The ideation of final year undergraduate project topics as a creative process: The case of a distance learning engineering module

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Abstract

At the Open University in the UK, final year engineering undergraduates are required to suggest a topic for their project. As this was considered a creative process, the three-component model by Amabile was used as a theoretical framework supporting the conclusion that instructional material supporting the exploration of the idea space should be improved. To do this, an online ideation toolkit was developed to help with the generation and focusing of ideas for possible topics. This was trialled on a small number of students by introducing it through a workshop. Its usefulness was then studied using questionnaires and semi-structured interviews. The study showed that most students benefited from the workshop in its own right, others who took the time to work through the toolkit in their own time, found that the toolkit indeed helped them with ideation and focusing their idea. The students main concern was that they lacked guidance as to the project level. The findings suggest that the development of creative thinking skills in students, one of the three components in Amabile's models, should be included in the engineering module studied here more explicitly.

Keywords: Ideation; idea generation; final year project, capstone project; engineering; distance learning

Introduction

In many disciplines around the globe, undergraduates are required to undertake a major project towards the end of their degree programme (Healey *et al*, 2013; Healey *et al*, 2012; Funston and Lee, 2014; Thomas *et al*, 2014; Vitner and Rozenes, 2009). These projects may be called by different names and vary in details but will be referred to as final year projects (FYPs) as they, amongst other things, share the same motivation. One reasons why engineering courses include an FYP is highlighted by Dutson *et al* (1997) who give some historical background to engineering education in the United States and explain that after the second world war emphasis was placed on the underlying theoretical principles to the detriment of practical engineering skills. Subsequently FYPs were introduced, as part of the remedy. Thomas *et al* (2014) summarize the literature regarding the motivation for FYPs well when they suggest four characteristics which should be found in more or less any FYP, i.e. applying skills and knowledge obtained during previous studies, self-reflection by the student on one's learning journey so far, providing a glimpse to the student of what work life will be like and providing a final piece of work to conclude undergraduate education.

An additional reason for a final year project may be accreditation requirements for, e.g., engineering degrees (Hussain *et al*, 2019). The Accreditation Board for Engineering and Technology (ABET), which is the example for the United States, requires accredited engineering programmes to culminate in a "major engineering design experience" (ABET, 2021) which is frequently implemented as a capstone project (Dutson *et al*, 1997; Blicblau and Dini, 2012). In the UK, the Quality Assurance Agency for Higher Education issues subject benchmark statements which are used as reference points for designing undergraduate and master's programmes (QAA, 2014), including engineering programmes

(Knight and Botting, 2016). Here, the *Subject Benchmark Statement*, *Engineering* (QAA, 2019) requires engineering curricula to include “substantial individual and group project work”.

The initial stage of an FYP includes the highly important task of selection or suggestion of a viable topic (Harrison and Whalley, 2008). This process may be to some degree dictated by the nature of the higher education provider. In many higher education institutions (HEIs), such as traditional universities, staff are required to not only teach, but also to do research in their subject area, which may open up the opportunity for them to suggest topics so that students can choose from a list (Hussain *et al*, 2019; Knight and Botting, 2016). One example of another type of HEI, which employ teaching staff without a research portfolio, is the Open University in the UK. This university may recruit recent graduates and further education teachers as associated lecturers (The Open University, 2020) and, therefore, the Open University has adopted a student-led approach when it comes to suggesting a FYP topic. Although this approach has some advantages, especially for stronger students (Knight and Botting, 2016), it also possess a number of challenges for student and staff alike, such as needing an “internal trigger” (Knight and Botting, 2016) to pique students’ interest, which may be difficult as undergraduate students rarely have the required expertise to suggest a suitable topic or the high time commitment to negotiate an appropriate topic (Hussain *et al*, 2019).

The support for the idea generation process, for finding this “internal trigger” (Knight and Botting, 2016) may vary depending on the pedagogic approach. The example discussed in this paper is the Open University module “The engineering project”[1] (The Open University, 2021b) which is constructivist in nature (Hush, 2015). In his seminal paper Bodner (1986) describes the characteristics of different models of knowledge and summarizes the idea behind constructivism as learners construct their own understanding according to their individual frame of reference (Bodner, 1986). This concept and its implementation have been extensively debated in literature. For instance, Kirschner *et al* (2006) put a number of different constructivist instructional approaches under the heading of “minimum guidance during instruction” and criticize this heavily, especially for novice learners. Other authors responded to this assertion and argue that Kirschner *et al* (2006) failed to differentiate different pedagogic approaches appropriately, but agree that extensive scaffolding and guidance is needed for problem-based and inquiry learning (Hmelo-Silver *et al*, 2007). Also Funston and Lee (2014) discuss the criticism found in Kirschner *et al* (2006) and point out that their capstone course provides necessary scaffolding whilst providing the opportunity for independent inquiry necessary to construct knowledge and meaning. Tomkins and Ulus (2016) provide a case study in experimental learning and find that the criticism by Kirschner *et al* (2006) has some merit in their setting, leading them to the conclusion that, for their students, adhering to a strict interpretation of experimental learning is “not liberating, but frustrating” (p. 170). This insight may also have a bearing on how to support the ideation for FYP topics.

Although the important aspect of developing the FYP idea has been acknowledged in the literature (Hauhart and Grahe, 2015; Hussain *et al*, 2019), if or how to support the idea generation process has received little if any attention for distance-learning FYPs. In fact, it seems that the assessment by Blanford *et al* (2020) is still correct which states that research efforts have been directed to FYP done by full-time undergraduate students who are yet to enter the workforce on a fulltime basis. Therefore this paper elaborates on the process of developing an ideation toolkit for the distance learning engineering undergraduate project module taught by the The Open University (2021b) and initial findings to elucidate how much scaffolding is necessary for a good student experience. As this is considered a creative process, the next section will discuss ‘creativity’ in the context of this module before the background research to this toolkit is summarized including a literature summary

[1] This module is a 30-credit undergraduate module taken over two semesters serving seven feeder modules (The Open University, 2021b)

and a survey of other relevant Open University modules. After the description of the toolkit and its evaluation methods, the results section summarizes questionnaire and semi-structured interview responses. The discussion section leads to a number of conclusions and recommendations.

Creativity

Although highly valued research into creativity has only been taken seriously from the second part of the 20th century (Sternberg, 1999). One reason may have been that the concept of ‘creativity’ was difficult to define making it hard to study systematically (Albert and Runco, 1999). Gube (2019), who summarized more recent literature on creative thinking, suggests that ‘creativity’ is frequently synonymous with the problem solving process such as the eight step, iterative model developed in the well cited paper by Mumford *et al* (2012) on creative thinking. This model, however, starts with ‘problem definition’ which is one step too late for this discussion, because it is concerned with the lesser research aspect (Gube, 2019) of finding a problem, that is to say with the idea generation process, frequently abbreviated to ‘ideation’. In this connection the well-known model developed by Amabile (1998) shown in Figure 1 has been adopted, because its application is less restrictive and can be used for the FYP idea generation process discussed below.

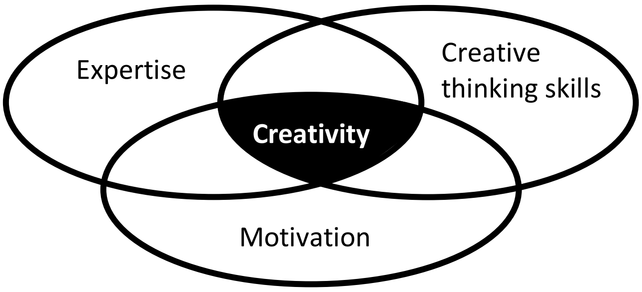


Figure 1: The three-component model of creation by Amabile

Looking at the aspect of motivation in Amabile’s model it can be suggested that is highly likely that students registering for the engineering FYP module discussed here have at least sufficient extrinsic motivation (Ryan and Deci, 2000) i.e. that of finishing their degree, as it is very likely that this is their last module. In addition to this there may be also intrinsic motivation (Ryan and Deci, 2000) as the students are required to suggest their own topic (Knight and Botting, 2016) and, therefore, suggest something they are interested in. It is also worth pointing out that a potential topic has to be suggested within the first two weeks of the official module start and it has been observed that, at this point, motivation is very high. Therefore, it may be concluded that the aspect of task motivation is fulfilled and not of the highest priority for topic ideation.

As discussed earlier, FYPs afford the opportunity to apply skills and knowledge acquired in previous modules with the implication that FYP modules themselves do not teach subject specific content. So the question arises as to whether final year undergraduates are subject experts (see Figure 1). A comment in Gube (2019) suggests this, but an undergraduate’s level of expertise may be insufficient to, e.g., suggest an appropriate research rationale (Hussain *et al*, 2019; Knight and Botting, 2016). Furthermore, Litzinger *et al* (2011) estimate in their paper on engineering education that undergraduate courses progress students only the first third on their journey to becoming domain experts. It is worth noting that the aim of undergraduate programmes is to develop students to becoming independent learners (SEEC, 2010), that is to say to acquire the necessary study skills which can guide them on their journey to expertise. Bearing this in mind it may be argued that students taking “The engineering project” module (The Open University, 2021b) may have at least some expertise in the subject area.

In her paper *How to Kill Creativity* Amabile (1998) lists brainstorming, problem solving and lateral thinking training as examples of developing creative thinking skills. In addition to this Amabile (1996) explains this term more formally when she says: “These skills include a cognitive style favourable to taking new perspectives on problems, an application of techniques (or “heuristics”) for the exploration of new cognitive pathways, and a working style conducive to persistent, energetic pursuit of one’s work.” Although some of these aspects relate to a student’s personality, the creative thinking techniques should be taught as part of the “The engineering project” module (The Open University, 2021b), because it is not guaranteed that students have been instructed in them or that they will associate them with project topic ideation. Hence, students on this module may be regarded as “novice learners” when it comes to the idea generation process requiring “direct instructional guidance” (Kirschner *et al*, 2006). Therefore, the next section describes the development of an ideation toolkit to more effectively support students on this distance learning engineering FYP.

Ideation toolkit

Sources of inspiration

The first source of inspiration informing the development of this toolkit was a literature review of ideation tools with emphasis on engineering courses. It showed that the overall aim of ideation was to explore the idea space more thoroughly by increasing quantity, variety and novelty of ideas (Bayırlı, 2020). These three aspects, together with the quality of the suggested idea, have been proposed as measures for the effectiveness of an ideation tool for engineering design (Shah *et al*, 2003), but no such study could be located for FYP topic idea generation tools.

Idea generation techniques have been divided into intuitive and directed methods where intuitive techniques aim to foster illogical thinking (Bayırlı, 2020) or in some other way shift a psychological block. On the other hand, directed methods offer a more structured approach relying on engineering principles or databases (Shah *et al*, 2003; Shah *et al*, 2000; White *et al*, 2012). Shah *et al* (2003) mention brainstorming as an example for the intuitive method and catalogued past solutions for the directed approach. A different framework has been suggested by Wang (2019) who categorises 87 idea generating tools as either individual or group techniques and then by the location of the ideation stimulus as either internal or external.

The literature review also showed that the use of ideation tools is quite prevalent in engineering design courses. One example is the paper by White *et al* (2012) who assess the ability of a mixture of intuitive and directed methods to reduce cognitive barriers of engineering design students to creativity. Glier *et al* (2011) use just one or two techniques to investigate their effectiveness for distributed FYP engineering design teams. Also Sangelkar *et al* (2015) deal with final year design engineering students when they point out that, although their students have been trained in a large number of idea generation techniques, they only used basic brainstorming for their FYP. This observation is followed by a description of how they teach eight methods in a tight time frame. Ostrowski *et al* (2020) and Lee *et al* (2019) report on idea generation on a biomedical engineering capstone course where they teach simple individual tools (e.g. brainstorming) before the teaching team introduces Design Heuristic cards and find that these cards were a good stimulus. Two other studies (Tang *et al*, 2021; Sintoris *et al*, 2018) employ ideation cards too, also referred to as “gamification cards” (Sintoris *et al*, 2018), with electrical and/or computer engineering students and discuss their usefulness and limitations. Unlike design engineering students discussed in previous papers, these students are trained to focus on the technical aspects of design solutions rather than on exploring the idea space (Sintoris *et al*, 2018).

Table 1: Project modules at The Open University

Module name	Disciple	Ideation tools/guidance	Remarks
The engineering project	Engineering	Previous project title Feeder module guidelines General guidance: • Careful with work-based project • Explore more than one idea • Pitch at right level	Seven feeder modules including design, environmental, mechanical engineering and electronics
The MEng individual project	Engineering	Previous project title Feeder module guidelines General guidance • Careful with work-based project • Explore more than one idea • Pitch at right level	Seven feeder modules including design, environmental, mechanical engineering and electronics
The MSc Professional Project	Engineering and technology	Text based and audio guidance on: • Talking to other people • Explanations of brainstorming for personal use • List of four mapping tools	MSc module for nine feeder modules including systems thinking, computing, environmental, and mechanical engineering
Research project (Post graduate)	Engineering and technology	Preparation website with extensive text based and audio guidance on, e.g., ideation. The same guidance is available on the actual module website and includes: • Explanations of brainstorming for personal use • Link to OpenLearn[2] course on systems diagramming • Past dissertations & abstracts • List of possible topic areas with explanations	MSc modules for six feeder modules including systems thinking, computing, environmental, and mechanical engineering The aim of the preparation website is for the student to develop a draft of their research proposal.
Science Project Course - Radiation and Matter	Science (Physical science)	Very detailed theme guides with suggested literature Advises to consult general science magazines/ science news	Six versions, e.g. physical science which has five topics Normally literature review based

[2] OpenLearn is a free educational website by The Open Universtiy

Module name	Disciple	Ideation tools/guidance	Remarks
Apprenticeship computing & IT project	Computing	N/A	Idea developed in previous module
The computing and IT project	Computing	Project preparation forum (peer) Introductory video (including coming up with ideas) Example types of projects Sample project titles Feeder module guidelines Discussion of five sources of inspiration Project requirements Personal considerations	15 feeder modules
Investigating psychology 3	Psychology	Methodology evaluation worksheet Employability considerations Discussion towards end of previous module	Student chooses research methods first and then works on the topic with a tutor
Issues in research with children and young people	Social work	Mindmap mentioned Planning grid Encouragement to consider interest	Requires only a small scale literature review (3000 words)
Exploring legal boundaries	Law	Introductory audio Text based advice on: • Searching newspapers for legal content • Experience of module lecturer • Advise to make list of law topics the student is interested in	Sample material illustrating the expected level of assignment submission.

The reference to gamification in Sintoris *et al* (2018) sparked an interest in how this could be applied to the ideation toolkit. The literature review by Subhash and Cudney (2018) showed that there has been an increased interest in gamified learning in higher education since 2010 and pointed out that such an approach does not necessarily refer to use of games in education, but rather the design elements from games. This review suggests that the inclusion of points, badges and levels improves student motivation and engagement. The reviewers also note that there is a lack of gamified learning in the field of engineering education. Viberg *et al* (2020) reported on research on the gamification of online ideation platforms by including a leader board, progress bar and a point system. This design was compared against a conventional design and the result showed that the small number of participants of this study preferred the gamified version as they found it more engaging and motivating.

A second source of inspiration was a survey of undergraduate project modules in other disciplines and engineering master's project modules at the Open University. Table 1 includes also the engineering project module discussed here as a comparison and summarizes ideation tools used in these other Open University modules together with a summary of further guidance on the topic idea generation process. These modules were identified by examining all honours degree courses (The Open University, 2022c) and it was found that some courses do not require an FYP as such. For instance, language studies may only teach extended practical skills in the target language, rather than offering a project module, during the final level of undergraduate studies (see The Open University (2022a) as an example). If an FYP was required, then such a project module normally served a number of feeder modules, which may have had an impact on the choice of the project topic area. For instance, Table 1 indicates that the FYP for engineering has seven feeder modules ranging from renewable energy to fluid mechanics and electronics (The Open University, 2022b), which should have been studied before attempting an FYP and FYP topic needs to be based on the feeder module. This table also indicates that instruction material regarding ideation tools and guidance is generally more limited on undergraduate FYP modules when compared with engineering related MSc project modules.

A final source of input was the Open University undergraduate module *Innovation: designing for change* which contains a detailed project toolkit (The Open University, 2021a). This toolkit lists 14 different tools and activities under the heading 'starting point' and provides links for them with detailed explanations and step-by-step instructions. These suggestions include, amongst other things, brainstorming or brainwriting, random stimuli, sketching, interacting with others in various settings and SWOT/PEST analyses.

Developing the toolkit

Towards the end of the literature review, four more tutors, who also supervise engineering projects online at the Open University, were recruited so that five of the seven feeder modules were represented (see Table 2). This spread was advantageous as the FYP students had to draw on feeder module topics for their project. This team met online approximately every two week for four months (for about an hour each) to discuss the toolkit itself and its deployment. During the initial discussion it became apparent that it was easier to delineate the idea space for 'hard' engineering modules (i.e. MST326, T312, T356 and T357) as opposed to the design oriented feeder module T356. In a later session the overall aims of the toolkit were summarized as to providing inspiration to students with no firm ideas and assisting those with ideas to focus on developing them to a stage where they can have an efficient discussion with their tutor.

The initial draft version of the toolkit was based on T312 and consisted of three sections implemented in Google Forms. These parts were:

- A generic first section with an introduction video explaining the purpose of the toolkit and its sections, and text fields for student name and preferred email address (see Figure 2). This section allowed for branching to either the ideation tool section (radio button ‘I need a bit of help’ in Figure 2) or the suggestion form radio button ‘I have an idea' in Figure 2).

- The ideation tools (part of this section is shown in Figure 3). This part also starts with an explanatory video which is followed by suggestions on how to read around topics covered by the feeder module (called ‘prerequisite module’ in Figure 3), step-by-step guidance on brainstorming for personal use, a step-by-step guide to random stimuli (with video) and a drop down menu to see a selection of feeder module specific sample titles including a word cloud.
- A module specific project title suggestion form. (There were actually two identical, but the second form was optional.) Figure 4 displays part of the T312 form and shows that the student was required to choose which feeder module topic their specific idea relates to. This was followed by a selection of tools and techniques studied during the feeder module and, although the students were encouraged to select options from there, they were not required to do this. This first form also required the student to submit a draft title, an engineering question (a question mark was compulsory) and a short explanation of the background.

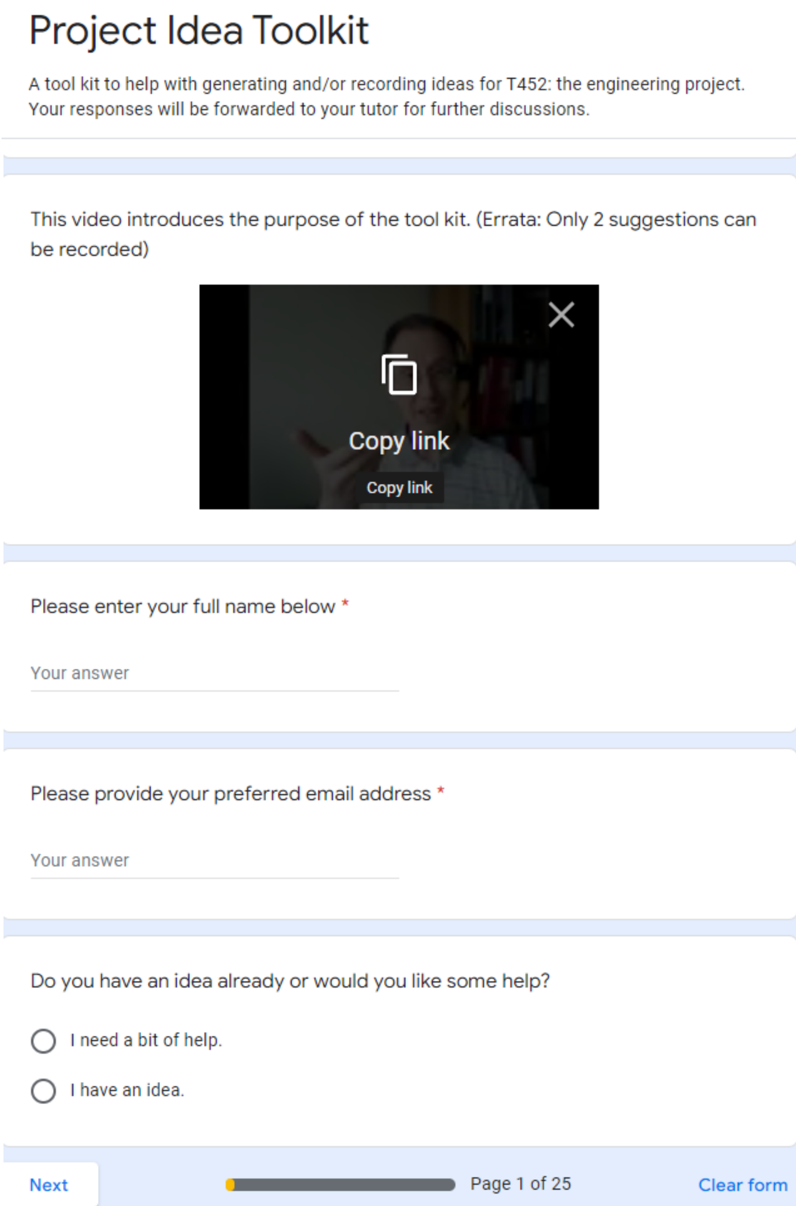
Table 2: Participating tutors’ specialism

Feeder module title	Open University module code
Mathematical methods and fluid mechanics	MST326
Electronics: signal processing, control and communications	T312
Innovation: designing for change	T317
Engineering small worlds: micro and nano technologies	T356
Structural integrity: designing against failure	T357

The ideation tool selection included both intuitive and directed methods (White *et al*, 2012). For instance, the intuitive technique of brainstorming (White *et al*, 2012) was included as, not only was it taught using a step-by-step list in the postgraduate module, but is also highly regarded in other undergraduate ideation tool teaching sessions (Ostrowski *et al*, 2020; Lee *et al*, 2019). A list of sample titles was incorporated as a directed method to show the spread of possible topics (Shah *et al*, 2003). The sub-section explaining how to use random stimuli was included to foster illogical thinking mentioned by Bayırlı (2020).

Both the ideation tool section and the suggestion form(s) referred back to the feeder module to ensure that students worked within the required idea space. Similarly, the tools and techniques were related to the feeder module to ensure that students fulfilled the project module requirements by basing their project on their feeder module. This section was complemented for the T317 module with tools from other modules as the feeder module may not provide enough opportunity for the required engineering analysis.

To explore the idea of gamified learning, a progress bar (see Figure 2) and point scoring (see Figure 4) were incorporated. Because of conditional branching, the progress bar was a poor indicator of the actual progress and scoring system had to be made to work using the tools available in Google Forms. However, it was felt that including them would give an opportunity to discuss these features with students to see if these toolkit elements had the potential to increase student motivation.



Project Idea Toolkit

A tool kit to help with generating and/or recording ideas for T452: the engineering project.
Your responses will be forwarded to your tutor for further discussions.

This video introduces the purpose of the tool kit. (Errata: Only 2 suggestions can be recorded)

Please enter your full name below *

Your answer

Please provide your preferred email address *

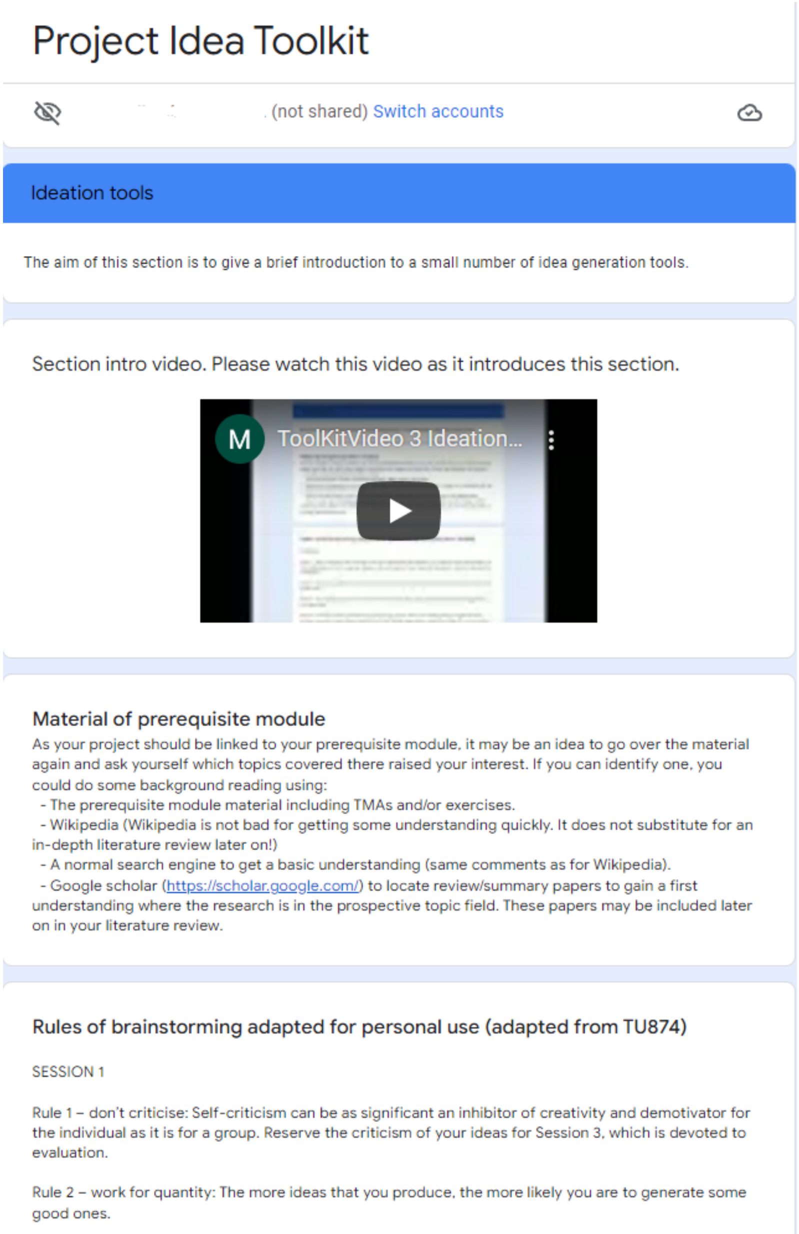
Your answer

Do you have an idea already or would you like some help?

- I need a bit of help.
- I have an idea.

Next   Page 1 of 25   Clear form

Figure 2: Introductory section of ideation toolkit



Project Idea Toolkit

(not shared) Switch accounts

Ideation tools

The aim of this section is to give a brief introduction to a small number of idea generation tools.

Section intro video. Please watch this video as it introduces this section.

Material of prerequisite module

As your project should be linked to your prerequisite module, it may be an idea to go over the material again and ask yourself which topics covered there raised your interest. If you can identify one, you could do some background reading using:
- The prerequisite module material including TMAs and/or exercises.
- Wikipedia (Wikipedia is not bad for getting some understanding quickly. It does not substitute for an in-depth literature review later on!)
- A normal search engine to get a basic understanding (same comments as for Wikipedia).
- Google scholar (https://scholar.google.com/) to locate review/summary papers to gain a first understanding where the research is in the prospective topic field. These papers may be included later on in your literature review.

Rules of brainstorming adapted for personal use (adapted from TU874)

SESSION 1

Rule 1 – don't criticise: Self-criticism can be as significant an inhibitor of creativity and demotivator for the individual as it is for a group. Reserve the criticism of your ideas for Session 3, which is devoted to evaluation.

Rule 2 – work for quantity: The more ideas that you produce, the more likely you are to generate some good ones.

Figure 3: Part of ideation section

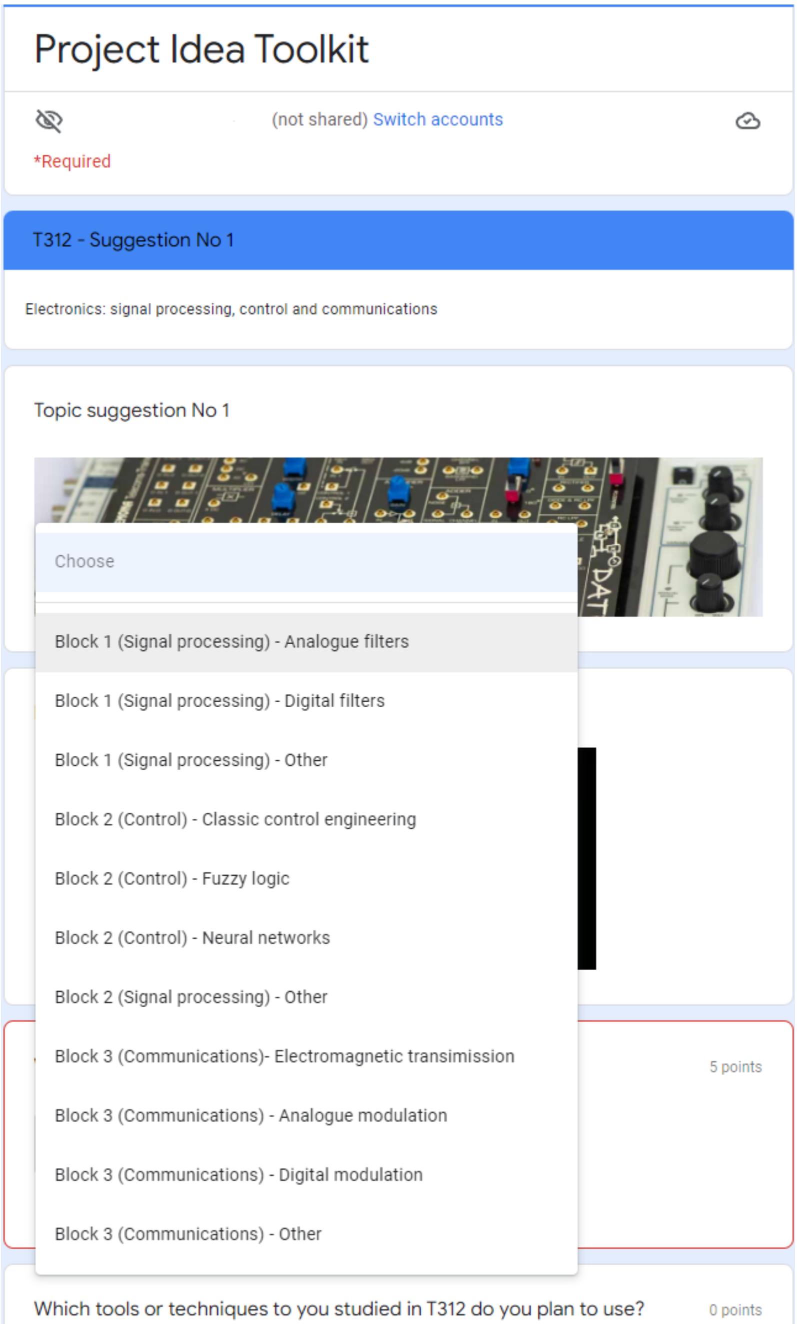


Figure 4: Part of T312 suggestion form

Deploying the toolkit

In addition to discussing the toolkit design, the tutor team developed a deployment strategy to assist in studying whether this online approach to scaffolding improves student experience. As this study involved human participants, the Open University process was satisfied by submitting a risk assessment and registering the project with their Human Research Ethics Committee.

Although this toolkit has been designed to be a standalone item, the initial deployment involved an online workshop for participating students which had two sections and was designed to last up to 90 minutes (but actually took just under two hours). During the first part one tutor introduced the aims of the toolkit before the students were asked to try it out to see if it worked as they would expect or if they could 'break' it (e.g., find links that did not work). During the second part two tutors introduced the concept of random stimuli and demonstrated this in a subsequent breakout room session, whereas the remaining two tutors discussed the benefits of engaging with the feeder module specific material and brainstorming. These two also ran a breakout room session, parallel to the random stimuli session, to work through a brainstorming example. To obtain an indication how much the workshop (rather than the toolkit) helped with the ideation process an entry and exit poll asking students to respond to the question "How confident are you in coming up with a suitable topic for the project?"

One of the challenges to deploying this toolkit was the small pool of possible student participants. As this was an explorative study, only the student groups led by the five participating tutors were invited to take part in the study. As the normal size of such a group is six, only 30 students could be invited to participate through sending emails to all five student groups. The nine students who were willing to help were given an information sheet and returned a signed consent form.

The second challenge was the timing. Tutors learned only just before the start of the module who their students would be, as students were allocated according to their choice of feeder module. In addition to this, students were required to submit an initial idea less than two weeks after the module start. Recruiting students for a workshop taking place only four days after the official module start was challenging, but this early date was deemed appropriate to provide authentic idea generation support.

Studying the toolkit's usefulness

Tahir and Wang (2021) studied the effectiveness of ideation tools (in their case ideation cards) in a higher education setting. They suggest that a more valid study method was needed than subjective students' opinion and used video recording and ideation output. Similarly other authors (Lee *et al*, 2019; Sangelkar *et al*, 2015) report on the impact of ideation instruction in an undergraduate engineering setting where they analysed outputs of a face-to-face idea generation workshop to evaluate their interventions. However, as the module discussed here is distance learning without a face-to-face element, this type of assessment was not possible. Therefore other study methods were used, in particular, similar to Fiadotau and Sillaots (2020), students were asked to submit a short questionnaire shortly after the workshop session. This was complemented by a semi structured interview a couple of months later following the reasoning in Ostrowski *et al* (2020).

The students were encouraged to return their questionnaires, which asked them to evaluate the usefulness of the workshop and the toolkit separately, no later than one week after the workshop. Filling in the questionnaire after the workshop gave the students time to use the toolkit at their leisure. The questionnaire contained 16 short questions in four parts. Part one investigated if the students' respective feeder module prepares them for project topic ideation. This was followed by a section exploring what the students had done before the workshop to come up with an idea and about the students' expectations of the workshop. The third section asked questions regarding the usefulness of the toolkit and the gamification elements. The final part asked for improvement suggestions for the workshop and the toolkit.

All students that attended the workshop were also invited for a semi-structured interview taking place about two months after the workshop. In the intervening time the students had to submit a topic proposal and receive feedback from their assign tutor and other colleagues supporting students from the same feeder module. The reasoning is similar to the one presented by Ostrowski *et al* (2020) who argue that this time allows students to reflect on the intervention and engage further with the ideation process. Furthermore, it was felt that the proposal feedback could support this reflective process as it may give a good indication if the topic idea meets the module requirements. For both the questionnaire and the interviews a thematic analysis was performed (Nowell *et al*, 2017).

Limitations

The aim of this study was to give credence to the idea that FYP modules with student-led topic suggestion in engineering should include some instruction on idea generation tools. It does not claim that the selected mix of tools and techniques is the best one but uses a pragmatic approach of selecting readily available tools and techniques. In addition, the number of participating students was small, only 30% of the available tutor group students participated, and it was not examined how the other 70% fared with their topic ideation.

Results

Despite the challenges in recruiting participants described above, nine students from all tutor groups were recruited of which eight returned their questionnaires and three participated in the interview. Table 3 shows that the feeder module T312 had the highest number of students, whereas no T357 student provided feedback. Again, the interviewees came from different modules and thus provided a good spread given the constraints.

Table 3: Student participants

Open University module code	Questionnaire	Interview
MST326	2 students	1 student – Student A
T312	3 students	1 student – Student B
T317	2 students	1 student – Student C
T356	1 student	

The entry and exit polls asked the same question at the beginning and at the end of the workshop inquiring about how confident the students felt in coming up with a suitable project topic. Five responses were recorded for each poll and showed a progression from the 'not really confident' or 'not confident at all' categories at the beginning of the workshop to the 'somewhat confident' or 'very confident' bracket.

The questionnaire analysis showed that only one student had a clear topic idea before the workshop, that is to say at the beginning of the module. This was despite all but one student having used different avenues to generate a possible topic idea, including reviewing the feeder module material and looking at previous FYP titles. All students reported that they found it challenging to suggest a topic at the right level. Five of the students expected that the workshop would help them in generating an idea and these students actually felt that the workshop met their expectations in this respect. Two students correctly identified the beta testing of the toolkit as the aim of the workshop and pointed out that they felt more time should have been allocated for this. Overall, all students found the workshop helpful for their ideation. However, the help did not necessarily come from the tools and techniques, but from the discussion with other students and the tutors. The questionnaire revealed that students benefited from the toolkit in different ways. There were some comments relating to the tools: A T312 student indicated that the dropdown menu shown in Figure 4 helped him to "to set suitable parameters" and a T317 student found that the toolkit helped her to refine her ideas. The main criticism of the toolkit was the inconsistent progress bar and the point system as it was not immediately obvious what the score really meant.

Interview results

The first set of interview questions explored how the students came up with their project titles and showed that all of them spent quite some time in finding a suitable project. For instance, student A revealed that he had had to defer this module for an academic year, and then found it difficult to come up with an appropriate title. The student who selected T312 as his feeder module intimated that he had struggled with this degree all along and he did better in T312 then in other potential feeder modules. After he used the same type of reasoning to select control engineering from T312, he looked around this workplace for inspiration and discussed the problem of coming up with a project topic with colleagues. Furthermore, this student also carefully read through module descriptions, but indicated that he found the description rather vague. Finally, student C noted down interesting topics in her potential feeder modules but was dissuaded from selecting *Structural integrity: designing against failure* as a feeder module by a forum post for that module.

One benefit of the workshop was the social aspect as can be seen by student B's comment, as he found it quite reassuring to see fellow students struggling to get started with project topic ideation. Having said that, student A said that he was more of an introvert and that the facilitated demonstration of the ideation tools was more helpful than a student-led discussion. Also, student C found the review of the ideation tools and how they related to the project module helpful despite having studied them in her feeder module. This student was the only one who really understood the original intention of the workshop as beta testing the toolkit whereas the other two students thought that the workshop was designed to explicitly help them with generating a project idea.

The interview questions relating to the toolkit showed that two out of the three engaged with the toolkit after the workshop. The comment by student C communicated that she found both the ideation tool section and the project form useful as they helped her "getting ideas going" and then refining her ideas. Student A also found the equivalent drop down menu displayed in Figure 4 useful for idea generation as it "focused [him] on something". Both students found visuals useful, e.g., the word cloud of the sample titles (Student A) or the sample topics explained by text and an appropriate illustration. Student C felt that they played a similar role to random stimuli. Both students emphasised that they found an indication of their progress through the toolkit helpful. However, the progress bar could not be implemented properly because of branching and the students picked up on that. The responses to missing items of the toolkit ranged from "if it wasn't there, I wouldn't have known" (student A) to how to improve specific items in the tools and techniques section (student C).

Although motivation was not specifically included in the interview questions, responses indicated a spread from getting "the pass mark and [getting] over the line" (student B) to "I'm trying quite high" (student C). Another aspect that came to the fore was that the interviewed students were not sure about the required project level and this despite carefully reading through the description of the project module (student B) or attempting it for the second time (Student C).

Discussion

The discussion presented above treated the ideation for FYP topics as a creative process using Amabile's creativity model (Amabile, 1998) as a backdrop. Although the study was quite limited, it suggests that the task motivation is high. One indication is that two out of the three interviewed students explained their motivation without being prompted. It also seems quite likely that other students will be motivated to look for topic ideas as this task is allocated to the first two weeks of the module. This assumption is also supported by the questionnaire responses where almost all students indicated that they have invested some time and effort before the workshop, which took place only four days after the official module start, to find project ideas. Another aspect of Amabile's model is subject expertise, and the interviews showed that the students had some awareness of their limitations in this respect.

Although the original intention was that the ideation toolkit would address the third aspect of Amabile's creativity model by itself, it turned out that the workshop fulfilled a similar role. The majority of workshop participants expected direct assistance with the ideation process and the responses showed that this was fulfilled. One participant suggested that a workshop should be developed further into a day school to which the toolkit would provide a backbone. However, two of the three interviewees suggested that the toolkit by itself was helpful in both the idea generation and focusing phase, thus suggesting that, for them, the design aim was met. The third interviewee did not use the toolkit after the workshop but looked at the feeder module material and his workplace for inspiration. The conclusion that there is no "one-size-fits-all" approach when it comes to supporting the idea generation process is hardly surprising when examining the paper by Wang (2019) which lists over 80 ideation tools. However offering a small selection of tools, techniques and suggestions can be a good starting point to formulating a good FYP topic (Gube, 2019). The fact that only about a third of the invited students attended may indicate that they had an idea already, but other reasons, such as inconvenient timing of the workshop or the added administrative process of returning a signed consent form, may have held students back from participating.

One major aspect that came to the fore in both the questionnaire and the interviews was that students did not understand at what level their projects should be aimed. This may be because students did not really understand what the learning outcome "the ability to solve problems in developed technologies using well proven analytical techniques" (The Open University, 2021b) means in practical terms. This is understandable as this learning outcomes needs to accommodate different engineering disciplines and may be slightly differently interpreted in these fields, but a dropdown menu, similar to Figure 4, together with a list of techniques studied in the feeder module may help to more readily operationalise this learning outcome.

It was also interesting to note how other disciplines approach FYPs in distance learning modules. Many disciplines devote significantly more than the two weeks the engineering project module does, to the supported generation of topic ideas. This may be related to the discipline, for example the phycology FYP module requires a student to select the study method first, before the topic is developed with a tutor. However, other STEM subjects, such as physical sciences and computing & IT, seem to offer more advice both in idea generation or within the subject area.

Conclusion

- Based on the creativity model by Amabile, which defines 'creativity' as the intersect of motivation, expertise and creative thinking skills, it can be concluded that creative thinking skills should be included in the engineering project module as this is the aspect where students are the most deficient.
- A collection of tools and techniques similar to the toolkit proposed here should be investigated further as to their usefulness to support the initial ideation process. This support should be available to the students shortly before the actual module start.
- An easily accessible explanation of what constitutes a good FYP, or project examples should be given to guide students in suggesting projects at an appropriate level.

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