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Making Connections: Networked Mindmaps as a student centred assessment for learning.

Barry Ryan
Technological University Dublin, barry.ryan@tudublin.ie

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Flipping Over; Student Centred Learning and Assessment.

Name: Dr. Barry Ryan

Affiliation: Dublin Institute of Technology.

Address: School of Food Science and Environmental Health, College of Science, Dublin Institute of Technology, Dublin 1, Republic of Ireland.

E-mail: barry.ryan@dit.ie

Twitter: @CBS_Lecturer

Webpage: http://www.dit.ie/fseh/stafflisting/ryandrbarry/

Tel: +353 1 402 4379

Fax: +353 1 402 4495

Abstract
Engaging students is a difficult task faced by all academics. Student engagement can be achieved by giving ownership of their learning back to the student and by carefully aligning the assessment methodology to the students learning and future employability. To promote learning ownership in this case-study, a group of final year students were involved in the design of the delivery ('*flipped classroom*') and assessment strategy ('*flipped assessment*') of the curriculum. Upon reflection, students noted a deep understanding of their self-selected topic by taking ownership of their learning and their 'assessment for learning' within the bounded learning environment. Additionally, students enhanced their soft skills and developed proficiencies appropriate for future employment and lifelong learning.

Key Words
Flipped classroom, flipped assessment, concept map, student as producer, student engagement.

Research Question
Can the "*flipped classroom*" and "*flipped assessment*" approach to teaching and 'assessment for learning' enhance student engagement, improve perceived student understanding and catalyse lifelong learning in a collaborative learning module?

Introduction

Engaged and Productive Students

Student engagement can be defined as a "*student's willingness, need, desire and compulsion to participate in, and be successful in, the learning process*" (Bomia et. al, 1997, p.294). However, students often exist as passive consumers of knowledge, never fully engaging, thinking deeply or truly understanding. Passive students expect knowledge to be passively transferred to them from their teacher with minimal input on their behalf. This may be a legacy from the common spoon-fed approach to knowledge '*transfer*' in second level education in an all too often teacher-centred learning environment (Scharle & Szabo, 2000). One approach to engage and motivates students to become responsible for their own learning is to integrate active learning and appropriate assessment into the curriculum. Indeed, Biggs (1999) notes that meaning, and subsequent understanding, "*cannot be transmitted by direct instruction, but is created by the student's learning activities".* The academics role then changes from source of all knowledge to learning facilitator; suitable learning activities must be incorporated into a scaffolded and structured learning environment. If the correct learning environment is created, students can become empowered to take ownership of their learning. Empowered students are likely to become engaged students; engaged students are likely to be active "*producing*" students. However, creating a learning environment conducive to student empowerment is subject to many variables; assessment and the traditional hierarchical student/academic relationship being two of the most crucial.

Assessment; Hurdle or Step-ladder?

Assessment is an inescapable fact of higher-level education and is often viewed as hurdle over which students must jump in order to prove their attainment of the learning outcomes of a particular course. Student opinion on learning is influenced most by the assessment of learning (Boud, 1998; Gibbs & Simpson, 2004). Furthermore, if the curriculum, learning activities and course assessment(s) are not correctly aligned and integrated, student alienation can develop leading to disengagement. Typically the type of assessment is dictated by the academic, further distancing the student from the assessment (Dorman et al., 2006). Although assessment cannot be removed entirely from a curriculum, subtle changes can result in positive outcomes not only for the student, but also for the academic. For example; correct alignment of the learning outcomes with the assessment, the assessment strategy itself and also the quality of feedback provided to students can all have a massive effect on the overall perception of assessments by students. Students can take ownership of their learning and view the assessment as a positive experience where they are assessed *for* learning rather than the processes being an assessment *of* learning. This approach is an additive and step-wise approach; the learner constructs their knowledge through completing the assessment and, through feedback and reflection, can deepen their understanding and hence move to the next level of comprehension. Additionally, reflection by the student on their learning experience should form an integral part of the assessment strategy; this may take the form of a reflective blog or journal for example. Some benefits of

reflection include a deeper appreciation of the content and an improvement in learning effectiveness (Boud et al, 1985).

Flipping Roles, Transferring Responsibility?

Traditionally, a hierarchical relationship exists between students and the academic. In a typical classroom environment, a student spends most of the class relatively inactive (listening, taking notes, etc) compared to the dominant and active academic (lecturing, posing questions, summerising etc). The academic also usually sets, and grades, the course assessment. The academic is central and the students are peripheral to the learning environment. Reversing, or flipping, these roles place the student at the centre of the learning environment.

The flipped (or inverted) classroom devotes much of the face-to-face contact time to small group and class brainstorming, peer-review and other epistemological processes such as wondering, critiquing, collaboration, visualisation and connection making (Ryan, 2011). The students must carry out preparatory work (prescribed reading, independent researching etc) before class; this frees up face-to-face class time allowing the students to be knowledge sources for their peers during in-class discussion. The concept of the flipped classroom is not new; humanities and social science students are, for example, regularly required to carry out selected readings before a class and the reading then forms the basis of an in-class discussion, facilitated by the academic (Barrett, 2012). The use of a flipped classroom in Science, Technology, Engineering and Maths (STEM) education is gaining in popularity with Peer Instruction (PI), championed by Mazur and co-workers (Crouch & Mazur, 2001) being one of the most popular flipped classrooms variants currently in use.

If emerging teaching and learning strategies, such as the flipped classroom, are implemented can traditional assessment paradigms adequately, and fairly, assess students (Dochy, 2009)? The flipped assessment is a further step towards simultaneously addressing this conundrum, levelling the learning environment, improving student engagement and increasing student responsibility for their own learning. Similar to the flipped classroom, the flipped assessment encourages open dialogue and collaboration between the academic and students. The assessment strategy is collaboratively designed; the assessment type, timing and grading rubric are agreed by negotiation and discussion between the academic and the students (Rundquist, 2012). Flipping the assessment aligns to the concept of the flipped classroom; it is a natural progression to allow students the freedom to learn and express their learning in a way that is most appropriate to the student whilst still maintaining academic rigour and equality. Including students in assessment design further empowers the student; the student views the assessment as something they had a voice in designing rather than something that was dictated to them. Finally, peer assessment can also be incorporated into the flipped assessment; however, care must be taken to ensure equality and fairness (Dancer & Kamvounias, 2005).

Purpose of this study

Case study group

In this case study the effect of implementing a different teaching and assessment approach to a final year, optional, advanced topics module was investigated. In this student-centred teaching approach, the philosophy of the "*flipped classroom*" was implemented in conjunction with a "*flipped assessment*". This collaboratively agreed flipped assessment *for* learning took the form of a group developed concept map, timed presentation and interactive class demonstration. In this case study, a concept map was a visual representation of ideas, or key words, connected by labelled linkers. The module that formed the basis of this study was delivered to a mixed class; pharmaceutical, food and nutraceutical students all at Level 8 (Honours Degree based on the Irish National Framework of Qualifications), for one hour per week over the course of a twelve-week semester. Module assessment was initially 100% examination; however, this was changed to 100% continual assessment (see pedagogical change below). The modules primary aim was to allow the students to develop their understanding of advanced topics in their chosen degree areas. These topics are normally closely associated with, but not necessarily central to, their programme curriculum; typically these topics are specific to developing trends or concepts in the relevant industries. Additionally, students developed their literature searching, data analysis and synthesis skills along with preparation for their final year project presentations and soft skills enhancement.

Rationale

After a number of deliveries of this module, several re-occurring issues became apparent. Due to timetabling constraints the module was co-taught, thus combining different classes of related programmes (e.g. pharmaceuticals and nutraceuticals). A traditional, didactic pedagogical approach was initially implemented; however, students became disengaged when an advanced topic that was not relevant for their chosen career was the subject of the lecture. Furthermore, although in-class activities were carried out, the overall level of social knowledge construction (e.g. pair-sharing or group work) was poor as the students could not see the point in carrying out the activities and they tended to work in groups with peers from their own degree programme. There was some *ad hoc* social knowledge construction for specific outside class activities (e.g. over coffee or breaks in class); however, this was limited to a small number of the class. Finally, it was difficult to set an appropriate and fair common assessment for all students given the diverse class make-up.

Pedagogical change: flipping the classroom and assessment

In order to address the deficiencies listed above the module was redesigned in line with best quality assurance practices within the Institute. Feedback was provided on the module strengths and weaknesses by students who had just completed the module as per standard practice within the Institute. Inclusion of student input into the redesign of a module is important as Barnett and Coates (2005) note that students must be actively engaged in curriculum development in order for positive outcomes to be achieved within the student population. This is most effectively achieved by including students as integral parts of curriculum (re)design and as key drivers of the "*living curriculum*" (Barnett and Coates, p.2, 2005). Student feedback, along with personal and colleague

observations, provided the foundation upon which to build the redesigned module. Two major module changes were introduced which mirrored the integration of the flipped classroom and the flipped assessment. The method of assessment was altered from 100% terminal exam to 100% continual assessment to best align to this new teaching approach.

Methodology

In this case study, the 'flipped classroom' was defined as focussing academic/student face-to-face contact time on meaningful activities that would develop the students understanding of a topic. Preparation activities were scheduled during the week leading up to the face-to-face class in order to prepare the student for the flipped classroom time. The 'flipped assessment' approach in this study not only included the student in the design of the assessment (e.g. how the student group was to be assessed, the weightings each assessment component and the marking rubric), but also flipped the assessment in terms of the learning. The flipped assessment in this case study was an assessment *for* learning, not *of* learning. Typically an assessment is perceived as a hurdle that a student must overcome to 'prove' their understanding, in this approach the assessment was used to assist and structure the students learning. The assessment was scaffolded around the development of an annotated concept map on a relevant topic of choice selected by each student group. Guided and active learning were central to the 'flipped' approach outlined in this study.

In class activities

Engaging and creative in-class activities; such as role-play, discussion forums and peer review supplemented the minimally guided approach to concept map development as part of the assessment *for* learning strategy. Initial activities addressed group formation and engagement based on Tuckmans' (1985) "*Forming, Storming, Norming and Performing*" model. Subsequent group activities were more structured; group sizes, time and outcomes were all given to the students before the activity commenced. The outcomes of the activities assisted each individual group in the development of their unique concept map on a week-by-week basis, from initial concept(s) to final map. The students were free to choose their own topic for their concept map, so long as it an advanced topic with some relevance to their programme of study. The lecturer, acting as an activity facilitator, circled the room during the activities to make sure the students stayed on topic, to play '*devils advocate*' to stimulate the participants' discussion and also to provide academic feedback on the concept map development (King, 1993).

Outside class activities

The epistemic processes of wondering, critiquing, collaboration, visualisation and connection making were extended beyond the in-class activities in the aligned outside class work. Between each face-to-face class students researched individual sections and collaborated with their peers to advance their concept map. Abstract concept connections were encouraged; however, appropriate rationalization was required during group, peer and academic review. In order to align their personal research with that of their group mates most student groups communicated through the Institutes' virtual

learning environment, *Blackboard*, some reverted to familiar social media outlets such as *Faceboook* and texting, whilst others met face-to-face.

Assessment of Process and Product

The central assessment of this case study was the development of a student centred concept map. It was required that the map be available electronically, for integration into the students' ePortfolio (see later). Many students developed their mind map electronically from the start using freely available software (Edraw, Openmind, Blumind) or online mapping tools (Mindmeister, Mindomo, Wisemapping, Gliffy). Other groups carried out their initial development in hard copy, before translating into an electronic version for final upload. These students documented their learning journey in their ePortfolio through digital images of their paper based maps. In addition to the development of a concept map each group had to effectively teach their topic to their peers through concept map presentation, run-through and rationalization. Each presentation was limited to 15 minutes and a further 15 minutes for the presentation group to answer questions and engage the class in an interactive demonstration/activity. The final assessment component of the module was an individual reflective essay completed in the weeks after the module was finalized based on short weekly blogs. Students documented every aspect of their group and personal learning journeys by means of ePortfolio. Initially students were provided with examples of suitable ePortfolio systems (e.g. Mahara, Google Sites, Wix, Pearltrees) and minimal technical assistance from the lecturer. To maintain some level of consistency each student was required to document their learning journey under key headings (e.g. blogs, final map and development, presentation and demonstration development) within their ePortfolio. This did not limit the creativity of each student, as they could choose to display their content in whichever way they deemed appropriate. Engaging and interactive ePortfolios were encouraged and each student within the class could review all public areas within their peers ePortfolio. Some students choose to keep their weekly reflective blogs and final reflection private to just the lecturer and the student.

Pedagogical evaluation

Pedagogical evaluation followed best ethical practices, and conformed to the Institutes Research Ethics Guidelines (DIT Research Ethics Committee approval number: 65/10). The data collected over the course of two academic years took several forms; an anonymous multiple choice questionnaire (n=30), an independent academic facilitated discussion forum (n=8), an anonymous evaluation sheet (n=30), an anonymous standard Institute module review form (n=24) and a personal researcher reflective diary (n=1). All data were collected once the students had completed the module with the exception of the reflective diary, which was recorded on an on-going basis. The reflective diary recorded 'informal' discussions with students, personal observations and comments. Students were asked for verbal consent to allow the researcher to record an interesting or relevant point raised during an informal discussion. Qualitative data were coded into several key themes and sub-themes based on researcher interpretation influenced by Strauss and Corbin's (1990) Method of Constant Comparison. Data triangulation, where at least three independent data sources were aligned, was carried out during qualitative theme coding to ensure only valid themes were investigated and

the examples and findings are based on feedback from as broad a student base as possible.

Evaluation and Discussion

Pedagogic evaluation incorporated several sources and, after thematic coding, converged on five key themes addressing the research question. These themes map onto previous research in the area of the flipped classroom (Stone, 2012). Student feedback quotations are taken directly from the unprompted reflective assignment and also the prompted anonymous written feedback and discussion forum. Data included both positive and negative aspects of the student learning experience and these aspects are discussed under each of the themes below.

The Student Centred Flipped Classroom

Initially the students in this case study questioned the need for the alternative teaching and assessment approach. This case study was the first time these students had been exposed to a student centred learning environment and it was expected that this would be met, initially, by fear and resistance as the students were asked to actively learn outside their passive comfort zone. Felder & Brent (1996, p.43) note that students who are forced to take responsibility for their learning experience emotions akin to trauma and grief including '*shock, denial, strong emotion, resistance, withdrawal, struggle*'. The students noted all of these emotions when they were asked to reflect on their initial opinions on the course.

> *I recall the confusion which overcame the class on the first day when we discovered that this optional module was to be designed by us.*
>
> *When* [the lecturer] *presented the class with the idea that we could pick our own topic to focus on in a very contemporary way, I seriously thought about abandoning this option class!*
>
> *The first lecture was not introduced like traditional lectures; actually, it was up to us to decide what we wanted to learn and to do. The idea of coming up with our own proposal for a topic in conjunction with developing a suitable assessment was quite daunting. To be honest, it unnerved me a little because I was out of my comfort zone….I knew I would have to go and do the work myself.*

These students were accustomed to didactic teaching, which encompassed a pre-determined type of learning and assessment by the lecturer. This case study adopted a change in pedagogy to one where the students set their own learning goals and implemented their own plans to reach these goals (Jonassen, 2000). A common question typically connects student centred learning and provides the link to frame the learning space for the students as they proceed about their individual learning journey (Pedersen and Liu, 2003). However, in this study, a common '*flipped assessment*' was used to connect the various learning journeys within the class and also the individual journeys within each group.

> *The sense of freedom to look at a topic we had chosen from a different point of view was most interesting and allowed me to take away a lot more than from a usual module. Interestingly, it was this idea I disliked most about the module at first, I thought "where is the structure?"*

The flipped classroom focuses class time on student lead discussion and this took place in small groups during this case study. It was important that the lecturer keeps all groups on task during discussion time, particularly if this is the first time students have been exposed to collaborative learning. The majority of the student work is carried out outside class hours; it is important that this research is completed by all members of the group so the group can collaborate and learn from each others research during class discussion time. It is through group and lecturer review and evaluation during class time discussions that learning evolves co-operatively. Some students will struggle initially with both the pedagogy and the tasks. Many students, even strong students, may not have experienced active and co-operative learning. This, in conjunction with a complex curriculum, can result in student frustration as they struggle to find their learning path and deepen their understanding. Analogous to Bruner's '*Spiral Curriculum'* (1966) and Meyer and Land's (2006) '*Threshold Concept*'; students travel many times backwards and forwards over their personal learning terrain, moving further each time into their spiral of deep understanding. Eventually, through this academic and conceptual struggle, and many journeys to and fro-, the student overcomes the overarching concept threshold and releases their understanding within.

> *Initially we thought this* [topic] *was a good idea but after attempting to draw a map from it, it became apparent that the proposition was too long and the concept was too narrow. We had underestimated the amount of work and time that was needed to create our map.*
>
> *So there it was* [the concept map title] *in block capital letters at the centre of the page, and there it stayed for one whole class as we struggled as to what were the main points to be included on our map. After numerous attempts at assembling our map it clearly was developing. Each time we reworked the map we made minor modifications to make it better.*
>
> *In the end, perfecting our concept map turned out to be a much more challenging and rewarding experience than we anticipated.*

The role of the lecturer also changed based on this approach to learning, moving from the didactic "*sage on the stage*" to the facilitating "*guide by the side*" (Durgahee, 1998). Initially the lecturer provided assistance in group formation through serious play type games following Tuckmans' (1985) group dynamic model. Students noted, upon reflection, how these seemingly frivolous games (jigsaw making, card games etc) were crucial in their understanding of the key concepts in group formation and the development of good group dynamics. The lecturer also assisted the class as they formed and discussed their ideas for a student-designed assessment for learning,

termed a "*flipped assessment*". As the groups developed their own learning plan and worked, both inside and outside class time, on their concept map and presentation, the lecturer provided assistance and advice when needed. Decisions were made democratically within most groups; however, the lecturer was often consulted to ensure the group was moving in an appropriate direction in line with their learning plan.

> *It* [the pedagogical approach] *enhanced our creativity in the sense that we were driving the wheel and we were in charge although we could always ask for the guidance of the lecturer in case we needed it.*

Class time focused on the students as producers of knowledge and the enhancement of their individual groups work, there was no didactic teaching (Neary and Winn, 2009). The class was timetabled directly after lunch break; however, student groups would often meet before the start of class during their lunch hour; at the correct "start of class' time these groups would be engrossed in their student lead discussions. Social constructivism was evident throughout the module; several students commented during their reflections that they learnt from each other (Hodson & Hodson, 1998).

> *I feel this class allowed us, the students, to take control of our learning through group work as we utilized each other's opinions and talents.*
>
> *The fact that we were able to use class time to talk and develop our ideas and then further discuss our ideas outside class time was fantastic.*
>
> *It was our discussions on the topic that helped each of us increase our knowledge on* [the groups' topic].

Indeed, group work, peer and pair sharing were central to the success of this alternative approach to learning and assessment. The students felt empowered by their role as knowledge providers and active participants leading to a powerful collaborative and constructive learning environment (Cook-Sather, 2002).

Group collaborative student learning

Group work and collaboration can be a valuable tool in teaching and learning at all educational levels, particularly in higher education. In the Sciences, group work has been effective in promoting greater academic achievement, more favourable attitudes toward learning, and increased persistence through undergraduate courses (Springer et al, 1999). Central to this case study was the adoption of social constructivist pedagogy; the group work in this case study enabled each student to add value to their learning and the learning of their peers. Each member of the group then constructed their own knowledge based on the own experience and knowledge and that of their peers. Golub (1988, as cited in Smith and MacGregor 1992, p. 2) states that *"collaborative learning has as its main feature a structure that allows for student talk: students are supposed to talk with each other....and it is in this talking that much of the learning occurs".* In this

case-study there was no didactic teaching, student-led discussion comprised almost the entire academic-student contact time.

The group assessment for learning enabled group members to construct meaning through their learning activities (Biggs, 2002). Although a powerful teaching approach, group work is often resisted by students, the underlying reasons for this innate dislike are diverse; however, one of the most common problems is inequality of grade distribution (Ryan, 2011). Students fear they will not be rewarded for the effort they put into the group, with the 'free-rider' obtaining the same recognition as the person that invests to most into the group (Lubbers, 2011). This was particularly prevalent in this case study as the results from this module would have an overall effect on the students' final degree classification.

> *My initial feeling about undertaking the group work involved in this module was one of resistance. I felt that by being in a group, it could limit my chance of achieving a good mark.*

However, if the group is formed correctly, the dynamic is positive and the student lead activities are appropriate, even students that were initially opposed to group work noted the benefit:

> *What I most enjoyed about working as part of a team was the fact that the work pulled us all together and required us to communicate, collaborate, co-operate and give a commitment to each other.*

The students in this case study took ownership of their learning through the design and production of their own assessment for learning, the '*flipped assessment*'. The opinion of the class was that they were more engaged with the in-class and out-of-class activities because they decided what, when and how they learnt. Structured support and guidance was provided by the lecturer for those groups that struggled with the development of their concept map or engaging presentation through in-class activities. In this pedagogical approach, the learning took place in a bounded environment; the students were free to explore the bounded learning space either guided or minimally guided by the lecturer. The boundaries of the learning space were initially defined by both the lecturer and the class and the subsequent student designed assessment for learning allowed the class to discover their learning, assisted by each other and the lecturer (Thomas & Seely Brown, 2011).

> *The classes were relaxed in atmosphere but we knew what we had to do, this allowed the class to learn together while communicating in groups. It could be clearly seen from the second week that everyone in the group brought a unique quality to the concept map. Without the group working together the* [concept] *map may have never been fully formulated.*

> *One of the aspects I enjoyed was that the lecturer actually engaged with us at a group and personal level.* [The lecturer] *was constantly observing all the groups*

and all levels of activity in them. He offered advice and feedback on our projects on a weekly basis.

Upon reflection, the vast majority of the students appreciated the benefit of group work in their own development of deep, and true, understanding of all topics covered by the different groups. Several students also noted the development of interpersonal and "soft skills"

Group work is something I am not comfortable with and I tend to shy away from voicing my opinion. As the weeks went on I became more confident in myself and realized that my opinion is valuable. When the group liked an idea I had, I immediately felt a boost of confidence and I felt a sense of accomplishment.

I brought something different to the group as did the other two. In my opinion this created a balance in the team and a sense of equality, which I was very happy with.

The initial dislike of group work turned full circle for some students when they reflected upon the team spirit developed over the course of the semester. Groups worked together to deepen their own personal understanding using the unique skills, knowledge and experience brought to the group by the individual group members. Again, dedicated time for reflection is critical here to allow the students space to appreciate their personal development (Smith and Yates, 2011).

From the first time we sat down and put all of our thoughts on paper and discussed any queries we may have had to the final class presentation, I realized that we were a team and not competing individuals.

The type of assessment was crucial in encouraging students to work collaboratively and constructively as a group. The assessment, designed by the students, was too big to complete alone; the students had to work together in order to produce an aligned and well-constructed concept map. Having a visual central product to focus and structure the learning process encouraged the group to work together through the production process. During the assessment design it was collaboratively agreed that map integration and interconnectivity were required in the final product. Each group member worked on a specific section of the map; however, communication and peer-sharing was required to effectively join the map components together; this also promoted a positive group dynamic and aided in convincing the students of the benefit of group and peer learning.

Concept Maps as a "Flipped Assessment"

In this module the students were involved in the design and implementation of the learning approach and assessment. In this way the students took ownership of their learning and the assessment became a vehicle to assist them on their journey rather than a barrier they must overcome. The assessment was an assessment *for* learning, rather than an assessment *of* learning. Initially the students were intimidated by the perceived freedom and lack of structure provided as they had become accustomed to

didactic teaching, lower order thinking and shallow understanding as part of their assessments.

> *We had little experience of* [this pedagogic approach] *and I found this quite daunting. I was definitely out of my comfort zone.*

During the initial class sessions the students democratically agreed on a concept map as their assessment for learning ("*the flipped assessment*"). A concept map is a visual representation of concepts (or nodes) connected by labelled linkers (Ruiz-Primo, 2004). Concept maps have been employed as assessment methodologies for some time as they encourage active learning along with the development of critical thinking and decision making. Students can assimilate complex knowledge as it is organized and linked in the concept map (Noonan, 2011). In this case study the students were free to research any area, within the bounded learning space, to construct their concept map. Students spent time reviewing different concept maps that were not related to their course and also generated simple sample concept maps based on their current knowledge of a topic chosen at random. These initial in-class activities gave the students the confidence to move forward and work as a group on their own concept map. Students quickly appreciated the different learning style required, one where they became researchers and sources of information for the group.

> *This was a fresh approach to learning and I started to look at things with a different prospective.*

> *We realized quickly that we would never develop the map enough from* [the information they had]*; we had to brainstorm together to see what areas we could investigate and incorporate.*

> *Concept mapping enabled us to change a dull and boring subject into something challenging and invigorating in the sense that it inspired me to research further into the topic in order for all the links to interconnect.*

Some publications relating to concept maps as assessment methodologies cite this approach as simply a visual method for students to present their declarative knowledge; however, in this flipped assessment approach the student is provided with little or no assistance in formulating their declarative knowledge (Ruiz-Primo, 2004; McClure, et al, 1999). The students must socially construct their knowledge, progressing from simple declarative knowledge regurgitation to analysis, knowledge synthesis and ultimately, knowledge evaluation. Furthermore, Dhindsa and co-workers (2010) noted the deeper understanding, improved concept organisation and richer interconnectedness displayed by students that employed constructivist concept mapping as a learning tool for complex and abstract science material.

> *The map allowed us to integrate our existing and newly researched knowledge on the subject, analyse it and create "linkers"; we were learning without realising it.*

I had to become extremely involved in the material that I had research in order to fully understand how to link up the map. I found the map summarised our ideas, and helped us identify concepts and their relationship to each other

Concept mapping is not the panacea for all assessments. In this case study some groups struggled with this learning approach and individual students questioned its usefulness.

I was concerned that enough worthwhile material would not be covered compared to that that would be covered via a standard lecture format.

This is perhaps a hangover from the traditional approach to teaching and assessment that these students have become accustomed to. In this case study, the flipped assessment approach places an emphasis on enhancing lecturer-student contact time and one of the best ways to achieve this is to '*flip the classroom*' (Johnson et al., 2012).

Concept mapping as an assessment is composed of two parts; the initial concept map and the evaluation of the map (McClure et al, 1999). Informal evaluation of each groups concept map was carried out at regular stages of the developmental process, both by the academic and peers. Students in this case study appreciated the chance to view and provide feedback on their peers work. As each group was working on a different and unique topic, peers were willing to offer advice on how to improve maps, to suggest resources and to assist in software training. This echoes Corgan and colleagues (2004) suggestion that peer feedback enhances community spirit within a class whilst simultaneously providing additional learning opportunities.

Members of other groups [peers] gave advice for the development of our map and I enjoyed the openness and helpfulness of the class.

[The peer evaluation classes] allowed us see the standard in the class and also gave us some positive feedback on our map and also some suggestions for improvement. These classes also built my confidence in the quality of the work that we had done and I think that everyone felt better about the module after these classes.

Providing students with the time and space to critically discuss each others work and to provide constructive feedback was a novel process for the students of this case study; however, one that greatly enhanced the learning experience for those that took part. Aligned to this peer review is the concept of reflection. Again providing the place and time for this activity was equally as important in this case study.

Student Reflection

Students following this optional module were first introduced to reflective writing in the year previous to this case study in the form of short private blogs posted to the institutions VLE for review and comment by the academic responsible for the module

only. At the start of this case study, students were encouraged to maintain a blog or reflective diary during the module as a "*reflection-in-action*" attracted a small module assessment weighting. These weekly blogs could be used to guide and supplement their final "*reflection-on-action*" assessment upon module completion (Herrington & Oliver, 2002). Students remarked that the action and process of reflecting provided them with the space to deepen their understanding and contemplate their development:

> *Writing this reflection allowed me to look back on the past ten weeks of this module and assess what I have learnt and what skills I have developed.*
>
> *Writing this reflection has made me think carefully about everything I have learnt from this module, the enjoyable aspects as well as the problems encountered and how I over came them.*

This echoes Boud and co-workers (1985) ideology that reflection is an active and personal process that influences a person's ontological viewpoint resulting in "*a new understanding and appreciation*". Many of the students reflected deeply on the journey they had taken throughout the module, both on an academic and personal level.

> *I also learned how much can accomplished within the journey from A to B, not only improving the quality and structure of work but also becoming stronger as a person and as a group.*
>
> *I have most certainly benefited from this* [teaching and assessment] *method. Not only learning about the chosen topic and structuring a concept map, but more importantly I think, it opened my eyes to who I really am as a person.*

O'Rourke (1998) suggests that reflection allows individuals to make sense of, and connections between, the complex components of a module. Reflection allows students to appreciate the content of the module and also to develop their critical appraisal skills and originality (Hatcher & Bringle, 1997):

> *Although [Group X's] attempt at colour coding the sections didn't work out very well I still think it was an excellent idea that I would definitely adapt and employ the next time I create a concept map.*

The ability to critically reflect is an important skill in any profession and was just one of the soft skills that the students enhanced over the course of this module. Others prepared students for their future careers and continued learning.

Preparing the Students for Lifelong Learning.

Students that partook in this optional module also noted several additional benefits; not only academic. They rated the experience very highly and aligned their learning to the potential application in their life after college. The students in this case study had completed an industrial placement in the previous semester and were therefore aware of the competencies required in their potential future employment.

> *The experience also improved my ability to work and communicate in a group scenario and I would feel much more confident about carrying out a similar role in the future. It was like a real work project in a company because we had to self-manage our time and our meetings.*
> *I always wanted to create a website for my company to promote it after I finish college, but I never thought I could. After building my ePortfolio I now know I can do it on my own.*

Boud and Falchikov (2006) note the importance of aligning assessment in higher level education to lifelong learning and employability. Students should be provided with the skills to carry on learning post-graduation without the lecturer's assistance. In their reflections, several students commented on their planned future use of concept mapping.

> *I feel I have not just gained in-depth knowledge on* [concept maps topic]*, but also experienced team work, decision making, critical review and mental processing. For me this method* [of learning and assessment] *has revolutionised the way I use my thought process to break down information and understand things that I will definitely use in the future.*

> *The use of concept mapping will be a definitive part of my learning in the future, for example I have another one in the development stages as part of my final year dissertation.*

On a more personal level, students developed confidence in their ability to work as part of a team in a dynamic environment on new, and often complex, topics. Interpersonal skills were enhanced and students enjoyed being in charge of their learning. As the students produced something tangible and presented this to their peers, a sense of satisfaction in their accomplishments was noted in the student reflections.

> *This approach on learning challenged me in every class unlike most lectures. I felt quite proud of myself after our presentation with the positive* [peer and academic] *comments that we received. I found it challenging yet entertaining and fun.*

> *I not only learned a lot about our project, I also learned a lot about myself. I learned that communication is collaborative, not competitive. We each needed to listen to the other person's findings in order for our map to flow as without each other's information, there would be no map.*

> *I was surprised to see myself become quite enthusiastic and creative throughout the module which there is not really an opportunity to do in other modules.*

Recommendations for Practice

1. *Play*: Students will initially struggle with the concept of group work, particularly if they have not taken part in such a learning environment before. Simple, non-assessed group ice-breaking activities can be used to get the students to work collaboratively in small groups. Games (card games, board games etc) are a great way to get the students to work together improve peer communication and bring a little fun to the classroom.

2. *Demonstrate:* Students will question the benefit of learning from their peers. Students typically see the lecturer as the "expert" in the room and their role is passive consumer of knowledge. Ask the students to become producers of knowledge; start small and work towards the graded assessment. For example, invite each student groups to give a one minute presentation on something the group has a particular strength in (e.g. a foreign language) and allow their peers to learn from each group in a relaxed environment. This will give the student groups confidence in their own abilities to synthesise information.

3. *Negotiate:* Include your students in the design of how they learn and how they want to be assessed. A central assessment can focus and structure the groups learning journey if a flipped classroom approach is used; however, the students may have alternative ways of demonstrating they have achieved the learning outcomes. Be flexible and allow each suggestion to be rationally discussed both by the academic and student cohort. Your role is to provide academic rigour and logistical considerations in these discussions. Once the learning and assessment strategy has been agreed; document and make available to all students in the class.

4. *Document:* Ask the students to document their learning journey, be it digital (e.g. ePortfolio as in this case study) or paper based. This can be assessed and will reassure students who are worried about free-riders within the group. Documentation of process and the final product should be equally as important.

5. *Demonstrate:* Provide students with examples of what you expect; ask them do they agree. Use examples from within the class during peer feedback to allow the student to develop their skills of giving, and taking, constructive criticism.

6. *Involve:* As a flipped academic your role will change. You will not be the centre of the classroom. It will take time to adjust to your new role and release the control of the classroom. Initially it may be helpful to set guidelines for your students; for example a sound to gain everyone's attention to bring people out of group discussions and into a class debate. Be enthusiastic about the flipped classroom; enthusiasm is infectious, if the students see you are committed they will have a reason to be committed also.

7. *Review:* Start off by flipping one event (e.g. a single class activity) and build towards a whole module. Once you have completed a 'flip' (small or large) take

time to review and reflect on the experience. What went well or not so well? Take it as an iterative process with small steps towards a fully flipped curriculum.

Conclusion

In this case study, student engagement and student ownership of learning was achieved by giving the students freedom to explore their bounded learning environment as part of a group and by including the student cohort in the design and implementation of the assessment. This assessment *for* learning was carefully aligned to the students learning goals and also future employability. Students reflected and commented on their mainly positive learning experience. The primary aim of this case study was to investigate if an alternative pedagogical and assessment approach could enhance student engagement, improve student understanding and prepare the student for life after college. One student quote is testament to the potential of this alternative approach:

> *After every single class I would come out and my mind would be buzzing with both information and ideas, which is something that rarely happens when I leave regular lecture. One indication I felt this method of teaching is better than traditional methods is that I was always looking forward to the next class. I feel much more confident about my abilities and that I can add value to any environment I work in.*

Limitations

This study was carried out at a single institution, focusing on a single module. The number of students participating each year was limited as the module was en elective optional where student could choose one of four electives. Additional studies can be carried out to investigate the applicability of this approach in other educational settings and levels.

The researcher was also the lecturer involved in facilitating the face-to-face elements of this module. Pedagogical evaluation data were collected anonymously where possible (e.g. online survey) or by an independent colleague (discussion forum); however, student and participating researcher bias cannot be totally discounted. Participation in each evaluation data set was voluntary and this may have attracted the extremes of the student group (e.g. those that were really engaged or those that wish to sound off). In order to reduce the likelihood of this, a mixed method of data collection was utilised. Students were aware that participation (or non-participation) would not affect their module grade or lecturer opinion of them.

The researcher was also the designer of the project; however, best pedagogical practice was observed at all times. Colleagues were used as “critical friends’ in the design and ethical approval was achieved for the project evaluation design and implementation. Researcher bias during project implementation was unavoidable, as both the researcher and lecturer enthusiasm for the project was evident. In order to reduce this effect, the students were made aware at the start of the process that they were taking part in an alternative learning process. Researcher bias during data

analysis also cannot be discounted entirely; however, data triangulation was used to ensure only valid themes were investigated and examples selected were representative of the general student cohort.

Biography.

Dr. Ryan is an applied biochemist and currently lectures on biotechnological, biochemical, chemical, quality and other ancillary aspects of the food and (bio)pharmaceutical Sciences. His pedagogic research focuses on the integration of novel technology into the teaching and learning environment and the effect of assessment, feedback and blended learning on undergraduate learning.

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