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Creative teaching design in STEM: Using graduate learning outcomes to distribute students' existing knowledge in first-year biology practical work groups

Julia Savage
Deakin University, Australia, julia.savage@deakin.edu.au

Jillian Healy
Deakin University, Australia, jillian.healy@deakin.edu.au

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Abstract
In Australia, a significant number of students enrol in first-year university biology without the benefit of high school biology. In order to help students support each other, the authors of this paper (a central unit academic developer and a biology coordinator of first-year biology) created a classroom activity that facilitated the distribution of the more experienced students of biology throughout the practical work groups. An important feature of this creative design for forming groups, called the *GLO Activity* in this paper, was the embedding of two of the University's key teaching and learning priorities within the activity. These were the University's eight graduate learning outcomes (GLOs) and, inclusive education practice. We discuss creative pedagogies in STEM (Science, Technology, Engineering and Maths) and their link to supporting students in their first year of university study. We explain our scholarly thinking behind the GLO Activity and evaluate its impact. Finally, we reflect on how we, the educators, found satisfaction in thinking deeply to create a new learning structure for a biology practical class that solved one teaching challenge but also met a number of the University's curriculum principles.

Keywords
creative teaching design, practical groups

Introduction

As part of our commitment to contributing to scholarly teaching practice, we wish to share a novel teaching design for STEM practical work groups that is informed by the theories of constructivism, inclusive practice and first-year university transition pedagogy. In presenting the teaching design, we share what we have learned about pursuing a creative approach to teaching in STEM – for the students and, perhaps unexpectedly, for ourselves. Our particular view of creativity is informed by Pollard et al. (2018), in that we focus less on teaching *for* student creativity and more on how academics can teach creatively. A definition of creative teaching practice in STEM with which we align includes "surprising, multi-disciplinary, risky, focused on process and product, aligned to learning outcomes and produces knowledge that is new and valuable" (Pollard et al. 2018, p. 181). For the purpose of discussing the teaching design, we have called it the *GLO [Graduate Learning Outcomes] Activity.*

Initially, we identified one specific challenge for which we sought an appropriate educational intervention: coordinators of first-year biology are challenged by the need to support the learning of both students who are experienced in studying biology and those who have not studied biology previously. However, when we applied the scholarly teaching lens of constructivism to our challenge, we found opportunities for further learning possibilities. We knew that students' previous educational experiences in biology were but one of many diversities students bring to a biology practical class, and so we sought to ensure that inclusive practice values and transition pedagogies informed our learning activity.

We thought a focus on teamwork might help us design a learning activity to achieve our goals. As teamwork is one of our university's eight graduate learning outcomes, this prompted further exploration. Could we help students in their first year of study understand the benefits of diverse work teams (for study and future work) and, at the same time, introduce all eight graduate learning outcomes? These outcomes are similar to those of other Australian universities, and faculties are required to map how graduate learning outcomes are embedded in degree courses to meet standards in curriculum alignment. They are summarised here as: discipline knowledge, communication, digital literacy, critical thinking, problem-solving, self-management, teamwork and global citizenship. Graduate learning outcomes are known in higher-education literature as identified attributes, competencies or qualities graduates should acquire for employment by the end of a degree (Hill et al. 2016). First-year students benefit from early opportunities to understand the employability skills they will need to demonstrate by the end of their degree. We reflected: What if we could achieve multiple outcomes through one teaching activity? Our intention then became to introduce the university's graduate learning outcomes by using them as the framework for an activity that would weave together the various threads of distributing prior biology knowledge, supporting the broader inclusive-practice principles and establishing a supportive peer-to-peer learning environment for first-year students. The result of this thinking (which we detail) was a group formation activity, the GLO Activity, which was trialled with three cohorts of biology students in the third trimester of 2015. Students provided immediate written feedback on the activity's (mostly) positive value as a learning experience. We present an evaluation of the students' comments as well as discussion of our observations and future recommendations. Finally, we reflect on whether our intentions were achieved for those who would like to use the GLO Activity in the future.

Constructivism, inclusive education and first-year pedagogies

Churchill et al. (2013) define a constructivist learning theory as an approach to teaching that recognises that a person's learning will be mediated by their prior experiences and understandings (p. 12). Accordingly, a teacher will not present a discipline concept as an introduction to new content knowledge; instead, a teacher will create an opportunity to activate students' existing knowledge. In this way, students are required to construct new understandings by reflecting on their earlier thinking (Killen 2013, p. 54). Providing a learning path that has the students' context at the core of teaching provides an inclusive environment that supports diversity in educational backgrounds, gender, sexuality, ethnicity, (dis)ability, age, health, location, socioeconomic status and first language (Hockings 2010). First-year pedagogies focus on addressing particular issues for students transitioning from high school, and with diverse personal circumstances, into university (Kift et al. 2010). These three fields of educational literature informed the GLO Activity.

The need to embed study support for first-year students in the core curriculum

Our specific challenge is a widespread issue for educators teaching first-year biology in higher education. Managing the diversity of students' prior experiences in the study of biology is a significant teaching and learning concern. In general, transition issues for first-year students are well known and documented (Crisp et al. 2009; Kift et al. 2010; Krause & Coates 2008; Yorke & Longden 2008). Students in the sciences may be joining courses that often have very high numbers of students, are broad in scope and complexity and present inexperienced students with potential difficulties accessing staff and resources (Bone & Reid 2011, p. 710).

Importantly, poor transition does not just result in poor grades. A less-than-successful transition from secondary school to university can result in poor retention of first-year students. Students who struggle in a first-year course of study are at risk of opting out of their course entirely (Kift 2009). While conscious that our university offered extensive peer-tutoring programs for new students, we sought to embed a social and academic support structure within a student's core curriculum, as it more closely fitted our goal of a constructivist approach to learning, where learning outcomes focus on the knowledge-construction process from a student's perspective (Bada 2015). Our desire was to create a peer-to-peer support approach *in situ* to benefit all new students in the first-year biology classes.

Setting the conditions for collaborative, inclusive group learning within peer-to-peer context in the teaching of biology

The value of collaborative group work as an example of student-centred learning is well documented (Armbruster et al. 2009; Ekimova & Kokurin 2015; Hammar Chiriac 2014). In particular, we suggest that collaborative learning in highly structured groups is the most likely learning design to achieve high-impact learning outcomes (Kuh 2008). With respect to STEM disciplines, people learn best in active learning environments "involving problem-solving discussions with peers", and this is more effective than traditional lectures (Eberlain et al. 2008, p. 271). Overton and Johnson (2016) argue that the evidence on what constitutes effective learning and teaching in STEM disciplines strongly suggests that learning that includes group learning is a variant of problem-based learning that enhances students' transferable skills, maintains their motivation, makes them better post-graduate students and facilitates better retention of knowledge (2016, p.10). However, not all students like group work (Armbruster et al. 2009; D'Souza & Wood 2003; Kimmel & Volet 2012; Tucker & Abbasi 2016). Armbruster et al.'s study (2009, p. 209) of a newly enhanced curriculum design for first-year biology suggests that students were focused and engaged in the group-work exercise, yet student feedback ranked group work relatively low in terms of student learning. Armbruster et al. did comment, however, that a lack of task rigor may have played a part in students' overall poor perception of the value of the group work. When the task was sufficiently challenging and it couldn't be solved by most students individually, there was an observable increase in student participation (p. 205). Other studies suggest free–riders have a negative effect on student perception of group work (D'Souza & Wood 2003; Hall & Buzwell 2012; Tucker & Abbasi 2016). Assigning roles within groups –a "jigsaw approach" (Aronson & Patnoe 2011) – or cooperating on tasks may assist with equitable group-work practices for specific, short-term learning tasks, but our intention was to create learning groups for the duration of the subject that would sustain deeper learning relationships between students.

The role of emotions (affect) in learning is critical to successful transition from high school to university study (Trujillo & Turner 2014; Batz 2015), and student emotions have a significant impact on group work. High interpersonal congruence (Polzer et al. 2002), where group members' beliefs about themselves are matched by the feedback they receive from group members, contributes to successful collaborative learning, as students' emotions are engaged positively in social interaction. Students who construct knowledge together and share understandings about their learning together achieve socially rich interdependence (Lawrie et al. 2014), which is an ideal condition for learning. This level of structured connection between students can contribute to student well-being. As Gale (2012) suggests, "It is about how we structure the student learning experience in ways that open it up and make it possible for students to contribute from who they are and what they know" (p. 252). While the design of learning activities specific to group work is central to productive learning, we argue that the method for forming student groups has a high impact in setting the conditions for productive learning. When work-group formation is not left to chance (that is, when students do not self-select groups, or are not randomly allocated by the instructor), there is a greater possibility for educators to intervene in the facilitation of productive and equitable roles within work groups that meet students' expectations of socially rich interdependence.

An intentional curriculum design (Field et al. 2015) that prioritises a small network of social and academic support elevates the status of a student work group to that of a collaborative partnership, and disrupts existing social and academic boundaries that can act as barriers for new students. The more structured the peer interactions, the greater the density of the networks that cut across existing clique boundaries (Webb & Engar 2016). This is important, as the perceptions of some ethnic-minority students, women and students from non-traditional backgrounds in first-year courses at university require direct intervention to disrupt a lack of self-belief created by the effects of stereotyping (Harackiewiez et al. 2014). This is especially so in STEM disciplines (Marchina & Gokhale 2010). A well-structured group formation process (such as the GLO Activity) can act as a form of intervention to mitigate perceptions of a subject-knowledge deficit amongst inexperienced biology students by asking all students to reimagine what strengths they bring with them that will be valued and useful to other students with whom they will form their core learning network.

Pedagogical reasoning behind using graduate learning outcomes in a group-formation activity

Graduate learning outcomes (also described as graduate attributes or graduate capabilities) have been a part of university discourse in Australia and internationally for some time (Barrie et al. 2009; Oliver 2013). As mentioned earlier, the authors' university has eight GLOs that, in brief, encompass the following domains: discipline knowledge, communication, digital literacy, critical thinking, problem-solving, self-management, teamwork and global citizenship. It is the authors' experience, however, that academics who teach can sometimes find it difficult to elicit graduate learning outcomes explicitly in the form of curriculum content (to bring them alive for each learner). The GLO Activity places the GLOs at the centre of the learning design by focusing on students' perceptions of their own GLO strengths at that time. Students are asked to reflect on what GLO attributes they already bring to their first-year biology practical class. This strategy works as a means to introduce the university's focus on graduate employability attributes that will be developed over the students' progress toward a degree. More immediately, we use the eight outcomes as a means for students to reflect on their current attributes. While this is beneficial for active learning and instructional impact in general, more specifically it facilitates an introductory explanation of desirable graduate learning outcomes from a positive, rather than a deficit, perspective ("Which attributes do you have?" rather than "Which attributes will you need to acquire?")

Importantly, forming student groups using the GLO Activity allows a focus on a range of personal attributes that are not based on typical social identities (such as gender, ethnicity or nationality), thereby mitigating to some degree the effects of such identities that are known to result in some students feeling less able to participate actively in group work compared to other students (Eddy, Brownwell & Wenderoth 2014). We are mindful that gender and ethnicity may affect self-selection of strengths in the GLO Activity. Varsavsky, Matthews and Hodgson (2014) found gender differences in students' self-evaluation of particular graduate attributes. Notably, they found that male students reported confidence in scientific content knowledge and in quantitative skills, while female students reported greater confidence in oral communication, scientific writing, teamwork and ethical thinking.

Through an emphasis on the principles of constructivism (design the learning from the perspective of what the students know about themselves, others and the world at this time) that are a necessary foundation for good group work (Nelson & Kift 2005), the design of the GLO Activity achieves a teaching and learning focus on teamwork previously reported to appear infrequently in cohorts of students (Varsavsky et al. 2014). The GLO Activity also positions graduate learning outcomes within a personal framework for students, achieving a greater sense of relevance for students that Oliver (2013) identified as a challenge. The GLO Activity was designed to privilege less-typical social identities, but we acknowledge that some students' self-evaluations of particular GLO strengths may be rooted in stereotypes rather than reality.

Importantly, students were engaged in a learning activity that was unexpected in a biology practical class. While group work in practical biology classes is a traditional method of learning, participating in a group-formation activity that requires students to strive for a maximum level of student diversity based on graduate learning outcomes was a surprising element that provided students with opportunities to think differently about the learning process and the unique contributions they, as individuals, brought to a collaborative community of learners. It is our contention that creative pedagogical design can lead to students creatively sharing skills and perspectives (Pollard et al. 2018); moreover, importantly, when STEM teachers are creative in their teaching, this can also lead to professional and personal benefits for themselves.

The impact of creative pedagogies in STEM

When a learning activity focuses on the process of learning itself, it requires a shift in thinking about *how* students learn rather than *what* students learn. The GLO Activity asks students to reflect on and articulate their own learning attributes within the broad framework of graduate outcomes. This reflective emphasis is in itself a valuable capability for future employment and life-long learning, and is often an integral feature of work-integrated learning experience and assessment (Wingrove & Turner 2015). Finding ways to engage students from very diverse backgrounds in critically oriented reflection requires more than one strategy or pathway aside from a reflective writing journal (Harvey et al. 2016). The discourse relating to reflection and graduate attributes may be unfamiliar for some students in a first-year biology subject, and the GLO Activity provides a practical context for introducing the language associated with reflection and employability attributes. In short, while students were expecting to launch into their introductory practical about using microscopes, they were required to think and talk first about the bigger ideas relating to employability. They were also asked to engage in an activity that explicitly called for the verbal sharing of skill sets in forming diverse work groups as learning leverage. This was a rigorous group-work activity that could not be solved by individuals (Armbruster et al. 2009). Instead, students were asked to solve a learning-*process* problem, and their current understanding of their own graduate attributes provided the learning content for engaging in solving it.

For academics teaching in STEM, creative pedagogy is likely to involve teaching practical classes in ways they themselves were not taught (Morbach-Ad et al. 2014). There is a need to be innovative to engage students who bring with them highly diverse educational experiences. In working to address this need, the STEM academic and the academic developer in this study enjoyed the creative thinking that occurred during the collaborative design of the GLO Activity. We found this particular experience of curriculum design and classroom application to be an example of making a space for creativity and innovation in STEM teaching. We felt fulfilled professionally (Kleiman 2008), and we reflected that this was important for our own teaching sustainability.

Case-study methodology

Our research intention in conducting a study on the outcomes of a teaching and learning intervention (the design and implementation of the group-formation activity called the GLO Activity) was to provide an opportunity to share a new pedagogical practice that may lead to a change in students' learning, especially in STEM fields of education. We believed that a case-study methodology would achieve this, as we intended to focus on one site for investigation (Yin 2009) of a first-year cohort of biology students. We were looking closely at related contextual conditions: the students' previous educational experience of biology, and their self-perception as learners. A case-study methodology is most appropriate when the research question asks "how and why", and the phenomenon to be studied is in a real-life context (Grauer 2012, p. 70). While a case-study methodology may lack the generalisability to accomplish our desire to "share a new pedagogical practice", we agree with Stake's (1995) suggestion that harmony with the reader's experience can lead to the possibility of generalisability.

The study design

This study was conducted with approval from the university's human ethics advisory group and was carried out at one Australian university during the final trimester of the year (2015). The qualitative data collected in this project sought to identify the students' and academics' perspectives of the usefulness of the GLO Activity to achieve the desired outcomes. Surveys were distributed to three cohorts of students for completion and collected during their first practical classes when the activity took place. Observation notes taken by the two authors during each iteration of the class provided essential detail on the variations across three iterations of *what the* *teacher did and what the students did*. The academic developer explained the consent process to students at the beginning of each practical class and facilitated the GLO Activity, and the biology staff demonstrators distributed and collected the consent forms and surveys in the last 10 minutes of the practical class.

Students were asked to complete four questions in the short survey:

1. Have you studied biology as a subject before starting university? If yes, where and when did you study biology?
2. The purpose of the GLO group-formation activity is to form diverse work learning groups. Was this achieved? What did you learn about your group members?
3. What changes, if any, would you make to the group-formation activity?
4. Which graduate learning outcomes did you choose as strengths? Why did you choose those outcomes?

The three cohorts

The GLO Activity was trialled in three practical biology classes of varying sizes ranging from 11 students to 25 students. 66 students in total were enrolled in the classes, 29 of whom consented to completing the survey. The university study program operates on a trimester schedule, and the three practical classes were scheduled for the third (and final) trimester for the year. It may be important to note that the classes included a small number of students (nine) who were repeating the biology subject due to unsatisfactory performance in a biology subject earlier in the same year.

The GLO group formation activity: What is it? How was it done?

The intention of the activity was to (a) embed an experienced biology student (GLO 1, discipline knowledge) in each group of four, (b) introduce GLOs to students through experiential means and (c) create inclusive work groups reflective of a diversity of strengths that could provide a supportive social learning structure for first-year students.

A teaching script was used to plan and implement the GLO Activity. The script was also useful for the practical demonstrator staff who distributed and collected the student surveys during the practical class. At the start of the first practical class, students were introduced to the university's eight Graduate Learning Outcomes, (GLOs) asked to select two GLOs they believed were their current strengths, guided to talk to each other about their own GLO strengths and, finally, asked to solve a challenge to form groups of four with a maximum diversity of GLOs strengths.

Figure 1. The Graduate Learning Outcome group-formation Activity (GLO Activity)

Discussion and evaluation of students' feedback surveys

As part of the study design, students were asked to record their self-selected GLO strengths in the student survey. Their self-selection of GLOs resulted in some surprising observations. A little more than half the participants reported having studied biology before, but GLO One, discipline-specific knowledge, was only the fourth-most selected strength (Table 1). This may link back to the findings of Leohr and colleagues (2012) relating the quality of a student's high-school biology experience to their success in biology at the university level. At a later date, it may be instructive to investigate how significant students' instruction in high-school biology is in determining early success in first-year biology.

Interestingly, the GLO most frequently selected by students was teamwork (12 out of 29 students; Table 1). This was a surprise to us, as our anecdotal impressions and existing research (Armbruster et al. 2009; Tucker & Abbasi 2016; D'Sousa & Wood 2003) suggested that students dislike teamwork. Certainly ably-facilitated group work has been shown to increase students' positive attitudes to teamwork and team learning (Ekimova & Kokurin 2015), so it seems likely that the opposite is also true.

Graduate learning outcomes (order per university's required representation)	Number of respondents
GLO 1: Discipline-specific knowledge	7
GLO 2: Communication	2
GLO 3: Digital literacy	5
GLO 4: Critical thinking	4
GLO 5: Problem-solving	8
GLO 6: Self-management	9
GLO 7: Teamwork	12
GLO 8: Global citizenship	4

Table 1. Students' self-selection of existing graduate learning outcomes attributes

Generally speaking, students were positive about the GLO Activity. 12 out of 29 students said they felt no changes were necessary to the learning design, and others suggested improvements such as allowing the activity to go for longer, or incorporating more group-work discussion into the following laboratory exercises to strengthen the bonds between the group members. Only one participant responded in a wholly negative manner, commenting that they felt the activity "*was weird full stop*". However, within the context of STEM, we found this comment consistent with asking students to approach their learning differently compared to more traditional methods of STEM pedagogy. Another felt that the activity had been conducted in a somewhat patronising manner, commenting, *"Perhaps it could be discussed/explained in a way that reflected that people knew about diversity etc. already."* This last comment reminded the researchers that they needed to stress to students that they were aware of the range of experiences within highly diverse groups of students.

Given that successful student transition and a sense of belonging (Crisp et al. 2009; Kift et al. 2010; Krause & Coates 2008; Thomas 2013; Yorke & Longden 2008) are important for retention and success in undergraduate programs, it is highly desirable to deliver teaching activities to integrate students both academically and socially. Of the 29 students, all but one commented that the activity did create discussion about themselves as individuals and the diverse strengths that existed in the newly formed group: *"I learned people have different strengths than me and I could benefit from being exposed to diverse strengths and interests."* This comment was typical of the perceived advantages students identified from engaging with a structured work group based on students self-selecting their existing learning strengths. Some students were pleased they had the chance to discuss the different courses they came from: *"I learned about their interests and what they are studying and why"* and *"I learned all kinds of information from them and their related fields of study".* Other students highlighted the differences in thinking that were shared. One student commented, "*It allowed us to discuss our ideas and our thoughts,"* and another valued the *"different perspectives"* experienced in the group-formation activity.

Class activities that encourage students to become part of a university learning community are particularly valuable, as social and collaborative engagement are better predictors of student attainment of graduate outcomes such as communication and problem-solving than teaching or program quality (Smith & Bath 2006). The GLO Activity described in this study was designed to encourage students to engage with their peers to enhance their sense of belonging and to share their expertise. This is particularly important in a first year of study when students are establishing their learner identities in a new environment, and are at greatest risk of leaving their studies (Kift 2009); moreover, students often find it difficult in their first year to seek appropriate assistance if they are experiencing difficulty (Bone & Reid 2011). Some students in the study focused on the advantages of working with a supportive group of peers: *"I learned their names and biology background and how to contact each other about any help we could give each other"* and *"They are willing to help each other and that will enhance my communication skills."* One student focused specifically on the challenges faced by shy students and how the GLO Activity helped them to discuss this: *"There were some shy group members. I learned I'd had a similar experience and other team members might be feeling this way".* Importantly, one student's survey response drew our attention to the fact that not every group was able to speak openly together: *"I didn't learn much about them. There could be more interaction between students."* Even with every effort to bring students together through a discussion structure, it is possible that four students may still have trouble talking to each other. In future, the GLO Activity script will include a reminder note to facilitators to observe for this situation in particular, and to assist group members in finding their voices if required.

Discussion and evaluation of researchers' observations

While the academic developer sought to follow the GLO Activity teaching script in all three classes, there were some minor differences to the script in task instructions and interactions with students. Our observations recorded details about the classroom interactions that, along with students' feedback surveys, provided the authors with data to evaluate the value of the GLO Activity. Overall, the observation data indicated that the GLO Activity achieved our goals. However, there was one particular theme that indicated that our instructions to students needed to be more consistent. This related to how our teaching instructions affected students' ability to establish their social connection through discussion within their newly formed group. In each class, we observed that small differences in how we presented the GLO Activity to students had greater significance on the students' outcomes than we anticipated. For example, we learned that we needed to ensure time for more discussion within the newly formed groups for students to explain their choice of GLO strengths to each other. When this occurred well, we observed that the groups of students were more likely to discuss their social-media plan thoroughly for connecting with each other outside of the practical class.

Our key recommendations include (a) ensuring students are positioned to maximise their social-interaction opportunities during the GLO Activity, and (b) ensuring that the whole biology curriculum is aligned carefully with a four-member group structure. In particular, after the GLO Activity group-formation process was completed, students moved to group stations for a practical class on the use of microscopes. While students stayed in their newly formed group for the microscope work, the worksheet should have referred to the newly formed groups as part of the practical task. Similarly, assessment tasks need to align more practically with groups of four students, especially at points where students could provide purposeful, formative assessment feedback to each other. Of particular significance here is the deliberate positioning of students' roles in the process of learning; that is, the concept of students as partners in learning with each other. Students' learning partnerships are more about learning processes than outcomes (Matthews 2016); this is consistent with our design thinking relating to the GLO Activity. Students became partners with each other when establishing their diversely skilled work groups. This occurred successfully because, as we believed (and confirmed in this study), first-year students of biology did bring skill strengths with them that, once harnessed in diverse work groups, reduced the significance of individual differences in students' prior educational experience in the study of biology.

Limitations of the study

This study involved 66 students, 29 of whom completed the post-GLO Activity survey. While the data from the survey provided the researchers with important student feedback on the usefulness of the activity, the relatively low number of students and completed surveys is limiting in scale. The researchers also note that the study did not have a mechanism for capturing data on the longevity of the out-of-class social connections among students within their groups (over the period of the biology subject and beyond). This would have provided useful evidence on how well each group's social-media strategy was achieved.

Conclusion: Were we creative? Did we meet the principles of constructivism, inclusive practice and transition pedagogies?

This study evaluated the implementation of an activity designed to use graduate learning outcomes to distribute an experienced biology student within each work group of four students in a first-year university practical class in biology. We developed peer-to-peer strategies to support first-year students within the discipline's curriculum; this is consistent with the principles of constructivism that help to activate students' existing knowledge and personalise the learning process. We found that a focus on creating a diverse group membership process led to the desired distribution, while also enacting a teaching approach that reflected our university's inclusive-practice framework. The conceptual model we used to identify students' diversity was the university's graduate learning outcomes statement. This statement provided us with a positive framework to establish students' differences, rather than distributing students by inappropriate difference markers such as gender or ethnicity. The group formations remained together for the length of the trimester, and students were guided to establish out-of-class means of contact. These were explicit strategies that supported students' sense of belonging, and thus were consistent with first-year pedagogies. Importantly, using GLOs as a means to form work groups also engaged first-year students with an experiential method of understanding the purpose of the broad graduate skills they will build over the course of their degree. The development of the GLO Activity resulted in a change of practice for all future cohorts in first-year biology at the University.

Our process of designing a new solution to a teaching challenge is consistent with Pollard et al.'s definition of creativity (2018, p. 181), as we focused on process and product, used a surprising method to form practical work groups, aligned with outcomes and produced knowledge that was new and valuable for the students (as well as new knowledge about teaching practice). A complex thinking process was required so as to meet the principles of constructivism, inclusive practice and first-year pedagogies, and this was professionally and personally fulfilling (Kleiman 2008) for ourselves. Our own engagement became a site for reflection about our teaching and learning values and strategies. We gained confidence in our ability to design creative pedagogies to benefit students studying in STEM disciplines. An important implication for practice lies in the strategic pairing of a biology teaching academic and a central unit academic developer in solving a specific teaching challenge. This collaborative model is replicable in many universities. The collaboration had a positive impact on the quality of the students' learning experiences; faculties could consider such collaborations as part of a professional-development program supportive of scholarly teaching and learning in the disciplines.

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