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The Idea Acceptance Model

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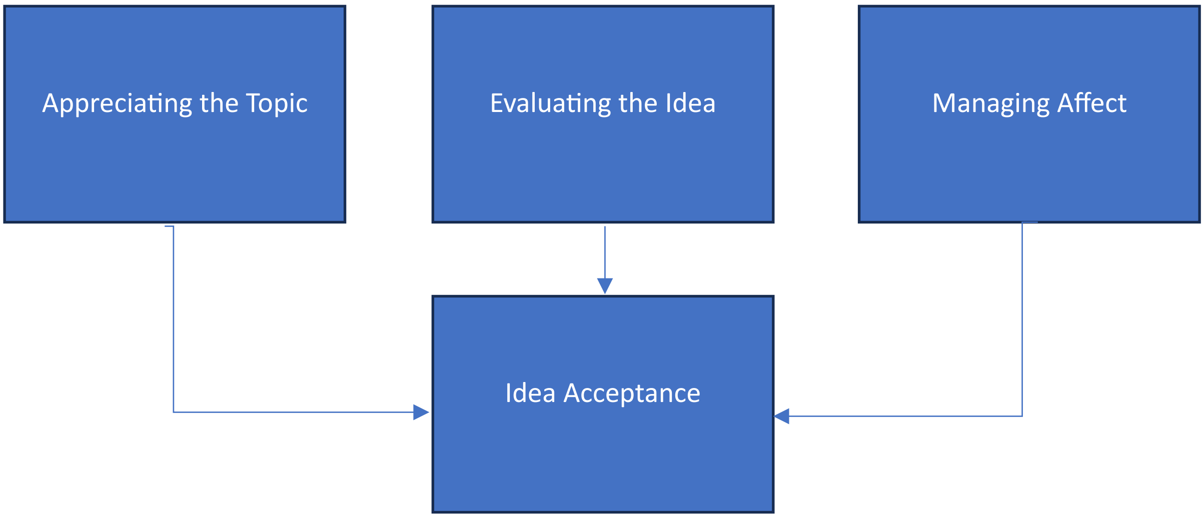
Abstract

What influences a student's acceptance of an idea? Is it the persuasiveness of an argument? The clarity of the explanation? The authority of the teacher? Something else entirely? We all probably have an innate idea that idea acceptance involves one or more of these things, but how often do we consciously think about these elements in our teaching? As passionate educators, we typically want to make our teaching more engaging for our students, but this can often leave us puzzled when some of our students are still not learning our content.

This paper attempts to help address this problem by providing an Idea Acceptance Model that can be applied in the teaching of Engineering. The model is inspired by the Feedback Literacy Model which breaks feedback literacy down into "Appreciating Feedback", "Making Judgements" and "Managing Affect" and proposes a similar 3-step model of "Appreciating the Topic", "Evaluating the Idea" and "Managing Affect". Satisfying all 3 components of the Idea Acceptance Model should lead to Idea Acceptance (as seen below).



This model has come out of research that has targeted how to effectively teach students in STEM fields (like Derek Muller's thesis on *Designing Effective Multimedia for Physics Education*), as well as other work on the persuasiveness of an argument and the role of emotions in idea retention. Research-based examples of teaching practices that relate to each of the components of this model are also given in this paper to help the reader think about each component as it relates to their teaching.

It is suggested that educators should think carefully and critically about how their teaching relates to each of the idea acceptance components, as a roadblock in any one of them could prevent a student from ever accepting an idea. It is also theorised that different Engineering Topics lend themselves to different barriers. Highly technical topics likely have to contend with the "Appreciating the Topic" and "Evaluating the Idea" sections (as students are less likely to have pre-existing affective barriers to technical ideas) whereas subjects covering professional skills likely have to focus on addressing the "Appreciating the Topic" and "Managing Affect" sections as students often need to be convinced of the value of these skills and often have pre-conceptions of their importance.

1. Introduction

Academics often find themselves trying to get students to accept new ideas. Sometimes this is in the form of a lecture on new content that the students haven't seen before. At other times, this comes in the form of answering a student's question or explaining something to a student one-on-one. Increasingly academics are trying to get students to come across these ideas more naturally in project-based learning environments. In all cases, however, Academics are trying to get students to accept ideas and achieve learning outcomes.

In order for an idea to be accepted, however, a lot has to go right. A student needs to be interested enough in the idea to engage with the content, they need to evaluate the truth of the idea, and they need to be able to emotionally accept the idea, even if it doesn't agree with some of their pre-existing beliefs.

We subconsciously use different techniques to address these barriers, but it is rare that we think about these barriers to idea acceptance explicitly. This lack of an explicit framework to think about why students are not accepting an idea can lead to some degree of frustration when our students are not achieving their learning outcomes.

In order to address this, this paper attempts to formalise the idea acceptance process and to relate the different areas of idea acceptance to commonly used teaching techniques and practices. The model draws heavily from the Feedback Literacy Model [1] to identify three key areas that are needed before an idea can be accepted. Further justification of this model is provided by referring to historical work on persuasion, behavioural psychology [2] and rhetoric such as the elements of Logos, Ethos and Pathos originally discussed by Aristotle in 350BC [3] as well as more modern literature on barriers to student learning in STEM education [4], [5], [6].

2. From Feedback Literacy to Idea Acceptance

In their 2018 paper on developing student feedback literacy, Carless and Boud [1] propose a 4-part model that describes the feedback literacy process (see Figure 1). The model says that students must first appreciate the need for feedback, make judgements about the appropriateness of the feedback and manage the emotions (or affect) that comes with receiving negative or constructive feedback. Carless and Boud argue that achieving these three feedback literacy competencies maximise the chances that a student will actually learn from feedback and take action.

While there have been attempts to build on this model in the feedback literacy space, such as Chong's Ecological Perspective [7] and Wongvorachan et al.'s digital feedback literacy model [8], these models have not become as ubiquitous as the original feedback literacy model. An investigation of these models find that they tend to take the original feedback literacy model in its entirety and add additional dimensions and information too it (see Figure 2). These dimensions tend to dilute the original model, reducing the value of the framework.

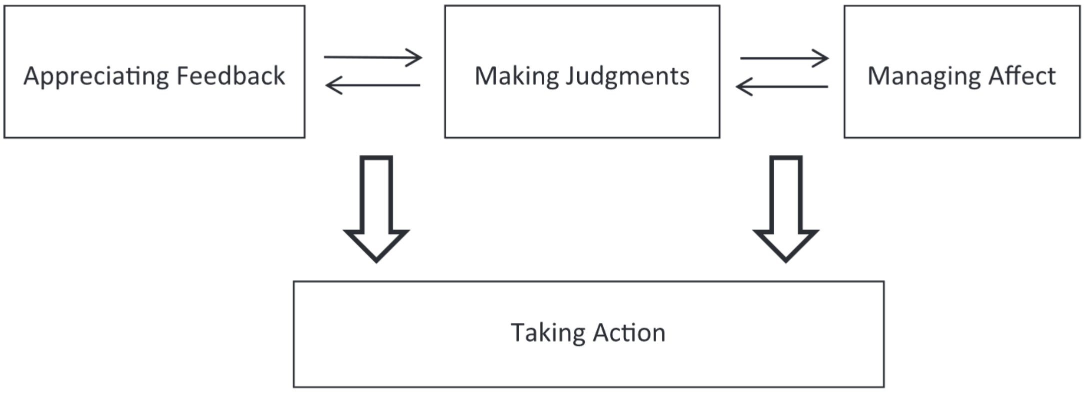


Figure 1: Carless and Boud's Feedback Literacy Model [1]. The model breaks feedback literacy into Appreciating Feedback, Making Judgements and Managing Affect. These three components lay the groundwork for taking action.

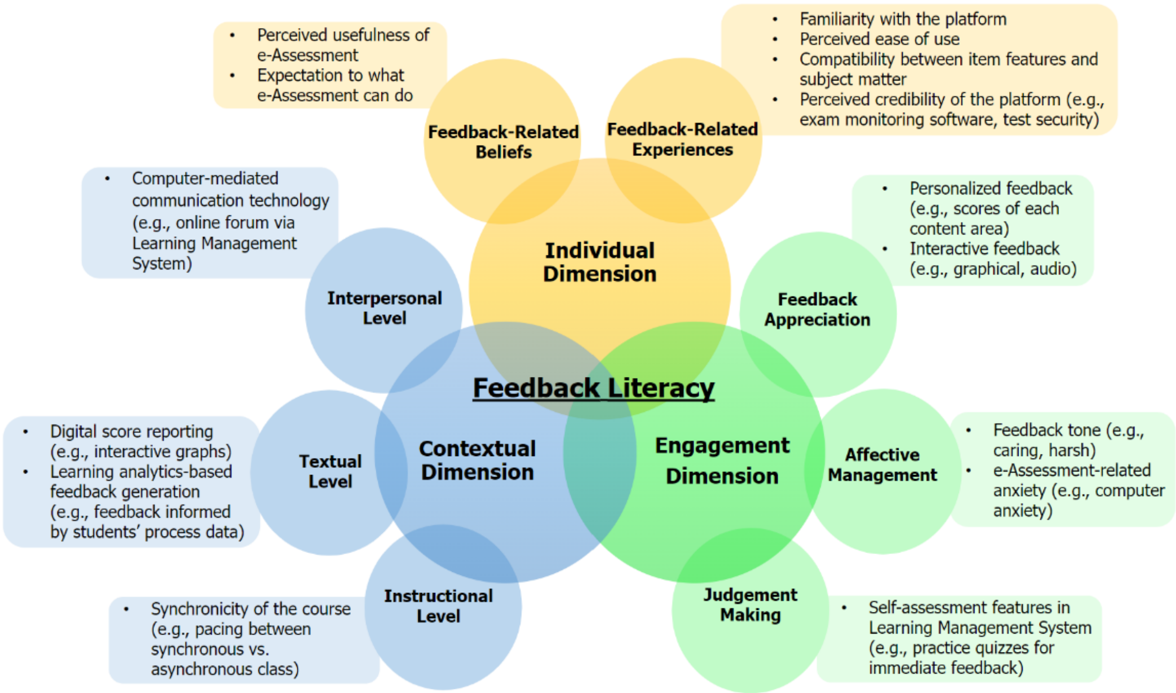


Figure 2: Wongvorachan et al.'s evolution of the feedback literacy model [8]. The original model by Carless and Boud makes up the Engagement dimension, Chan's ecological model makes up the Individual and contextual dimensions and Wonvorachan et al's contributions make up the dot points around the bubbles. The excessive detail in this model makes it less effective as a framework.

One strength, therefore, of the original model is its simplicity, and so the three-pronged structure was adapted into the Idea Acceptance Model. However, this simplicity is only helpful as the framework itself comprehensively captures feedback literacy with its three interdependent components. Thus, any simple model attempting to adequately create an effective framework should learn from these three categories and create similar, all-encompassing categories.

When attempting to relate idea acceptance to feedback literacy, it becomes clear that the feedback literacy model is actually just a specific case of the acceptance of an idea. This is because for a student to learn from feedback that is given to them, they have to internalise and accept the idea given to them by the teacher. This process requires the cognitive evaluation of the idea (making judgements), the appreciation of the idea (appreciating feedback) and managing the emotions associated with the idea (managing affect). Thus, an appropriate framework for idea acceptance would comprise of the same three areas, just worded to reflect their association to any idea as opposed to feedback literacy. This model can be seen in Figure 3.

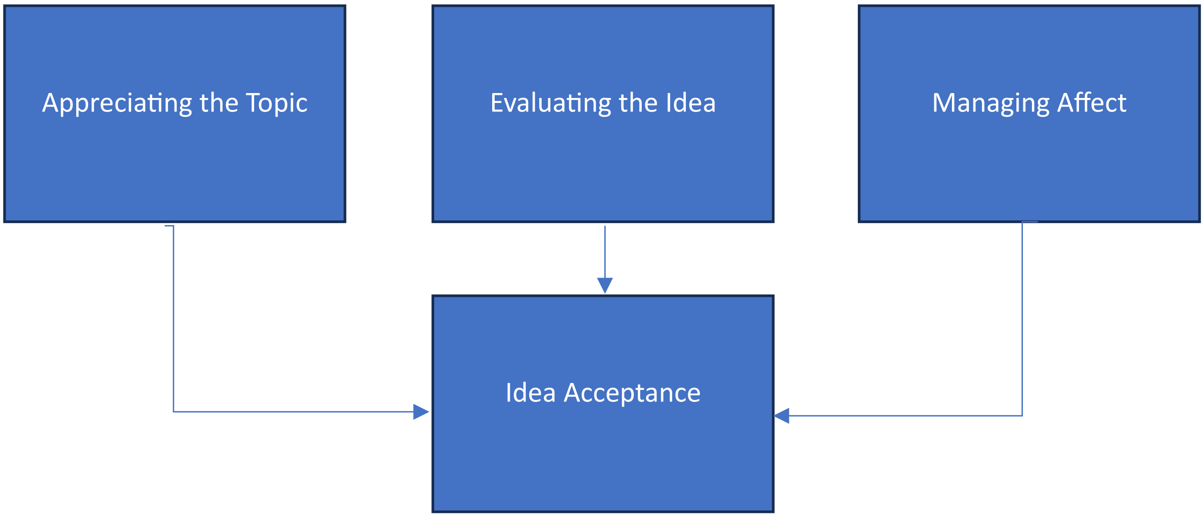


Figure 3: The Proposed Idea Acceptance Model. The model contains three dimensions: Appreciating the Topic, Evaluating the Idea and Managing Affect. All three dimensions are required to achieve Idea Acceptance.

This model is also inspired by the ideas of *Logos* (Logic), *Ethos* (Character) and *Pathos* (Emotion) first described in Aristotle's Rhetoric in 350BC [3]. Aristotle described all rhetoric as a combination of these three components and recognised that while we all use some combination of these techniques naturally, formalising the components assists in the deliberate practice of Rhetoric. While there is some debate as to whether Aristotle encourages the use of all components equally [9], [10], it is undeniable that Aristotle recognises all three components as being effective at changing the minds of others.

Modern research into the role of Logos, Ethos and Pathos in debates [11], [12] confirm Aristotle's theory and demonstrate clear advantages of each of the different persuasion techniques. It was found that Logos induced more mental workload on participants, Ethos and Pathos increased the engagement of participants and that pathos was the most effective at convincing participants to change their opinions [11]. This implies the need for a teacher to be consciously thinking about the clarity of their explanations, the perception of their character, and the emotions they are invoking in their students if they want to give their students the best chance to learn.

3. The Case for Affect in Engineering

While it may be obvious to an educator that debating or responding to feedback requires the management of affect (we all get a bit emotional when we disagree with a comment or some feedback that we receive), the role of affect may be less obvious in the communication of Engineering Ideas. After all, many Engineering concepts rely on mathematical facts that are surely less susceptible to affect than feedback comments.

While there may be some truth to the fact that different ideas need to manage affect to different levels, research and experience has consistently shown that ideas in mathematics, science and engineering are still susceptible to emotional or illogical responses [4], [5], [6],

[13], [14], [15], [16]. One primary cause of these emotional responses is the misconceptions that students have about a topic [4].

In his PhD Thesis on Designing Effective Multimedia for Physics Education [4], Derek Muller showed that while giving a clear explanation of a difficult topic is typically appreciated by students, it is often ineffective in actually getting them to chance their misconception on that topic. However, Muller found that starting with the misconceptions about a topic (such as having a student in a video express their incorrect understanding) was much more successful at getting them to accept the new idea.

The presence of Affect in STEM is also noted by math teachers who attempt to teach the Monty Hall Problem to students [5], [13], [17]. This is an infamous probability problem which outlines a scenario where a contestant has to pick one of three doors (one of which contains a prize), before the gameshow host (named Monty Hall) opens one of the other empty doors and asks the contestant if they would like to stay with their door or switch to the remaining door.

The question that is usually asked is "should the contestant switch doors or stick with their initial choice?". Mathematically, it can be demonstrated relatively easily that the contestant should switch doors as switching will grant a 2/3 chance of winning. However, many people instinctively believe that it shouldn't matter whether the contestant switches or stays, as the two doors should mean that they have a 50/50 chance to win either way.

While it is not unusual for people to have incorrect instincts regarding probability problems, what is unusual about the Monty Hall problem is how people respond to being told the correct answer. Mathematician Jason Rosenhouse [17] describes explaining the Monty Hall problem to his students as dealing with the 5 stages of grief, and the original article which popularised the problem in 1990 and 1991 resulted in thousands of letters being sent to the editor of the magazine complaining that the columnist got the answer wrong [13]. Some of these letters came from professors of mathematics and physics, showing the power of affect even amongst those who are experts in the field.

It is clear then, that Engineering should recognise the power of affect in the decision-making and idea acceptance of students. While it may not be a barrier for every engineering topic, being aware of it as a potential barrier to learning can help educators design their classes and units appropriately.

4. Putting this Model into Practice

Ultimately, the purpose of any theoretical model in Engineering Education is to improve the teaching of engineering to students. To that end, the Idea Acceptance Model has been broken down into its three components and each component has been associated with some suggested teaching methods. The suggested teaching methods draw from existing academic literature and are intended to help academics to think about the implementation of the model. In order to maximise the likelihood of idea acceptance, academics should endeavour to practice at least one of the teaching approaches from each of the three components.

Component 1: Helping Students Appreciate the Topic

Before a student can evaluate or be affected by a topic, they must first be convinced that the topic is interesting or worth engaging with. This links to the expectancy-value model of motivation theory [2] which states that students engage with tasks they value and/or expect to be good at. While some students' past experiences might mean that they naturally appreciate a topic already, other students may need additional motivation before they can engage with the idea. Below are some example practices that teachers can use to help students appreciate their topics a bit better.

Teaching Practice 1: Demonstrating practical applications of the content [18] – Research has shown that giving practical applications of a topic at the start of a lesson can increase the interest and thus intrinsic motivation of students.

Teaching Practice 2: Run a quiz or survey prior to teaching the content [19] **–** Asking students questions at the start of a topic that are able to be answered with information from that topic can increase their enjoyment and motivation when learning about it. Like demonstrating practical applications, this piques the interest of students and gives them a reason to want to learn about it. An in-class survey or poll can also be used to demonstrate a concept prior to you teaching it.

Teaching Practice 3: Cultivate student interest [2] **–** One way to cultivate interest is to directly ask students about their experience with a topic. This helps make it clear to them that the topic has both intrinsic and utility value [2], motivating them to engage more deeply with it. One example of this might be a Transport Engineering lecturer asking their students about how they get to campus, how they travel to social events, etc… The lecturer can then use these student experiences to show the relevance of Transport Engineers having to predict a user's mode choice. Another practical way to cultivate interest would be to connect your topic to a recent news or media event that already aligns with your student's interests. For example, the importance of fluid mechanics could be linked to a recent Formula 1 race win, engaging students who have pre-existing interests in that field. It is worth noting that this technique can be difficult to implement when teaching abstract topics.

Teaching Practice 4: Use interesting and relevant visuals in your lessons [20] **–** Most of us know the importance of using visuals in PowerPoint slides to increase engagement, but we still may use text-heavy slides in our teaching. One thing to note is that it is important for the visuals to be relevant to the material being taught. Unrelated "decorative" visuals have been shown to be ineffective.

Teaching Practice 5: Integrate activities and examples into your lessons – Activities and examples in lessons can serve multiple purposes. While they can help consolidate learning, another important use for them is to increase engagement. With self-reported attention spans seemingly declining with the rise of the internet [21], [22] it is more important than ever to integrate some activities in your lessons to help break the content into smaller, more digestible chunks. The added activities also have the effect of adding natural variation to the lessons, something that can also assist with student engagement.

Component 2: Getting Students to Evaluate the Idea

Once the students appreciate the topic, they are then able to start evaluating the ideas that are being presented. Some students may highly value your authority as a teacher, and so will be willing to "take your word as gospel". Other students will need additional information to evaluate the ideas that are presented, ask you to repeat an explanation or just simply state that they don't understand something. Below are some ways you can help with this evaluation.

Teaching Practice 1: Use helpful analogies [23] – When explaining particularly difficult or abstract concepts to students, it is common for educators to use analogies in their explanations. Appropriate analogies can greatly enhance a student's conceptual understanding of a topic, but imperfect analogies can exacerbate some pre-existing misconceptions. To help avoid the propagation of misconceptions, it may be beneficial to flag to a student why the analogy may not be perfect in your explanation.

Teaching Practice 2: Use extreme examples [24] **–** When demonstrating a general principle or equation, it can be helpful to show the principle working at the extremes [24]. One common suggestion for mathematical problems is to "take the problem to infinity" and "take the problem to 0". This tends to show the overall behaviour of a function, and so increases the persuasiveness of the argument (e.g. "as the random noise component x tends to infinity, it becomes clear that the equation no longer depends on y. This makes sense because it is modelling a completely random system").

Teaching Practice 3: Understand when less is more [25] **–** While we often try to give more information in order to help students, there are situations when providing less information actually helps students understand the content better. The main point here is the relevance of the information, a short summary that focuses on the key takeaways needed can be more impactful than a long lecture with all the information.

Teaching Practice 4: Explain it in a different way – In cases where students ask clarifying questions, it can be helpful to give them an alternate explanation for the same concept. It is not uncommon for the same explanation to be given to two people and for them to understand them completely differently. One theory that tries to explain this is Variation Theory which states that two people who hear the same explanation can focus on different parts of it and consequently learn different things [26]. Giving a student an alternative explanation therefore gives you the chance to focus on the key idea you are trying to convey and allows the student to understand the problem from a different perspective.

Teaching Practice 5: Cite your sources and acknowledge other perspectives [27] **–** As mentioned in Aristotle's Rhetoric, the Ethos of a speaker can be an important part of persuasion [3]. While for some students the trustworthiness of an academic might be sufficient, other students may expect you to cite your sources, especially with regards to contentious or novel topics. This helps present the information as being more than just your opinion, assisting students with the evaluation process.

Additionally, in areas of Engineering that might be more subjective (such as ethics and professional skills) it can be helpful to acknowledge that reasonable minds can come to different conclusions based on the same set of facts. Coming across diverse perspectives has been shown to increase empathy and improve ethical decision making in students, as it teaches them their original perspective is not necessarily universal [27].

Component 3: Helping Students Manage Affect

As was discussed earlier, even if a clear explanation for an idea is given, students can still be naturally resistant to it. As a result, we need to acknowledge the role that affect is playing in their idea acceptance and help them to overcome it. This affect can manifest itself in different ways depending on the situation, and so below are some different suggestions of what an educator can do to help deal with them.

Teaching Practice 1: Start with the misconceptions [4] – As was shown in Derek Muller's work [4] starting your explanations by describing and refuting some common misconceptions can be helpful in teaching students a counter-intuitive fact. Lecturers are usually aware of misconceptions based on common mistakes in previous years, so they can use this to inform their teaching. An extension of this idea is to ask students what they think about a topic before teaching it. This can be a helpful way of understanding your student's misconceptions if you don't have any prior student data. This then allows you to tailor your teaching to address these misconceptions.

Teaching Practice 2: Use immersive technology to increase emotional investment [28] – It is well established that emotions enhance cognitive retention [29], and so students could benefit if educators aim to increase their emotional investment. One such approach could be the use of Virtual Reality to increase emotional investment [28]. This is typically more effective than a classroom environment as it allows a student to experience something from a different perspective. Similarly, Generative AI such as ChatGPT could be used to get students to interact with and learn from a database in a more natural and engaging way.

Teaching Practice 3: Share person-centred stories – As Benlamine et al. discovered [11] pathos was the most effective way of convincing others to change their opinions. Engineering educators can learn from this by attempting to invoke pathos in their students when teaching. For many engineering topics, this can take the form of real or fictional stories of people interacting with Engineering designs and concepts. These case studies and stories are already relatively common in some areas such as the teaching of Ethics [27], but this can be expanded to other areas of Engineering, especially Engineering Design.

Teaching Practice 4: Validate your students' feelings [30] – There are some ideas and topics that naturally provoke hesitant or resistant feelings on the part of the student. Walther et al. [30] describe students feeling awkward when they were asked to engage in roleplays, for example, and suggest that acknowledging this awkwardness while emphasising the utility of the activity assisted in getting students to manage this affect.

Teaching Practice 5: Ask students to articulate their biases [31] – Whether we know it or not, our upbringing, culture and experiences affect how we see the world. These conscious and unconscious biases can be a barrier to accepting a new idea, as it may not be compatible with our existing beliefs. While it is good to have a mixture of perspectives and beliefs, asking students to expressly acknowledge their biases helps them understand that their perspective is universal, and opens them up to the possibility of accepting a new idea.

5. Different Topics Require Different Focuses

While a teacher would ideally implement practices from all three components of the Idea Acceptance Model, some topics naturally lend themselves to needing more of one component than another. For example, a highly technical topic that doesn't really relate to any pre-existing intuition likely needs a greater focus on the "Appreciating the Topic" and "Evaluating the Idea" components. This is because the lack of intuition would likely make the topic difficult to appreciate, and the students will need clear and persuasive explanations to understand it. It is anticipated that the "Managing Affect" component will be less crucial in this case, as the lack of intuition will mean that students will not have many misconceptions or emotional barriers.

Conversely, a subject covering professional skills will likely have to focus on addressing the "Appreciating the Topic" and "Managing Affect" sections. This is because students often need to be convinced of the value of these professional skills within an engineering degree, and often have pre-conceptions of their importance and proficiency in these areas [32]. However, it is suggested that the "Evaluating the Idea" component may be less of a barrier as students are also more likely to think of many of these skills as intuitive or common sense.

The final pairing of components is "Evaluating the Idea" and "Managing Affect". This implies a topic that students already appreciate and engage with, but also that they struggle to evaluate the idea and manage their affect. This may describe the teaching of basic physical principles in science and engineering such as buoyancy, weight, inertia and the like. A student's exposure to these concepts in day-to-day life may provide the motivation they need to engage with the topic, but this may also mean that they form misconceptions about how these physical principles work. These misconceptions can make it difficult to teach the subject and students can struggle to evaluate the content taught by the teacher.

6. Spreading this Knowledge Within the Faculty

While individual academics have a responsibility to teach well and understand some of the best teaching practices in our field, the reality is that many Engineering academics will not have had to engage with the ideas of rhetoric and behavioural change in their academic life. As such, it is also the responsibility of the Engineering Faculty as a whole to share this knowledge with it's academics and to persuade them of its importance.

It is recognised that in many universities, this sort of training is typically done by either an introductory teaching course or mandatory professional development workshops. The Idea Acceptance Model itself can easily be shared in either of these formats as it is designed to be a simple 3-step model that helps articulate what many academics may intuitively know.

However, it is important to recognise that the very act of convincing academics to adopt this model is an example of trying to achieve idea acceptance. As a result, it is important to consider the three elements of idea acceptance when running these training sessions, ensuring that our academics: appreciate the value of the workshop (and aren't just there due to mandatory compliance), have a chance to evaluate and consider the applicability of the model, and are able to effectively manage their affect and resistance to change. Appropriately addressing these three components should lead to a more widespread adoption of the model.

Conclusion

As has been shown throughout this paper, it is important for engineering academics to consider both logical and affective barriers to idea acceptance. The Idea Acceptance Model attempts to make these different barriers explicit by breaking down Idea Acceptance into the three components of "Appreciating the Topic", "Evaluating the Idea" and "Managing Affect". While most academic teaching likely already contains a mixture of these approaches, deliberately thinking about the three components of Idea Acceptance allows engineering academics to tailor their teaching to their topic's and their students' needs. A selection of teaching approaches has been suggested to help academics with the development of their lessons, and some topics have been identified as needing more of one component than another.

Future researchers can build on this model by creating a more comprehensive list of teaching approaches that academics can use, as well as by specifically identifying more engineering topics and how they relate to the three components of Idea Acceptance. Expanding these two sections will help academics identify topics that will need additional attention, whilst simultaneously giving them the tools to address them.

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