks for reflection, but not necessarily critical reflection, as the questions do not explicitly ask about biases and assumptions. The level of critical reflection would always be limited in a 300-word assignment, however, introducing reflection to the cohort at this stage of their programme provides an opportunity to build on this graduate employability skill later on in the programme, e.g. at Level 6, developing greater criticality as students progress and gain experience.

### *Outcomes and observations*

The individual commentaries were interesting to mark on a personal level because, unusually in a science course, individual students were allowed to have an individual voice. Although the pieces were frequently a little clumsily written, being the first time the students had written anything reflective, and perhaps mixed in terms of honesty, there was a range of insights and personal observations that demonstrated both that students had engaged well with the task and that it had been useful to them.

The course team noted that some students had missed (or misunderstood) the reflective part of the brief and had simply described what they did; this would likely have been prevented by providing a reflective model for them to follow (Jasper, 2013). However, almost all were able to recognise how they used feedback from previous pieces of work quite specifically, and many were able to describe how they would use this again in future work. Some students gave more personal insights too about how they have worked to develop skills, e.g. language skills. Students generally struggled more with reflecting on how their choices in group work affected how the group functioned, and whether there were alternative ways of working, but this would have been difficult to discuss meaningfully within the 300-word limit.

This is compounded by general training in science writing, which is to be objective, and finding the balance of considering your own actions objectively and in a wider context is challenging. It is also probable that students would have benefitted from some more input on how to write the reflection. It is quite different from the other work they produce, and the guidance provided was quite minimal, which may have led to students feeling more uncomfortable branching into this new writing style than they needed to be. The reflection was only 300 words, and we were concerned about giving guidance that ended up being significantly longer than the work they needed to produce, but more guidance would have been helpful. For future years, this will include suggesting a reflective framework for the students to work within, and perhaps reducing the expected content to allow greater depth of reflection. One option would be to allow the students to choose just one of the questions to address.

There was a possibility that students would use this piece of writing as a place to rant about their group. Clearly this was not the intention, and professionalism is key. Having marked the assessments we found that very few students actually used it as a place to complain and only one or two out of 75 lacked professionalism in places. Where students did not respond in a professional manner, this was addressed in feedback, so this assessment also provided an opportunity to build on professionalism, an additional benefit for all stakeholders: students (as graduate employees), employers and the education provider (reputationally).

A limitation of this assessment as a learning tool is that, because this piece of work is in isolation in the course, students do not currently have the opportunity to build on their critical reflection skills going forward within their degree. Students, therefore, may not take the feedback they were given on this work particularly seriously, knowing they will not have to write another similar piece in the future. We think it is worth expanding the reflective approach to be more widely adopted, giving students a chance to develop these skills. It is also important that the wider importance of reflective skills in the workplace is highlighted.

## *Discussion*

Overall, we found this assessment to be a positive intervention. The enforced engagement with the marking criteria in the peer assessment gave students the opportunity to understand the expectations in depth and also gave them the opportunity to see how others approached the task. Although the reflective element provided a place for students to have a voice, they may have benefitted from more support and perhaps too much was asked within the short word count. This could be developed further to better clarify the aims and support students to be more critically reflective, using a more focused brief and a simple reflective model such as Gibbs' reflective cycle (Gibbs, 1988), or Jasper's simple three-step ERA model (Jasper, 2013).

Some students may have felt more uncomfortable talking about their own decisions than scientific analysis, which is where they are used to working, due to the lack of experience the students have in evaluating their own inputs (Hill et al., 2020). Colomer et al. (2013) found that many students struggle with reflective learning because they are used to other types of learning, though some feel directly uncomfortable or unmotivated. Although student discomfort is not ideal, we think it mainly highlights the need for greater training in self-assessment approaches as reflection is a key skill in the workplace (Colomer et al., 2013). Additionally, it is likely that some students find the group work itself more challenging than others, particularly neurodiverse students who might find it difficult to manage group demands and scheduling (Fabri et al., 2022). Autistic students may also find it challenging to express and communicate their emotions (Huang et al., 2017) and therefore may find reflective writing difficult. While reflection may help these students to consider their own responses and work on those skills, if they also find reflection difficult, this might prove extra challenging for those students. We argue that this should not preclude neurodiverse students from taking part in group work or reflective writing, but it might mean that those students require additional support to structure their writing and to work in a group.

Clearer expectations will be set to reduce the cognitive load on students and ensure they are focusing on the output that was intended. This may include giving additional guidance and introducing similar assessments elsewhere in the course, including as formative pieces. In isolation, this small piece of writing was perhaps aiming to cover too many questions and it was therefore difficult for the students to go into depth on any of them. To solve that problem, specific questions would ideally be spread across formative and summative assessments throughout the course. With those modifications, there is potential to roll this type of assessment out across a degree course to encourage the building of critical self-awareness and reflective skills. Table 1 below presents a possible programme of reflective development across the degree with interventions spread through an existing tutorial system and to accompany assessments.

**Table 1.** Hypothetical design for a scheme of reflective development and self-assessment through a science degree course, complementing existing structures such as tutorial systems and honours projects.

| | Level 4 | Level 5 | Level 6 |
|---|---|---|---|
| Tutorial system | Reflective diaries/simple self-rating and discussions in tutorial systems | Building reflective diaries with CV writing and careers sessions | Building reflection practice into Honours project meetings and weekly log |
| Coursework submissions | Basic self-assessment grading forms to accompany submitted work | Reflective self-assessment forms to accompany submitted work, with peer assessment where relevant | |

While the initial scope in the discussed assessment was small, this reflective framework could encompass thinking about protected characteristics such as gender and disability, positionality and intersectionality, inclusivity and diversity, colonial legacies and beyond, and provide a basis for real change for both individual students and the future of science research if considered more widely.

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## *References*

Begum, N., and Saini, R. (2019) ‘Decolonising the curriculum’, *Political Studies Review*, 17(2), pp.196-201. Available at: https://doi.org/10.1177/1478929918808459

Bhambra, G.K., Gebrial, D., and Nişancıoğlu, K. (2018) ‘Introduction: decolonising the university’, in G.K. Bhambra, D. Gebrial, and K. Nişancıoğlu (eds) *Decolonising the University*. London: Pluto Press, pp.1-18.

Brookfield, S. (2009) ‘The concept of critical reflection: promises and contradictions’, *European Journal of Social Work*, 12(3), pp.293-304. Available at: https://doi.org/10.1080/13691450902945215

Brookfield, S.D. (2012) *Teaching for Critical Thinking: Tools and Techniques to Help Students Question Their Assumptions*. San Francisco: Jossey-Bass.

Colomer, J., Pallisera, M., Fullana, J., Burriel, M.P., and Fernández, R. (2013) ‘Reflective learning in higher education: a comparative analysis’, *Procedia - Social and Behavioral Sciences*, 93, pp.364-370. Available at: https://doi.org/10.1016/j.sbspro.2013.09.204

Dobrin, D.N. (1985) ‘Is technical writing particularly objective?’, *College English*, 47(3), pp.237-251. Available at: https://doi.org/10.2307/376773

Eichhorn, M.P., Baker, K., and Griffiths, M. (2020) ‘Steps towards decolonising biogeography’, *Frontiers of Biogeography*, *12*(1), e44795. Available at: https://doi.org/10.21425/F5FBG44795

Fabri, M., Fenton, G., Andrews, P., and Beaton, M. (2022) ‘Experiences of higher education students on the autism spectrum: stories of low mood and high resilience’, *International Journal of Disability, Development and Education*, 69(4), pp.1411-1429. Available at: https://doi.org/10.1080/1034912X.2020.1767764

Gibbs, G. (1988) *Learning by Doing, A Guide to Teaching and Learning Methods*. Oxford: Further Education Unit, Oxford Polytechnic.

Grinsted, L., Murgatroyd, C., and Burkett, J. (2024) ‘Exploring attitudes to decolonising the science curriculum - a UK higher education case study’, *PloS One*, 19(11), e0312586. Available at: https://doi.org/10.1371/journal.pone.0312586

Harrison, M. (2005) ‘Science and the British Empire’, *Isis*, 96(1), pp.56-63. Available at: https://doi.org/10.1086/430678

Hart, A.G., Leather, S.R., and Sharma, M.V. (2021) 'Overseas conservation education and research: the new colonialism?', *Journal of Biological Education*, 55(5), pp.569-574. Available at: https://doi.org/10.1080/00219266.2020.1739117

Helyer, R. (2015) 'Learning through reflection: the critical role of reflection in work-based learning (WBL)', *Journal of Work-Applied Management*, 7(1), pp.15-27. Available at: https://doi.org/10.1108/JWAM-10-2015-003

Hill, M.A., Overton, T.L., and Thompson, C.D. (2020) 'Evaluating the impact of reflecting on curriculum-embedded skill development: the experience of science undergraduates', *Higher Education Research and Development*, 39(4), pp.672-688. Available at: https://doi.org/10.1080/07294360.2019.1690432

Holmes, N. (2018) 'Engaging with assessment: increasing student engagement through continuous assessment', *Active Learning in Higher Education*, 19(1), pp.23-34. Available at: https://doi.org/10.1177/1469787417723230

Hortigüela Alcalá, D., Palacios Picos, A., and López Pastor, V. (2019) 'The impact of formative and shared or co-assessment on the acquisition of transversal competences in higher education', *Assessment and Evaluation in Higher Education*, 44(6), pp.933-945. Available at: https://doi.org/10.1080/02602938.2018.1530341

Huang, A.X., Hughes, T.L., Sutton, L.R., Lawrence, M., Chen, X., Ji, Z., and Zeleke, W. (2017) 'Understanding the self in individuals with autism spectrum disorders (ASD): a review of literature', *Frontiers in Psychology*, 8. Available at: https://doi.org/10.3389/fpsyg.2017.01422

Jafar, A.J.N. (2018) 'What is positionality and should it be expressed in quantitative studies?', *Emergency Medicine Journal*, 35(5), pp.323-324. Available at: https://doi.org/10.1136/emermed-2017-207158

Jasper, M. (2013) *Beginning Reflective Practice*. 2nd edn. Andover: Cengage Learning EMEA.

JISC/AGCAS Prospects (2021) *What do graduates do?* Available at: https://graduatemarkettrends.cdn.prismic.io/graduatemarkettrends/03ab4cc3-0da8-4125-b1c7-a877e1d5f5fd_what-do-graduates-do-202021.pdf (Accessed: 14 May 2025).

Mello, L.V., Varga-Atkins, T., and Edwards, S.W. (2021) 'A structured reflective process supports student awareness of employability skills development in a science placement module', *FEBS Open Bio*, 11(6), pp.1524-1536. Available at: https://doi.org/10.1002/2211-5463.13158

Mello, L.V., and Wattret, G. (2021) 'Developing transferable skills through embedding reflection in the science curriculum', *Biophysical Reviews*, 13(6), pp.897-903. Available at: https://doi.org/10.1007/s12551-021-00852-3

Miller, E., and Konstantinou, I. (2022) 'Using reflective, authentic assessments to embed employability skills in higher education', *Journal of Work-Applied Management*, 14(1), pp.4-17. Available at: https://doi.org/10.1108/JWAM-02-2021-0014

Mora, H., Signes-Pont, M.T., Fuster-Guilló, A., and Pertegal-Felices, M.L. (2020) 'A collaborative working model for enhancing the learning process of science and engineering students', *Computers in Human Behavior*, 103, pp.140-150. Available at: https://doi.org/10.1016/j.chb.2019.09.008

Ogden, L.E. (2021) 'How gender bias has shaped reproductive biology', *BioScience*, 71(3), pp.216-222. Available at: https://doi.org/10.1093/biosci/biaa172

Piron, F., Diouf, A.B., Dibounje Madiba, M.S., Mboa Nkoudou, T.H., Aubierge Ouangré, Z., Tessy, D.R., Rhissa Achaffert, H., Pierre, A. et al. (2017) 'Le libre accès vu d'Afrique francophone subsaharienne', *Revue Française Des Sciences de l'information et de La Communication*, 11. Available at: https://doi.org/10.4000/rfsic.3292

Rosenthal, G.G., and Ryan, M.J. (2022) 'Sexual selection and the ascent of women: mate choice research since Darwin', *Science*, 375(6578). Available at: https://doi.org/10.1126/science.abi6308

Rose, S. (2009) 'Darwin, race and gender', *EMBO Reports*, 10(4), pp.297-298. Available at: https://doi.org/10.1038/embor.2009.40

Sarkar, M., Overton, T., Thompson, C.D., and Rayner, G. (2020) 'Academics' perspectives of the teaching and development of generic employability skills in science curricula', *Higher Education Research and Development*, 39(2), pp.346-361. Available at: https://doi.org/10.1080/07294360.2019.1664998

Sekarwinahyu, M., Rustaman, N.Y., Widodo, A., and Riandi, R. (2019) 'Development of problem based learning for online tutorial program in plant development using Gibbs' reflective cycle and e-portfolio to enhance reflective thinking skills', *Journal of Physics: Conference Series*, 1157(2). Available at: https://doi.org/10.1088/1742-6596/1157/2/022099

Sengupta, P. (2021) 'Open access publication: academic colonialism or knowledge philanthropy?', *Geoforum*, 118, pp.203-206. Available at: https://doi.org/10.1016/j.geoforum.2020.04.001

Sokhanvar, Z., Salehi, K., and Sokhanvar, F. (2021) 'Advantages of authentic assessment for improving the learning experience and employability skills of higher education students: a systematic literature review', *Studies in Educational Evaluation*, 70, 101030. Available at: https://doi.org/10.1016/j.stueduc.2021.101030

Stančić, M. (2021) 'Peer assessment as a learning and self-assessment tool: a look inside the black box', *Assessment and Evaluation in Higher Education*, 46(6), pp.852-864. Available at: https://doi.org/10.1080/02602938.2020.1828267

Succi, C., and Canovi, M. (2020) 'Soft skills to enhance graduate employability: comparing students and employers' perceptions', *Studies in Higher Education*, 45(9), pp.1834-1847. Available at: https://doi.org/10.1080/03075079.2019.1585420

Veale, C.G.L., Jeena, V., and Sithebe, S. (2020) 'Prioritizing the development of experimental skills and scientific reasoning: a model for authentic evaluation of laboratory performance in large organic chemistry classes', *Journal of Chemical*

*Education*, 97(3), pp.675-680. Available at: https://doi.org/10.1021/acs.jchemed.9b00703

Winstone, N.E., Nash, R.A., Rowntree, J., and Parker, M. (2017) '"It'd be useful, but I wouldn't use it": barriers to university students' feedback seeking and recipience', *Studies in Higher Education*, 42(11), pp.2026-2041. Available at: https://doi.org/10.1080/03075079.2015.1130032

Yan, Z., Lao, H., Panadero, E., Fernández-Castilla, B., Yang, L., and Yang, M. (2022) 'Effects of self-assessment and peer-assessment interventions on academic performance: a meta-analysis', *Educational Research Review*, 37, 100484. Available at: https://doi.org/10.1016/j.edurev.2022.100484

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