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> Special issue Knowledge Building as New Perspective for Education

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qwerty.ckbg@gmail.com www.ckbg.org/qwerty

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Student reflections on the integration of Knowledge Forum as 'equipment' for knowledge building practice Dina Soliman*, Andrew Whitworth**, Steven Priddis**

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Abstract

This study investigates the digital, media and information literacy (DMIL) practices that student developed through engagement with Knowledge Forum (KF), a platform designed to facilitate knowledge-building dialogues. Participants included 73 students enrolled in a DMIL course in a University in the UK. The dataset comprised reflective essays submitted by students, analyzed thematically to examine perceptions and patterns of engagement with KF. Findings show that students appreciated the *mesh structure* of KF views, and how it facilitated idea diversity. Findings also show that students demonstrated higher levels of community discourse around design ideas, particularly in comparison with previous course iterations. Evidence of how students came to understand knowledge building principles through the way they integrated KF into their practice is discussed.

Keywords: Digital Literacy, Digital Media, Information Literacy, Knowledge Building, Knowledge Forum, Practice Theory

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^{*} University of Toronto, 💿 orcid 0000-0003-2430-6111.

^{**} University of Manchester. Andrew Whitworth, D orcid 0000-0002-9971-4665; Steven Priddis, 🕩 orcid 0000-0001-6748-9216.

Corresponding author: dinaa.soliman@utoronto.ca.

Background

Knowledge Building

Knowledge Building is an innovative pedagogical approach which engages students in processes that typify knowledge-creating teams. Knowledge Building communities assume collective responsibility for knowledge, whereby explanatory ideas are produced, negotiated, and improved to advance the community's expertise (Scardamalia & Bereiter, 2003). Ideas are treated as conceptual artefacts, situated in a community space, which team members can explore and build on. Through idea-centred discourse, students work as epistemic agents (Scardamalia & Bereiter, 1991; Stroupe, 2014; Stroupe, 2018); they externalize ideas, identify authentic problems, determine goals and priorities, and evaluate their progress (Scardamalia & Bereiter, 2016; van Aalst, 2009), connecting their real-world experiences with the subject matter and the needs and demands of the world they live in. Students work creatively with ideas in 'design-mode' (Bereiter & Scardamalia, 2003; Scardamalia & Bereiter, 2017) where the focus is on sustained, collaborative development and improvement of ideas to achieve deeper understandings and higher levels of synthesis and coherence. A knowledge building environment - Knowledge Forum (Scardamalia, 2002; 2004) - is particularly designed to enable knowledge building communities to engage in ongoing, creative knowledge work in design-mode. The technological affordances of Knowledge Forum (KF) embody core principles which underlie the theoretical framework of Knowledge Building (Scardamalia, 2002; 2004).

Twelve interconnected Knowledge Building principles (Scardamalia, 2002) work in conjunction as a pedagogical guide which educators can use to establish knowledge building environments in local contexts. For example, the principles 'epistemic agency', 'real ideas, authentic problems', and 'improvable ideas' can "serve an important regulative function for both teachers and students, helping to keep higher-level goals in mind" (Scardamalia & Bereiter, 2014, p. 403). Scardamalia (2002) describes the socio-cognitive dynamics of each principle – what the principle entails in terms of focus and structure of the community, as well as the technological dynamics which facilitate those practices.

Digital, Media, and Information Literacy

A knowledge-building community of the type described conceives of learning as inherently social, reflecting Wenger's (1998) notion of the "community of practice". Building on that formulation, Wenger et al. (2009) noted how members of these communities will negotiate informational and technological practice as they create around them an environment that can help fulfil shared learning needs: they termed this the "stewarding of the digital habitat". Lloyd (2010) describes how developing competence in a practice setting is not just a matter of absorbing disciplinary knowledge - the "know-what", or "epistemic modality" (Lloyd, 2010, p. 161) - but also requires entrants into that setting to engage with its "social" and "corporeal" modalities: that is, the "know-how", "know-who", "know-when" et cetera. Anyone entering a practice setting, including knowledge-building communities, must learn to operate within these different modalities by navigating the "information landscape" of that setting, the terrain, pathways and signposts of which have been negotiated over time by the practitioners. This "landscape" is analogous to Wenger, White and Smith's "habitat", though extends beyond just technologies, to include people, policies, rules and so on.

Digital, media and information literacies (hereafter, DMIL) are essential foundations for these processes (Lloyd, 2010) and, hence, for knowledge-building itself. Yet differing models have been proposed to describe how learners might *build knowledge* about their landscapes/ habitats in ways that might be transferable from the educational into the professional setting. A functional, competency-based, approach (Bruce et al., 2006) would tend to introduce DMIL in didactic ways, defining required skills in advance and testing them through examination, before declaring the student as "digitally competent": essentially, the approach taken by certificates such as the European Computer Driving License (Whitworth, 2009, pp. 86-9). Yet such approaches Student reflections on the integration of Knowledge Forum / QWERTY 18, 1 (2023) 37-65

reduce the complexity of digital practice, and the knowledge built about technology and information, to the imposition of predefined ideas about "competency" with this or that technology. This view tends towards technological determinism – if *this* technology is introduced, *that* practice should follow. It fails to acknowledge the ways in which, even in the formal academic setting, competent practice is not only imposed, but also *negotiated* against the background of a practice architecture, within which, dialogue and affect (emotions, goals, beliefs) will prompt learners to develop their own perspectives on DMIL (Whitworth, 2020) and, hence, on the technologies in use.

Knowledge Building in DMIL

Little, if any, prior work has explicitly attended to how the development of DMIL practice may or may not be integrated with knowledge building dialogues, and the technology used to support these dialogues. Use of a platform like KF to scaffold this cognitive work must mean that features of the tool itself – its capabilities, interface, usability and perceived affordances (Gaver, 1991) – mediate learners' individual and collective agency. In his discussion of practice theory, which underpins Lloyd's (2010) view of DMIL, Schatzki (1996, p. 113) explores the notion of *equipment* to explain how objects and tools help *integrate* dispersed practices (such as knowledge building) into specific settings:

...objects... acquire meaning within practices. This occurs, most importantly, whenever objects are used in the performance of constituent actions. Teaching, for instance, encompasses writing on blackboards and other surfaces with certain entities, which therewith receive the meaning, things with which to write.... These meanings are 'practical' meanings, and the entities possessing them can be called, following Heidegger, 'equipment' (Zeug).

Practice, therefore, must encompass some kind of "interwoven understanding" (Schatzki, 1996, p. 114) of the equipment that is used to perform that practice: here, the 'things with which to build knowledge'. Put simply, students will be learning and negotiating KF, at the same time as they are learning and negotiating the subject matter (epistemic modality) and the application of this disciplinary knowledge to practice (social and corporeal modalities).

The purpose of this study is to explore how graduate students – with no prior experience with the Knowledge Building approach or KF – perceived and engaged with KF as a 'digital habitat' as they explored and negotiated DMIL practices. By qualitatively analyzing students' end of term reflections, we seek to answer the following questions:

- 1. How did students perceive the affordances of the equipment that is Knowledge Forum?
- 2. In what ways did students engage with Knowledge Forum as they developed and negotiated DMIL practices?
- 3. Did students come to understand knowledge building principles through their negotiating digital practices on the platform?

Method

Context and participants

The setting is a postgraduate taught course entitled *Digital, Media and Information Literacy*, part of the Master of Arts in Digital Technologies, Communication, and Education (MA DTCE) program at the University of Manchester, UK. Our study took place in the 2021-2022 iteration of the course, from February to June, 2022. 78 students were enrolled, over 80% being from China.

Whitworth et al. (2011) describe how this course is based on not only developing knowledge of DMIL principles, but also their application in different practice settings. The goal is for students to design, and justify, DMIL activities that they could deploy for specified target audiences. For example, a student might design activities aimed at helping elderly Chinese learners develop their use of smartphones; to develop understanding of sexual health information among adolescents; or help university teachers cope with a shift to teaching via videoconference.

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2021-22 was the first year that KF had been used on the course. Previous iterations had adopted various interactive platforms including a WordPress blog and Padlet, but, particularly in 2019-20 and 2020-21 when most of the course had to be taught online, these had not been perceived (by teacher or students) as satisfactory (Whitworth, 2022). Interactions on these platforms were not directly assessed, and there was no clear connection between ongoing tasks and the final course assignment, which could explain the low contribution levels in terms of both quantity and quality – as noted by the course instructor. What was lacking was the collaborative, dialogic element. Students received feedback on their work from the course tutor, but not from peers. Nor was there any reflective element to the final assignment, thus, little need for students to attend to their *collective* epistemic agency, and the way in which the technologies-in-use facilitated this agency.

Implementing KF in 2021-22 was designed to encourage students to generate more ideas and to work as a community to advance collective understanding and improve design work. As part of the final assignment, each student wrote a 750-word reflection on their reaction to KF and the ways in which the interactions on the platform contributed (or not) to their final design. These are the texts that form our dataset.

A significant point is that students were using KF without having been explicitly introduced beforehand to knowledge building principles, as described above. This offers an opportunity to consider how they perceived KF 'fresh', as a provided part of the digital habitat that they were expected to engage with, rather than as a manifestation of underlying pedagogical principles with which they were unfamiliar. An interesting question therefore is whether they came to understand knowledge building principles *through* their negotiating digital practices on the platform. This will be a particular focus of our analysis.

Knowledge Forum Design

The impetus to implement KF as the main environment for the DMIL course was driven by the perceived conceptual connection between

knowledge building principles and principles of digital, media, and information literacy. The course adopts a practice-oriented approach to DMIL (Lloyd, 2010), which emphasizes social practice, as ideas and concepts are co-constructed by members of the community. Throughout, students define problems, critically engage with the literature, share experiences and expertise, and produce ideas that are valued, used, and built onto by members of the community. These practices represent the key knowledge building principles of *idea diversity, improvable ideas, constructive use of authoritative sources, symmetric knowledge advancement*, and altogether enact the principle of *community knowledge, collective responsibility*.

Knowledge Forum views

A dedicated KF community was created for the course, with different views (design spaces) organized to facilitate engagement. Initially, five views representing the 'Key Areas' were created - higher education, schools, workplace, community, and healthcare - categorizations of the information literacy field identified by Whitworth (2014, p. 77). Resources were shared by the instructor to highlight relevant scholarly contributions in each area. In the first few weeks, students were expected to read and contribute ideas to at least one of the five views. This breakdown enabled students to identify problems, find connections, and highlight promising design prospects across different information literacy sectors, gaining a broad view of the field prior to focusing on specific areas of interest. At the midpoint, students submitted a proposal for their design activities. After reviewing these proposals, new 'Working Groups' views were created that represent different contexts suggested by student designs. As shown in Figure 1, the 'Key Areas' views were still visible on the home page but placed below the 'Working Groups' views to give prominence to the latter. Thus, the KF space was restructured to reflect the categories of knowledge and ideas developed by the students. Then, for the second half of the course students are expected to contribute to at least one of the working groups views - ideally the ones that represent the context of Student reflections on the integration of Knowledge Forum / QWERTY 18, 1 (2023) 37-65

their designs, although they are encouraged to explore and contribute to other views. This two-stage progression aligns with previous DMIL works which suggests that learners tend to skip the orientation/exploration stage and move too quickly to work focused on final design tasks (Kuhlthau, 1993; Steinerovà, 2010), thereby bypassing the key initial stage which can help them perceive real problems, generate and improve ideas, and set their knowledge building goals.

Figure 1. Knowledge Forum home page showing the 'Working Groups' and 'Key Areas' views



In KF, community members contribute ideas in *notes*, and connect ideas by citing or building on each other's notes. Each note is time-stamped, and note connections are made visible by connecting arrows. Figure 2 shows some notes and connections in the *Schools* view.



Figure 2. A section of the 'Schools' view in KF

Note. A blue square indicates a note which has not been read; a red square indicates a note which has been read.

Scaffold design

A key feature of KF is the Scaffolds, which are tags that authors can add to a note. Scaffolds are designed (by the instructor or via negotiation with students) to facilitate productive discourse moves to support inquiry (Scardamalia, 2004). Three scaffold sets were created in this course to support discourse needs of the DMIL community: (i) *Constructive use of the literature* includes tags to encourage questioning, highlighting promising and relevant/irrelevant ideas, and finding connections between different resources; (2) *Practices and the target audience* prompts students to generate ideas around DMIL practices and problems; and (3) *Design work* engages students in collaborating on advancing each other's designs. Figure 3 shows the different tags/ moves created for the three scaffold sets. Figure 4 shows an example of one scaffold support used in a students' note, citing a contribution of another student (to preserve anonymity, student names have been replaced by system IDs.).

Figure 3. Scaffold supports in the DMIL Community



Figure 4. Student note showing scaffold use and citation

| | | | | | | | | | | - |
|--|---|---|--|--|--|---------------------------------|---------------------------------|---------------------------------|------------------------|--------|
| Ongoing training | | | | | | C L | Created by .ast modifi | : u19201W ed: 4/2/20 | / 22, 4:57 | :54 PM |
| Read Edit Author(s) Co | nnections History | Properties | Source | | | | | | | |
| Ongoing training | | | | | | | | | | |
| Scaffolds: Practices and the target audien V | Formats - Β I | Ū € | <u>A</u> • | <u>A</u> • | ≣ • | - - | P | <> | P, | ¶ |
| This might help me address my educational challenge This suggests a skill deficit This is a practice from which others could learn This is a problem that needs | This is a problem quality and profession personally think that s more attention to teac | that needs al level are i cchools shou cher training | solving related to Id pay mo by u1938 | "It can t students are attent 34W) - | be seen ti ' learning ion into t | hat a te 1 achiev teacher | acher's ements trainin | s psych s, and j g." (| ologie I "Pay | cal |
| solving This suggests an information need Other stakeholder groups might see this differently | Just thought on your post I had inspirational, practical and ambitious initial teacher training, I think most people who train to teach in the UK might echo this. I think the magic lies in the continued investment in ongoing training. | | | | | | | | | |
| | It is easy to fall into to students need to adop quality ongoing trainin investing in this, | eaching rout ot growth mi og- and perh | ines and r ndsets, ta aps the g | rely on to ke risks a overnmer | ols and to and schoo nt should | echniqu ols neec conside | es. Tea I to inv er the r | ichers l est in l necessi | like high ty for | |

Support for using analytic tools

Another key feature of KF is the suite of analytic tools designed to help community members assess their individual and group progress. These tools represent the knowledge building principle of *embedded*, concurrent, and transformative assessment. In this course, students were introduced to analytics via three optional drop-in sessions that took place in March/April. Tools discussed in the sessions include the (1) Scaffold Growth tool, which displays a bar graph of the frequency of use of KF scaffolds (see Figure 3) by selected students at selected times in different KF views (Resendes et al., 2015), (2) Ideas building tool, which displays a social network graph showing build-on activities in the community, and (3) Key concepts tool, which provides links to notes which contain references to key concepts. In this course, the list of key concepts includes phrases like 'media literacy', 'misinformation', 'information landscape', etc. Video tutorials of the different tools were posted in KF. While students were not required to use the tools to assess the individual and community progress, some student reflections included ways they found the tools useful, as discussed below. Video tutorials of the different tools were posted in KF. Students were invited to email the teaching team if they had any questions related to the tools or other features of KE

Data Collection and analysis

As part of the final assessment, students were asked to write a 750word reflection on their experiences of using KF:

"Reflect on the contributions that the community (through the Knowledge Forum) has offered throughout this semester, and what you offered other members of the community. How did those interactions inform your [design] ideas... help them develop, suggest changes etc.?"

To answer our research questions, we conducted thematic analysis (Braun & Clarke, 2006) of these essays to identify thoughts and behaviors that influenced student experiences. A total of 73

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students submitted essays, and all were analyzed in the study. As noted earlier, this was the first year in which these reflections were incorporated into the assignment, so there is no similar data from previous years to provide a comparison. However, it is questionable whether such data would have offered much insight. DMIL practices are innately context-specific (Lloyd, 2010), negotiated in specific times and places: thus, the question of whether KF was somehow 'more effective' than, say, Padlet in this setting is not among our research questions.

Data was coded inductively through open coding, where we generated codes as we explored the data. Initially, the course tutor (an author in this paper) who graded the students' work and was familiar with the entirety of the data examined four reflections (selected at random) and derived an initial coding framework. The codes were discussed with the two other authors, and then the three authors independently coded five more randomly selected reflections. Inter-rater reliability showed a 67.1% agreement, determined through an approach described by McAlister et al. (2017). The authors discussed and resolved conflicts. Reflections were re-coded, with inter-rater reliability showing 81% agreement. The remaining reflections were distributed and coded independently by the three authors.

A total of nine codes were derived from the data. The codes, their descriptions, and examples from student reflections are provided in Table 1.

| Code | Description | Example from student reflection |
|------|-----------------------------|--|
| DMIL | Reference to a DMIL concept | "An important moment for me was the study of Bruce's six frameworks in the works of theory module. The frameworks needed to be applied to concrete examples in order for me to better understand and translate them into my own use" |

Table 1. Codes used in analyzing student reflections

| KB | Reference to a Knowledge Build- ing concept | "KF gives both teachers and peers the opportunity to think about and chal- lenge others' ideas. This leads to a pro- cess of collective knowledge building (Scardamalia, 2002)" |
|-----|---|---|
| COL | Collaboration with others in the community | "I and another peer both researched the DMIL needs of refugees. Here we were able to share and compare lite- rature and research. This allowed us both to broaden our research; expos- ing both learners to a greater breadth of ideas" |
| IOD | Impact on design | "Initially, I had no idea what to do with my activity design, but due to the openness of the website, I could read other students' proposals. So I read [Student x] proposal, which inspired me to successfully identify the target group for the activity design and the specific activity program" |
| KF | Perceptions of KF: affordances and suggestions | "to see the benefits of the non-lin- ear affordances of Knowledge Forum and the ability to "build-on" the con- tributions of others and use the scaf- folds to structure ideas and responses." |
| AG | Advice/suggestions given to other students | "As such, I offered a provocation that aimed to help develop my peers" proposal. I asked about how they in- tended to use assessment." |
| TUT | Tutor's role | "I posted my own opinion after read- ing the literature provided by my pro- fessor" |
| SLF | Self-evaluation/ self-description | "I was engaging in asynchronous con- versations with myself, as I needed to engage and negotiate with the deci- sions and ideas that my past self made during the inception of the posts" |
| OTH | Reference to other student(s) by name to indicate specific interac- tions | "As [Student Name] said in her com- ments, teaching older people how to distinguish fake news is a way could cure the root of the disinformation problems" |

Findings

We identified 1109 references to the nine codes within the 73 reflections. Codes were tracked by the number of reflections in which the code was discussed ("mention") as well as the total number of references to the code in all essays ("weight"), as students could discuss a code/theme multiple times in their reflection. The results are summarized in Table 2.

| Code | Weight : number of references to the category (% of references) | Mention: number of essays discussing category (% of essays) |
|------|--|--|
| DMIL | 145 (13.1%) | 53 (72.6%) |
| KB | 65 (5.9%) | 29 (39.7%) |
| COL | 183 (16.5%) | 61 (83.6%) |
| IOD | 188 (17%) | 65 (89%) |
| KF | 240 (21.6%) | 62 (84.9%) |
| AG | 40 (3.6%) | 29 (39.7%) |
| TUT | 95 (8.6%) | 43 (58.9%) |
| SLF | 143 (13.8%) | 57 (78.1%) |
| OTH | 115 (10.4%) | 33 (45.2%) |

Table 2. Weight and Mention of different codes

Perceived Affordance of KF

From Table 2, it can be seen that "affordance of KF" (KF) was the code with the highest mention, with 240 references in 84.9% of the essays. One key affordance highlighted by students is the "*mesh structure*" of notes, which helps them visualize multiple connections at the same time. One student described this as being able to see "*not only the vertical development but also the horizontal comparison*". Students also noted how the build-on arrows contributed to deeper understanding of readings as well as improvements to their designs:

"This visualisation presents the process of the community members' thinking development along with our contributions to each other's ideas including questioning and supporting, and all these suggestions and discussions have helped to improve and rationalise our designs"

This visual structure was seen as a way to externalize the thought process of the entire community, with arrows representing students' efforts to broaden each other's ideas from different aspects – which students described as a '*curious experience*' and an '*enlightening process*'. One student described how community work on KF ultimately led to the formation of "*a large map of the information landscape*", with different ideas which helped expand their thinking and understand the material more deeply.

A number of students reflected on how scaffolds helped add structure to the knowledge creation process. Interestingly, one student described their use of scaffolds to "actualize the thinking mode of knowledge production while editing notes", which points to students understanding the significance of 'design-mode' work without being formally introduced to the concept. Other students noted that scaffolds help ensure "consistent discussions" in different sections and "encourage synthesis, analysis and evaluation" of ideas. One student discussed how scaffolds helped them engage with the literature:

"Their presence made me aware of how I should think about a particular piece of literature I had read or which people's views. And it made me think in terms of the issues and those issues in mind... For example, 'A connection between this and another reading' allowed me to read one text and think dialectically about the relationship between the two with the content of another text".

Some students reflected on their use of the search and tagging tools to look for keywords, and a few discussed the use of analytic tools – but the majority reflected on how KF allowed them to discuss ideas freely, ask questions, understand ideas from different perspectives, and – as articulated by one student – "*practice information lite-racy through interaction with other learners*".

Student Engagement with KF as they Developed and Negotiated DMIL Practices

"Collaboration" (COL) and "impact on design" (IOD) are the next two most frequent codes, mentioned by 83.6% and 89% of students, respectively, demonstrating that a large proportion of the cohort derived benefit from the collaborative nature of the platform and that this supported their design work. References to other students by name (OTH) frequently occurred within these two codes.

i. Impact on design (IOD)

Several students described how KF discussions helped them think of or reframe initial design ideas. For example, one noted how, as they were about to post their initial proposal, they viewed another students' design idea which led them to question and think deeply about their own:

"I was about to decide on the mental health group and post my proposal when I suddenly saw [StudentName]'s work. Her proposal is very close to mine. However, she focuses more on women, but I think... Her design of activity about the photoshop workshop really made me puzzled for a while... She also had questions about my activity about showing documentaries... However, our questions about each other's activity have made me reflected on my idea"

Students also acknowledged how questions posed by their peers led them to re-articulate, improve, and justify their design ideas:

"... the posts in the workplace group helped me get a perceptual understanding of our design plan. In addition, the pointed comments I received... made me pay more attention to feasibility issues and the concretization of teaching activities, and the distinction between theoretical frameworks, educational methods, and specific activities"

ii. Collaboration (COL) & advice given to others (AG)

Students discussed how collaboration with other students, through discussions and sharing of resources, helped fill gaps in their under-

standing. For example, one student explained how discussions helped them resolve confusion:

"For theories I don't understand well, others' generalizations and examples sometimes helps, because knowing where this theory is used and how it can be used to facilitate the design of teaching activities can help me understand abstract content more intuitively. For example, I was a little confused about the difference between "Learning to Learn Frame" and "Personal Relevance Frame" of Bruce's 6 frameworks. In KF, one discussion on a sex education program for high school students provided an example of application that helped me better understand their difference"

One student noted that this kind of open collaboration is something that they "*have not formally experienced before in learning; people often guard their work*". Students' reflections reveal that they have let down their guards and have offered advice to others to push their ideas and designs further:

"... I introduced the idea of 'trust-building' in our group to solve the problem another member is facing to convince and engage students in sex education"

iii. Self-description/self-evaluation (SLF)

Most students (78.1%) included some self-description or evaluation in their submissions. One recurring reflection is that they should have participated more in the KF discussions, and that they might have missed important ideas due to low participation. Some students had reservations towards building on their peers' ideas. One was concerned that their interpretation of others could be inaccurate. Another wrote that they were unaware of the importance of collective knowledge construction, and were not used to translating their thoughts into words. Other students described how they engaged with KF tools. For example, one student described their use of the keyword function:

"Through this function, I argue that I was engaging in asynchronous conversations with myself, as I needed to engage and negotiate with the decisions and ideas that my past self-made during the inception of the posts".

iv. Reference to tutor (TUT)

It is also interesting to note that 58.9% of students mentioned the role of the tutor in the process, though the code did not occur frequently within the essays. While most students acknowledged the role of community discourse in advancing understanding and designs, some students discussed that their ideas were influenced most by comments or suggestions made by the tutor.

v. Reference to DMIL (DMIL) / Knowledge Building concepts (KB)

DMIL concepts were mentioned almost twice as much as Knowledge Building concepts – which is expected, given that the former is the key focus of the course, and the latter has not been introduced formally. The codes have not been analyzed further for emerging themes.

Student understanding of KB principles through negotiating digital practices

The DMIL concept in itself is a manifestation of the principle of *real world, authentic problems.* DMIL engages students in processes and methods of understanding the complexity of information – which in itself is an authentic problem in today's digitally-mediated world (Bruce, 2008). Throughout the course, students engage in discourse around designs that could address DMIL needs of specific populations. Other principles were implied in students' reflections. For example, students' understanding of scaffolds as a means to facilitate discourse towards knowledge creation signifies understanding of *knowledge building discourse* where knowledge is refined through discursive practices of the community (Scardamalia, 2002; 2004).

The principle of *symmetric knowledge advancement* is evident where students mention both giving and taking advice to and from students in their groups. Community discourse and idea improvement, mentioned above to be lacking in earlier iterations of the course which used different equipment (e.g., Padlet), is now evident. Not only that, but students were also able to discern this principle through the use of analytic tools that they had not been directed to use, illustrating how they established this practice as useful and relevant through their own exploration of the equipment. For instance, this student [ID u18895], included an image in her reflective essay showing the use of the Idea Building tool, stating:

... the Idea Building showed that I interacted with the other group members 13 times under the topic of Health Literacy. 7 of these were questions and comments I made about the content of other people's proposals. For example, [u19176]'s topic reminded me of a similar study I had read when I was reading a paper under my topic, so I used [the scaffold] "a connection between this and another reading" to make my suggestion.



In my discussion with [u19222], I made suggestions on whether her target group could express their reflective content successfully when using photovoice. I was pleased to find that not only did our discussion help us to think more, [u18897] seemed to find content in our discussion that would inspire her.

In turn, student [u19222] said the following, regarding [u18895]'s contribution to her own knowledge:

I also found KF useful for expanding my research. [u18895] suggested useful literature, which I used to evaluate the use of PV [photovoice]for the target group in part 2 of my assignment.

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and goes on to also credit another student, from outside the group, as having offered relevant information:

...a post by [u18901] cited an interesting article that, though not immediately relevant to my proposal, helped confirm the use of PV was appropriate for understanding how underserved communities engage in information literacy and for fostering the development of information literacy.

In addition, students recognised how the KF interface afforded a visualisation of connections between ideas, and thus contributed to *community knowledge*. Here, [u18845] raises a comparison with Microsoft Teams: a platform for discussion, but not explicitly designed around KB principles:

When I used Teams... last semester, it was always difficult to organize everyone's feedback under one topic... All feedback posts were arranged in chronological order automatically, and if I wanted to reply to someone's idea specifically, I can only '@' her, which can be easily ignored because there were also other discussions between hers and mine. In KF, the relation between ideas is externalised and emphasised by arrows, which clarifies any connection and provides a bigger picture of every topic... This visualisation presents the process of the community members' thinking development...

Thus, the student makes a judgment based on her digital literacy; that is, on her ability to discern not just a technological difference between these two pieces of equipment, but on how this difference impacts on her knowledge building practice.

The principle of *idea diversity* was evident in students' reflections, but with certain limitations. Whitworth (2020) noted how extant maps of the information landscape, if these were perceived to have some authority, could constrain a group's ability to explore a landscape, rather than facilitate it. Here, there is evidence that the tutor's mental model of the landscape, reflected in the visual interface of the KF front page (Figure 1), did lead to students being reluctant to transcend boundaries that they perceived.

The structuring of the views through the two phases of the course (five topics in the first phase, ten in the second), mentioned earlier,

was, in part, a response to the large size of the cohort and the desirability of avoiding views becoming too complex for effective navigation of the information landscape (Whitworth, 2022). Students were advised that they should not feel constrained to only work in one view, and in their essays, some made reference to the fact that they had moved between topics to improve their ideas. For instance:

My target group was LM [linguistic minority] students, who belong to socially marginalised and higher education groups. Therefore, I had the opportunity to interact with two groups within KF. This was both an advantage and a challenge for me. Because I can interact with a wider range of people, but I also had to balance the concepts and understanding of DMIL within the different groups... when I posted my ideas in the higher education group, there was no response to me (probably because people did not know about my group or were not interested). But I was happy to get feedback from the socially marginalised groups.

However, while KF allows citation across notes in different views, the interface does not make it easy to visualise connections between notes that appear in different views. This fact, when combined with the students' desire to adhere to the model of the knowledge domain set up by the tutor and represented by the views listed on the front page, meant that cross-group activity was only rarely mentioned in the reflective essays. This student's comment is representative:

...although KF allows users to quote ideas across topics, the division of topics also creates a communication barrier for users. Students who choose different topics have less chance to communicate and hardly create new ideas.

This student perceives a "communication barrier" inherent in the interface of KF, instead of, as did the first student, a learning opportunity.

Finally, there was evidence of new practices being developed through use of KF. KF, as equipment, acquires meaning within the practice of knowledge-building: compare this with the quote from Schatzki, referenced earlier. But these meanings are not necessarily those of the course tutor. They may also be negotiated independently, Student reflections on the integration of Knowledge Forum / QWERTY 18, 1 (2023) 37-65

whether between students or, in some cases, through a dialogue with the self, using the technology.

To illustrate, take student [u18920], who was a 'super-user' of KF, having, by far, the highest level of activity of anyone using the platform, including the course tutor, with 3,719 interactions over the semester. However, only 25 of these involved him creating new material. 2,042 were reads, and 1,652 modifications. These figures were difficult to explain until the reasons were revealed in his reflection, which is worth quoting at length as it shows how this student too had interacted with, and thus negotiated his own practice with, features of the equipment that had not been introduced to the students directly, in this case the 'Time Machine' function:

with KF... I do not necessarily have a clear purpose every time I open it. In other words, I do not exactly know what I will encounter. I might just open it and see what other students have posted or what other people have responded to my views, like when I open Weibo or Twitter. Moreover, I might just log in to my "back garden", which is KF's personal workspace function...

As strange as it may sound, KF is a forum for communication, but I am very concerned about the personal workspace on it. I feel that while communication dramatically contributes to the development of human society, a personal space to think and evolve alone is also essential. In my personal workspace, I can not only record any of my thoughts at will but also dress up my space, such as placing my favorite photos. More importantly, I can still build on the content of other spaces, which means I am able to collect valuable anything I see... Because of its existence, when I open KF, it is not necessarily to communicate with others. It may also be to communicate with myself, communicate with my own thoughts, or see my previous thoughts. Then if I have new ideas, I can handily add them to it. That is to say, I can build my own information map here. Furthermore, the Time Machine function, which is also my favorite, allows me to see how my space has evolved.

Interestingly, while the essence of KF is to make ideas publicly visible so they serve as conceptual artefacts to be improved by others in the community (Bereiter, 2002), this student used KF primarily to communicate with himself – to keep track of his own rather than the community's evolution of thought. While the use of public personal workspace has indeed been used in other knowledge building envi-

ronments through the construction of personal views (for e.g., Soliman, 2021), this is an example of what (Bielaczyc, 2023) defines as a learner-preference challenge – that of favoring working individually rather than in a group.

The ways that students formed practices like these, as well as their self-guided exploration of analytic tools, demonstrates how their digital, media and information literacies are developed on this course, but not in a technologically deterministic way. Students are not engaging with these practices simply because they have been provided with KF, and told they are expected to use it. We see a much more dialogic approach to literacy, with authority over DMIL practice more distributed (Whitworth, 2014), at least for some of the learners.

Discussion

We need to remember that 'affordance' is, partly, a factor of what is designed into a technology: here see Scardamalia's (2004) points about how each of the twelve principles of knowledge-building can be mapped onto features of the KF platform. Knowledge Forum, as equipment, is thereby designed to integrate the practice of knowledge building into specific practice settings. But the reflections of the students on the DMIL course show how prior understanding of either the (dispersed) practice of Knowledge Building, or the platform, is not a prerequisite for students to be able to effectively engage with this practice. Thus, Knowledge Building is not dependent on KF in a technologically deterministic way. The affordances of technology are also a matter of how individual students subjectively perceive it to be useful to their practice in this specific setting – hence, as equipment - and of how practices are then negotiated around an *intersubjec*tive view of this equipment, as constituting the 'digital habitat' which helps the members of this community meet its shared learning needs (Wenger, 2009).

Collaboration *per se* is not the students' primary need. As noted, this pedagogical style was a new experience for many students and not something all necessarily welcomed at first. But our data show

that students, as a group, recognised the contributions that KF made to the *improvement of their ideas*, and thus indirectly, the betterment of their grades (which *was* their primary shared learning need). They particularly appreciated the way KF's interface specifically recorded and displayed connections between ideas, in ways that other discussion-based learning platforms (e.g., Teams) struggled to do; but this applied only *within* topic areas. They were less sure that the platform was helpful when it came to making connections *across* these areas; but this might have been a factor of how they perceived the course tutor as retaining authority in the course environment.

This perceived authority of the tutor perhaps also explains why most students reported engaging with the platform in ways that they had been advised to do by the tutor and other members of the teaching team, whether in help sessions, lectures, or online materials. There were notable exceptions, including the 'super-user' who developed a wholly distinctive mode of engagement with KF-as-equipment: however, this was an individual enterprise as he did not share this practice, or at least, no other student adopted it. Thus, his innovation did not become part of the repertoire of practice in this setting (Wenger, 1998). Some other students made use of features, such as analytic tools, that they had not been specifically advised to use, and to which they had been introduced only in passing. These are less innovative practices, but still evidence of a desire to learn about the affordances of this equipment through exploration and experimentation. The potential was there for these self-developed uses of KF to enter the repertoire of practice of the community as a whole, but in this particular setting, this potential was largely unrealised. Future iterations of the course could develop this aspect of the group's DMIL, however.

Let us consider 'knowledge' – and by extension, knowledge building – not as a singular phenomenon, but instead, return to Lloyd's (2010) tripartite division of knowledge into its epistemic; social; and corporeal modalities. Our study first confirms that the DMIL of learners in a higher education setting can be developed without breaking connections with disciplinary knowledge, or the epistemic modality (Lloyd, 2010, p. 161). While there was comparatively little explicit (that is, academic) reference to knowledge building principles in students' reflections, this may not be a surprise considering that they had not been previously introduced to this literature – and indeed, in that respect it may be significant that any such references appeared at all. But across all the reflections, the majority included explicit reference to disciplinary knowledge.

What is more apparent is how many implicit references to key knowledge building principles were made by the students, particularly the principles of symmetric knowledge enhancement and community knowledge, as discussed above. Manifestly, these place the students' practice with KF in both the social and corporeal modalities. The knowledge they were building in this setting was not purely 'knowwhat' – an approach typical of many academic settings (Lloyd, 2010, p. 161) – but also 'know-who' and 'know-how'. Students learned to see themselves as active agents not only in their own education, but also that of others, and of the community as a whole.

Limitations and Opportunities

This study describes efforts to engage students in DMIL practices through their use of KF as the 'equipment'. This work provides a starting point for exploring the explicit connection between the fields of DMIL and Knowledge Building. One limitation is the sample size and constitution, as the dataset comes from one course with the majority being international students who may have some language and cultural barriers that could affect their engagement. Opportunities to extend this research include examining the effect of introducing KB principles at the beginning of the course and revising the scaffold supports to facilitate deeper discourse for future iterations of the course. Additionally, student contributions in KF could be analyzed to explore ways students contribute to DMIL discourse.

Conclusion

In this study, graduate students engaged in DMIL practices using KF as the technology to facilitate their discourse on theory and design.

Analysis of student reflective essays revealed that students appreciated KF's visual representations of notes, with connections and views as representing the breadth and depth of the information landscape. Students also mentioned how KF scaffolds helped them with the analysis and synthesis of ideas. Student essays were also coded to determine the ways students engaged with KF as they developed and negotiated DMIL practices. Results show that most students discussed how the platform facilitated collaboration, and how discussions and sharing their resources supported them with developing their initial design ideas and later to improve their designs and justify their choices. Students also engaged in self-evaluation – assessing their level of participation and contribution to collective knowledge construction. A number of students also referred to the role of the tutor in the process.

Results also showed how students in this course integrated the equipment that is KF into their knowledge building practice in diverse ways. They did not have to be introduced to the principles of knowledge building before encountering the platform: rather, we can see evidence of how they came to understand these principles through the ways they integrated this equipment into their practice. A close review of student reflections showed some manifestation of principles such as knowledge building discourse, symmetric knowledge advancement, improvable ideas, and idea diversity.

Knowledge Forum itself and its collected affordances acquire meaning for these learners as they socially and corporeally perform their digital, media and information literacies and, thus, assert their epistemic agency in accordance with knowledge building principles. A question we cannot yet answer is whether these literacies prove to be transferable outside the setting of this course and continue to be applied in later study or professional life: a follow-up study with these learners in three- or four-years' time would be most illuminating.

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