A Survey on How Post-Secondary Courses in Interdisciplinary Studies Are Taught

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Abstract

This paper presents the study of course syllabi for interdisciplinary education. We have collected sixteen syllabi that were publicly available from post-secondary institutions and analyzed their content to understand the current and past practices of instructors of Interdisciplinary Studies (IDS), focusing on: (1) common topics that are taught in these courses, (2) how they are delivered, (3) what common learning outcomes are proposed, and (4) how they are evaluated. Analysis shows that there is little to indicate how the cognitive tools of IDS are cultivated and assessed despite this being a stated objective. We also compared this syllabi analysis result with a set of responses from the preliminary online survey as well as interviews that were conducted with the IDS researchers and educators. The findings from all these studies provide direction for developing IDS curriculum.

1. Introduction

This research follows from a series of investigations into the design of effective learning platforms and frameworks for Interdisciplinary Studies (IDS) education. This series began with a research project into how interdisciplinarians conduct their academic research [1]. This was followed by a theoretical examination of key concepts of interdisciplinary theory to propose a User-Centred Design (UCD) approach to designing IDS courses [2]. From here, an examination of emerging technology potentially helpful for facilitating IDS learning environment was conducted [3].

Now, in the interest of requirements gathering to bind this research series into an actionable agenda, this project was undertaken. In this paper, we present the study of sixteen course syllabi for interdisciplinary education that were publicly available from post-secondary institutions. We analyzed their content to understand the current and past practices of IDS instructors, focusing on: (1) common topics that are taught in these courses, (2) how they are delivered, (3) what common learning outcomes are proposed, and (4) how they are evaluated. Additionally, we compared these findings with information gathered through a preliminary online survey and interviews with IDS researchers and educators.

The paper is structured as follows. In Section 2, we will provide an overview of IDS and education. Section 3 will discuss the study settings, and Section 4 will provide the analysis of the results. After summarizing our study in Section 5, the indication for future interdisciplinary education will be discussed in Section 6.

2. Interdisciplinary education

The demand for more interdisciplinary education is loud, but what exactly is meant by this demand is not clear. The rise of interdisciplinarity is being driven by an increase in complexity resulting from the dense developments of science and technology among other webs of connection emerging across the globe [4], [5]. Indeed, complexity necessitates interdisciplinarity [6]. So, the question arises is this: how do we prepare students for these increasingly complex times?

To answer this question, it is first necessary to understand complexity in the context of IDS. Very generally, complexity refers to dynamic phenomena or systems. These systems are nonlinear as they consist of multiple interacting parts or variables [4]. These parts often self-organize into patterns with emergent properties [7]. Contemporary issues such as climate change, globalization, and pandemics are examples. Because these issues are complex, meaning they are comprised of many interconnected variables, a single perspective or discipline would offer very limited insight, thus an interdisciplinary approach is necessary [8].

Complexity necessitates interdisciplinarity, but 'doing' interdisciplinarity, or addressing complex issues, requires a non-reductionist approach to knowledge. Non-reductionism requires an approach to knowledge that centers on engagement, and this is different from more traditional approaches to knowledge that are based more on prediction and control or domination/manipulations of the object of study [9]. Thus, to employ interdisciplinarity to address complexity, a specific cognitive toolkit is necessary [4] This toolkit includes such things as empathy, open-mindedness, tolerance of uncertainty and ambiguity, and intellectual courage [5], [9].

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Teaching interdisciplinarity should involve cultivating this toolkit.

Examining IDS syllabi allows for the examination into if and how this cognitive toolkit is being cultivated and assessed. Given that interdisciplinarity requires an approach to knowledge that moves away from more traditional approaches, one might expect to find less traditional teaching, learning, and assessment strategies being employed. On the other hand, straying from traditional approaches to knowledge might conflict with legacy knowledge institutional practices, and so IDS instructors might reduce concepts of complexity and interdisciplinarity to fit into more traditional structures. Understanding what approaches are used and assessing what might be missing is necessary in order to design an educational platform conducive to interdisciplinary education. IDS involves a creative and adaptive approach to knowledge, and thus teaching IDS should involve cultivating relevant competencies.

3. Study settings

In this study, we collected sixteen syllabi from post-secondary institutions in the US, Canada, and Sweden. These syllabi were publicly available on the Internet. The authors surveyed these syllabi on several parameters including course levels, delivery modes, textbooks and other required reading materials, learning outcomes, types of assignments and class activities, and assessment methods and/or rubrics used. In particular, we were interested in finding certain patterns in terms of learning objectives and outcomes, and the corresponding activities/assignments and how they were evaluated.

4. Survey analysis

In this section, we will discuss the results of the syllabi survey.

4.1. Levels

Among all the 16 syllabi, 13 were for undergraduate courses, and 3 for graduate courses, offered between 1997-2020. Among the undergraduate courses, 2 were for the 1st year courses, 9 were for the 3rd year courses, and 2 were for the 4th year courses. While the sampling may not have been entirely uniform especially due to the small sampling size, this distribution seems to conform to the typical program curriculum at post-secondary institutions in that most of these IDS courses are usually offered as introductory cornerstone and capstone courses to bookend an IDS program.

4.2. Delivery mode

There were 5 courses offered online asynchronously using common learning management systems (LMSs) such as Blackboard (3 courses), Canvas (2), and D2L/Brightspace (1) (1 course lists both Canvas and Brightspace). These courses were offered between the years 2013-2020 academic years (1 course each in 2013, 2016, 2017, 2018, and 2019/20). The other 9 courses were offered in the traditional face-to-face mode, and 5 of them also listed LMSs as part of the content delivery methods, with Blackboard and Canvas again being their top choices.

4.3. Textbooks and reading materials

There are a couple of common textbooks used in the IDS education, and this is consistent with other academic areas as there are typically several popular textbooks in any academic study area. Repko [5] (6 courses) and Augsburg [10] (2) lead the list of the required textbooks among the courses surveyed. We also see a couple of courses that listed journal articles written by prominent IDS scholars such as Newell [6] (2) and Klein [8] (2). Some other reading materials include creative works to be analyzed from a disciplinary perspective and writing manuals.

4.4. Assignments/activities

The most common assignments/activities identified in these courses were: portfolio generation (6 courses), discussion boards (6), essays on a meta-analysis of IDS and/or to explain IDS (4), personal essay (4), essays on future plans/research proposal (4), and subject/background research paper (3).

As noted, (e-)portfolio creation was a common assignment. These portfolios typically consist of a platform in which the other assignments are housed. For example, one portfolio might consist of a personal essay, a writing sample, and a résumé. Each of these assignments is assessed on its own individually, and the portfolio is assessed as a separate assignment even though it contains the other previously assessed assignments.

We observe that there were three distinct patterns in these assigned activities. The first group of activities focuses on the study about interdisciplinary education itself. In this category, students needed to show that they studied and understood the common subject matters of interdisciplinary education as well as the standard research methodologies used in the student's own study areas of interest. Essays on the meta-analysis of the study areas including IDS itself, discussions (in class and/or discussion boards on LMSs), and quizzes to test their knowledge and understanding of the subjects are typical activities in this group.

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The second group of activities focuses on the development of cognitive and research skills. These research skills will show the effective applications of the learnt knowledge, methodologies, and techniques. Students are typically asked to work on common research tasks. These include such things as literature surveys and writing research proposals including hypothesis derivation and research methodology constructions by synthesizing a potential approach often gathered and modified from different disciplines. Self-reflection is another common activity related to metacognition which is an element of the IDS cognitive development. This reflection component typically involves writing essays about themselves, especially in the earlier segments of the term.

On the whole, there is nothing unique in regard to this second group of activities. The most secondary study requires these elements, and in terms of research and cognitive tools such as critical thinking, the syllabi reviewed do not place any focus on any aspect of cognitive or research development that is unique to IDS. The epistemology of complexity that underrides IDS, however, requires a more specific and more advanced cognitive skillset to be able to effectively manage all the messiness and uncertainty of IDS work [4], [10], [11]. This need is not reflected in this sample.

The third group of common activities in IDS courses are related to preparing students for the degree/program completion and for the future employment/job market. It is often the case that institutions offer IDS courses as capstone/cornerstone courses, which will provide students, instructors, and program coordinators with suitable opportunities to assign required deliverables for the completion of successor courses (e.g., from the cornerstone course to the capstone project) and/or for the completion of the degree/program requirements. The assignments are also used to direct students toward establishing themselves as marketable and employable individuals with interdisciplinary backgrounds, which can sometimes be difficult when the industry is seemingly looking to hire those with narrowed skillsets that fall within a single area of study (e.g., computer science, engineering, marketing). The typical activities in this group include (e-)portfolio creation, résumé writing, and future course selection plans to satisfy the degree/program requirements.

Such a heavy focus on professional and career development speaks to the need to articulate the unique credentials of an IDS degree. This is undoubtedly necessary given the lack of focus on the IDS-specific competencies and skills as discussed above. IDS is touted as being an academic area based on creativity rather than conformity, and thus one might expect instructors to focus more heavily on fostering creativity and associated skills rather than on conforming to the conventions of traditional disciplines. One might argue further that despite perceptions of economic demands seeking individuals with a narrow skillset, the current economy is indeed seeking adaptive creatives [11], and so students would be better served in learning environments that facilitate this development rather than activities that focus on merely showcasing degree completion journeys.

4.5. Assessments/rubrics

Properly assessing the student work in IDS can be complex and often subjective, and there seems to be little consensus on how this is done. This is partly because students in IDS are typically from a variety of academic backgrounds, and their work often reflects this. Assessment is not as simple as grading the work using the common rubrics that have been established in their respective areas because it is not reasonable to expect an interdisciplinary educator to be proficient in all academic areas likely to be represented by students with multifarious backgrounds. Rather, the assessment itself would have been an interdisciplinary approach meaning the assessment itself needs to be non-reductionist or holistic and adaptive.

There were two salient observations in the assessment approaches in these syllabi. The first observation was that learning outcomes are often evaluated based on somewhat superficial aspects of the work submitted or on something that can be easily assessed in a highly systematic manner. For example, writing assessments/rubrics often mentioned were numbers of words/pages, formatting and citation styles, grammar, and the number of errors. For degree/program planning, they were evaluated based on the number of expected credits while satisfying certain criteria such as the prerequisite and breadth requirements. The second observation was that, when more substantive evaluation points were mentioned, it was often vague or unclear on exactly what parameters would be used. For example, some grading schemes such as “graded on the overall interdisciplinary ideas” and “quality of critical thinking demonstrated” were common among the analyzed syllabi, but it was unclear how the overall interdisciplinary ideas or quality of critical thinking could be evaluated. These schemes could potentially be highly subjective, and the grading is mostly up to the instructors’ impressions of the assignment, or, as is often the case, their teaching assistants’ discretion.

Based on these observations, we see that the first type of assessments using a superficial set of grading parameters are typical approaches for courses mainly focusing on information transfer and top-down management of course deliveries. Indeed, this fits with the structure of legacy education institutional structures. In these courses, students learn about subject matters (i.e., about IDS) and they are graded based on how much of the information and knowledge

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were successfully transferred to and retained by each student. In the syllabi analysis, this type of assessment was understandably often used for the first group of activities (i.e., to learn about interdisciplinary education itself). While this is a legitimate type of learning (e.g., Stages 1 and 2 of Bloom's taxonomy of the cognitive domain [12]), the retention rate of the information for longer periods is likely low. Furthermore, this type of learning is not effective for IDS because, unlike the other traditional academic disciplines, in interdisciplinary education, there is little consensus around the 'facts' that need to be conveyed. More importantly, for effective IDS work, the skills of engagement as demanded by complexity and encapsulated by the concept of the IDS cognitive toolkit need to be developed [9]. These are particularly difficult to quantify, and thus require an alternative approach to teaching, learning, and assessing.

The second type of assessments, based on more subjective elements such as quality of interdisciplinarity or quality of critical thinking, for example, can often cause ambiguity as they often lack the standardized metrics to quantify the submitted work. Yet, these are essential elements of interdisciplinarity. In much IDS literature, it is said that doing interdisciplinary work can in fact foster and improve requisite IDS cognitive and other related skills [4], but exactly how one may evaluate these qualities as well as one's progress is rarely mentioned. It is perhaps the case that quantifying these qualities (e.g., assigning a percentage grade for creativity) and using them as part of a traditional assessment strategy for the course may not actually be essential or appropriate. An alternative might be to turn to arts education for interdisciplinary education tools. Areas such as music improvisation, for example, are also a creative and adaptive processes and thus require similar cognitive tools such as open-mindedness, perspective-taking, and tolerance of ambiguity [7], [13]. Drawing on teaching, learning, and assessment from such areas might provide more appropriate assessment frameworks as they often provide tools for measuring input rather than output. In other words, there may be ways of quantifying levels of engagement such as measuring the amount of time spent on a task rather than focusing on what exactly has been produced in that time. This shifts attention to the process rather than the product, and this would be more aligned with the epistemology of complexity that necessitates interdisciplinarity in the first place.

4.6. Types of Learning Outcomes and Course Objectives

Many of the course objectives and learning outcomes (LO) can also be categorized into the same three groups as the assignments/activities. That is, we observed that learning outcomes are one or a combination of the following: (1) understand about the interdisciplinary education (e.g., "understand IDS," "become acquainted with the concept of interdisciplinarity and the role of disciplinarity," "examine the historical roots of IDS in higher education"), (2) development of cognitive skills or attitudinal qualities (e.g., "risk-taking," "critical and analytical thinking skills," and "tolerance and sympathy"), and (3) preparation for the degree/program completion and for the future employment/job market (e.g., "produce a portfolio," "understand individual strengths and opportunities for improvement with respect to future success in increasingly interdisciplinary workplace and societal settings").

There were several observations to note here. LOs (or course objectives) were listed under their own headings on most of the syllabi (15/16), as this is typically one of the requirements to be included in a syllabus at most post-secondary institutions. There was one (1) course that went further to show which LOs will be assessed through which assignments/activities. Another (1) course included a table of assessment criteria, in which some of its LOs were mentioned. At times, a clear relationship between the LOs and the course assignments/activities for the purpose of curriculum or degree program development is apparent in the syllabi; however, indicating this relationship could be difficult to do so at the course level as many listed LOs are unattainable by simply completing a single course or assignment. That is, to acquire or accomplish IDS-specific LOs, courses likely need to be housed in a more holistic learning environment where IDS-specific LOs can be assessed over the duration of a full program rather than a single course.

5. Comparisons with Results from Online Survey with IDS Educators

5.1. Online Survey

As the preliminary study to the research of the IDS course syllabi analysis, we conducted a short online survey with the IDS educators and researchers. We solicited over 100 participants to take part in this short survey in the Spring of 2020, but presumably, due to the unexpected event of the global pandemic, we only received three responses and thus, we cannot provide any substantial statistical data from this survey. Despite the low response rate of this survey, however, the set of answers that we observed in these responses was nonetheless meaningful as a precursor to the syllabi analysis, and in line with the above findings.

In this survey, there were eleven questions, asking about the IDS courses taught at the participants' institutions. **Error! Reference source not found.** shows the screenshot of this online survey. In this

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survey, we focused on the similar aspects of the IDS teaching learning to those discussed above: i.e., (1) common topics that are taught in these courses, (2) how they are delivered, (3) what common learning outcomes are proposed, and (4) how they are evaluated. There was also an option to upload their course syllabi, but the three respondents did not include them in their responses.

5.2. Results and Comparisons

One of the most important responses that we found in this preliminary survey was that the cognitive tools that were listed in Question #5 were not explicitly listed as the LO in their course syllabus, but were "emphasized" in the teaching. It was also mentioned that by working on the assigned activities, such as participating in the online discussions, promotes open-mindedness, empathy, and tolerance of ambiguity. Or, they suggest that learning fundamental research skills through library databases develops critical thinking and improves students' ability to compare diverse perspectives.

Another interesting finding to note here was that even though they did not explicitly state how each assignment would be evaluated in the course syllabus, one respondent suggested that their evaluation scheme is often based on well-known rubrics (e.g., [14]). While we do not know if the instructor informs the students of the use of specific rubrics in class before assigning the homework/activity that the rubric is used for, having such rubrics that have been tested thoroughly is undoubtedly useful. Their use may potentially help mitigate such concerns as those raised in Section 4.5. Assessments/rubrics.

These observations revealed one important limitation of the syllabi analysis presented in this paper—the instructors may have a secondary or non-primary set of learning outcomes that they have in mind but do not always list on their course syllabi. The same statement is true for in-class/take-home activities and the corresponding assessment approaches. It is therefore important and crucial for us to conduct the follow-up user studies and interviews with IDS educators, in which we show them the results of the syllabi analysis and ask for their feedback on the results (e.g., "Are there data/results that surprised you? If so, what were they and why?", "Is there certain information on the learning outcomes or other related topics in the course syllabi that you withhold from students to know? If so, what are they and why do you not want your students to know?").

6. Comparisons with the Interviews with IDS Educators

6.1. Interviews

The semi-structured interviews with the IDS researcher at academic institutions were conducted as part of the same series of investigations into the design of effective learning platforms and frameworks for IDS education, and the results were previously published [1]. In this work, twenty-one IDS researchers were interviewed, twenty from humanities and social science, and one from a STEM discipline. The data collected from the interviews revealed four underlying themes on how the interdisciplinarians operate when conducting IDS research: (1) Exploratory Disposition, (2) Little Concern with Disciplinary Boundaries, (3) Mentorship and Community, and (4) Discrepancy Between What Interdisciplinarians Do and What They Teach.

6.2. Comparisons

In the fourth theme of the paper, the authors discussed the discrepancy between what interdisciplinarians do and what they teach, and it is this section that is of particular interest here. The authors note that the discrepancy between what interdisciplinarians teach and what they do is that they teach interdisciplinarity as a linear well-defined process. In their own interdisciplinary practice, however, a much more exploratory or wandering disposition is adopted. This wandering is structured by the resources, including other people, that they encounter, and their process is often messy, non-linear, and unpredictable. These are the conditions for unplanned discovery, or "smart luck," as one respondent called it [1]. Indeed, their process is similar to the complexity that interdisciplinarians purport to study.

The authors suggest that one of the reasons why the discrepancy between what the IDS researchers do in their own research and what they teach occurs is that the difficulty of dealing with the seeming *messiness* of the exploratory nature of the interdisciplinary research in teaching. While all the syllabi that we looked at employed some activities that are inherently exploratory and may lead to certain levels of messiness, it is understandable that giving undergraduate students complete freedom to explore their often poorly-defined research topics in a single-term class can be chaotic, resulting in incomplete/unfinished projects. Many may still argue that it is part of the interdisciplinary process, but, since the students do necessarily not have requisite skills or knowledge to conduct such research, it is unrealistic to employ these types of pedagogical approaches.

Furthermore, traditional disciplinary approaches are typically more structured, and the IDS programs are housed in educational institutions where the traditional, structured, and reductionist approaches have been dominant for decades. This reality implicitly, or often explicitly, also restricts what the IDS educators are allowed to do to deliver the course

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topics within a limited period (e.g., a semester, a program duration). The traditional disciplines typically ground their notions of academic rigour in the clean, predictable, and repeatable epistemic framework of legacy knowledge practices, and the seemingly loose approach of interdisciplinarity is another reason for the gap between what interdisciplinarians do and what they teach. Academics can garner a license to wander, so to speak, once established in their own discipline first. Undergraduates in IDS programs are not on that path, and so teaching that models the traditional disciplines may be a way of imitating traditional disciplines to compensate for the perceived lack of rigour often assigned to interdisciplinary work. In developing new elements of an IDS curriculum, there is also thus the co-related need to develop, disseminate, and advocate a new conceptualization of academic rigour in general (Frodeman 2014, 51 [16]).

These observations conform to what we have seen in the examined course syllabi as well. For example, many academic institutions have a common template of what needs to be included in a syllabus (e.g., course name/number, credits, office hours, learning outcomes, textbooks), and following this format will naturally result in a well-structured syllabus, regardless of how structured or unstructured the course design may be. Perhaps, the best way to transfer such information concisely in writing is to put it in a structured manner. This will likely help students (or whomever reads it) understand the content most efficiently.

Even without such a pre-determined format, however, it is still quite difficult to capture the exploratory and unstructured nature of the interdisciplinary methodologies in a syllabus that is only a few pages long. In fact, how the IDS courses are taught may not have to be in the same way as how the interdisciplinarians conduct their research. The ultimate goal of the IDS courses/programs is to prepare the students to be able to "address complex matters of cultural and environmental survival" [15]. The approach to accomplish this goal does not necessarily have to be unstructured and messy, especially for teaching undergraduate students who do not have prior disciplinary knowledge or experience. They will likely benefit from certain order and structure until they gain sufficient skills to tackle more complex real-world problems.

From this perspective, looking at the aforementioned three themes of learning outcomes gives us further insights about these themes. The first theme, "understanding of interdisciplinary education," more or less corresponds to the first two categories of the revised Bloom's taxonomy [17] ("remember" and "understand") and can potentially be considered as the primary steps towards becoming the domain expert, which, in our case, is an interdisciplinarian. At this stage of learning, our assumption is that the students do not yet have the skills to take on complex problems of IDS projects. While many different pedagogical approaches exist when teaching such topics, and each has its own characteristics, one of the traditional styles of teaching is a structured and sequential introduction of new topics in the domain (e.g., a top-down, or reductionist approach), rather than introducing broad methodologies and exploring integrative insights.

The second theme, "development of cognitive skills or attitudinal qualities," then loosely equates to the remaining four categories of the taxonomy ("apply," "analyze," "evaluate," and "create"). The development of skills to perform such actions undoubtedly requires non-reductionist approaches, and this is where some of the interviewees expressed the difficulty to teach and operate within the traditional academic institutional organizations. It is thus understandable that the examined syllabi did not include activities and assessment schemes that explicitly reflect a more specific and more advanced cognitive skillset than what is needed to effectively manage all the messiness and uncertainty of IDS work.

Finally, the third theme, "preparation for the degree/program completion and for the future employment/job market," is perhaps less to do with learning itself as the deliverables in this theme are often something like the completion of proper course selections for the program or professionally formatted CVs. Therefore, the goals in this theme can often be accomplished by following systematic and structured steps laid out by the instructors, similarly to the case of Theme 1. For this reason, the assessment schemes for Themes 1 and 3 that were described in the examined syllabi are often straightforward and somewhat superficial aspects of the work submitted or related to something that can be easily assessed in a highly systematic manner.

7. Conclusion

We collected and analyzed 16 publicly available IDS syllabi. The findings showed some interesting patterns and potential directions for the future of interdisciplinary education.

The epistemology of complexity demands interdisciplinarity which is a way of doing knowledge in a non-reductionist way. Despite this, most syllabi demonstrate a commitment to legacy reductionist pedagogical approaches. This is to say that much teaching and assessment deals with information about interdisciplinarity rather than facilitating the interdisciplinary experience itself. This is not surprising given that despite the relative novelty of interdisciplinarity and its challenge to traditional knowledge approaches, IDS programs are housed in traditional learning institutions that tend to be rather

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rigid and not well-structured for adaptability and change.

Learning outcomes that seek to cultivate cognitive elements and/or foster an interdisciplinary experience tend to be vague with little background as to how they will be assessed. This finding is to be expected as these are primarily subjective elements. It would thus seem reasonable to shift the focus to the process rather than the product. There are quantifiable variables regarding the process, such as the amount of time on a task, for example. This would require a change of attitude toward academic rigour, as focusing on process does not guarantee a high-quality product, but the need for this shift in academic values is implied in order to facilitate rich interdisciplinary education.

A great deal of syllabi focuses on framing their IDS degree in marketable ways. While this is necessary for all post-secondary students, IDS students might be better served by more focus on developing the requisite cognitive toolkit for interdisciplinarity. This way they develop stronger marketable skills rather than just a marketable degree.

As well, we have compared the results of the syllabi analysis with the previous results of the preliminary online survey as well as the interviews with the IDS researchers and educators. The comparisons verified that the findings from these previous studies were in agreement with those of the syllabi analysis, and provided some insights into how and why the examined syllabi were written.

8. Future Work

Interdisciplinary educators typically operate within legacy educational institutions, and this no doubt makes novel teaching and learning philosophies difficult to deploy. These institutions require measurable outcomes for program assessment and funding, and so it makes sense that educators will fall back on traditional teaching, learning and assessment methods to fulfill institutional reporting mandates. What is needed, however, is an academic space/framework that affords attention to process over product thus accommodating the full power and promise of interdisciplinary education.

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