Transformative learning in engineering education: the motivation factor

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ABSTRACT: In this article, the authors discuss the motivation factor that facilitates transformative learning in an engineering education context. A study was conducted by the authors, where four outcomes and three factors related to transformative learning in engineering education were identified [1]. The outcomes were: improved people and relational skills, project management ability becoming second nature, changes in ways of thinking and increased resilience. The factors that facilitated them were: the need to break out of comfort zones, the need to have crucial learning experiences, which were experiential in nature, and the importance of staying motivated throughout the entire process of transformation until completion. This present article focusses on one of these factors in greater detail; namely, the role of motivation in transformative learning. The authors' considerations presented in this article, which constitute a new research contribution, are supported by the interview data from their earlier study [1].

INTRODUCTION

Global challenges are becoming increasingly complex. Some of these complex challenges are enumerated in the United Nations Sustainable Development Goals (SDGs) [2] and the 14 Grand Challenges for Engineering by the National Academy of Engineering (NAE) [3], and others. Consequently, it is imperative for the training of engineers to rise to the challenge. It is no longer sufficient to focus exclusively on improving technical competencies as non-technical competencies are becoming recognised as equally essential. This is underscored by the various engineering education initiatives, such as the Washington Accord graduate attributes [4], the National Academy of Engineering's (NAE) Grand Challenges Scholars Program (GCSP) [5] and the CDIO initiative [6]. These initiatives give equal emphasis to both hard and soft skills, which is apparent in the attributes and competencies that they stress.

With regards to non-technical competencies, a study was conducted by Tien et al on the factors that promote transformative learning (TL) in engineering students [1]. The findings indicated that TL was facilitated by three factors. They were the breaking out of comfort zones, the need to have crucial learning experiences, which were experiential, and in being able to stay motivated throughout the entire process of transformation. The TL outcomes were found to be new and different ways of thinking, improved people and relational skills, project management ability becoming second nature and improved resilience. The comfort zone factor and the experiential learning factor were further elaborated on in earlier articles by the same authors [7] and [8], respectively.

In this article, the role of the motivation factor in transformative learning is discussed. A discussion on how to apply this factor in an engineering education context is also included. This latter aspect was not previously elaborated. The motivation theories applied in the discussion are the expectancy-value theory (EVT), the attribution theory (AT), the social-cognitive theory (SCT), the goal-orientation theory (GOT) and the self-determination theory (SDT). These are considered to be contemporary motivation theories [9] as opposed to traditional motivation theories, such as Maslow's hierarchy of needs, Skinner's reinforcement theory, Hertzberg's two-factor theory, McGregor's theory X and theory Y, McClelland's theory of needs and Vroom's expectancy theory.

Contemporary motivation theories were used instead of traditional motivation theories because they represented a more articulate and insightful interpretation of the phenomena. A brief introduction to the contemporary motivation theories is provided in the introduction with more explanation accompanying the discussion of findings. Firstly, motivation needs defining. It can be defined as *the process whereby goal-directed activities are initiated and sustained* [9].

The EVT recognises two independent influences on behaviour; namely, task value and expectancy of success. Task value refers to the extent to which an individual values the task with regards to its perceived benefits. Expectancy of success refers to degree to which an individual believes that he or she will be successful in the task if they try. The EVT proposes that motivation requires both a conviction that success is possible (expectancy) and the presence of an immediate or future gain (value) upon achieving success [10][11].

The AT seeks to explain why individuals react in different ways to a given experience. The AT proposes that such different responses may be due to the perceived causes that an individual attributes to the outcome of an experience. These perceived causes or attributions are usually subconscious, but they have a strong effect on an individual's motivation for future activities [12][13].

The SCT is a theory of learning that proposes that learning occurs as a result of mutual interaction between individuals and their environment and through observing others. With regards to motivation, the SCT considers self-efficacy to be of primary importance. The SCT considers that it is an individual's belief about what he or she can do that underpins all motivated action as without this belief he or she has little incentive to act [14].

The GOT identifies two types of goals which are performance goals and mastery goals. The central concern of performance goals is to demonstrate existing ability, to perform better than others and to avoid appearing incompetent. The main concern of mastery goals is the intrinsic value of learning and in constantly increasing one's competence [15][16]. Individuals with a performance goal orientation subconsciously believe that a person's intelligence or ability is fixed. Individuals with a mastery goal orientation believe that a person's intelligence and ability can improve through learning. These different goal orientations produce two entirely different types of motivation [17].

The SDT distinguishes between intrinsic and extrinsic motivation. When intrinsic interest in a task is present, an individual will be at his or her most productive and creative state. Extrinsic influences do not result in this same effect, even if they may still motivate. Hence, motivation varies not only in magnitude but also in quality [18]. The SDT explains how to encourage intrinsic motivation, as well as how to improve the quality of motivation when only external pressures are at work [19]. According to the SDT, motivation is influenced by three factors. These are autonomy, competence and relatedness.

Autonomy refers to *the need to feel free and self-directed* as opposed to feeling controlled, constrained or coerced. Competence is similar in concept to self-efficacy. It refers to *the need to feel effective*. While relatedness concerns *the need connect closely with others* [20].

A couple of other motivation factors not mentioned in the theories are social identity and stereotype threat [21]. Social identity refers to the sense of identity that an individual assumes as being part of a social group be it gender, race or religion, etc. Individuals who desire to conform to their social identities, consequently will be inclined to engage in activities that connect them to their social identity but may be disinclined towards activities that do not. Stereotype threat refers to the unconscious apprehension that negative stereotypes about one's social group may be applicable to oneself. Stereotype threat subverts performance in that a negative stereotype about one's social group related to a certain activity may cause an individual to underperform in that activity.

METHODOLOGY

A qualitative study was conducted adopting the interpretivist/constructivist epistemology, the basic qualitative study methodology and the selection of participants through purposeful sampling for semi-structured interviews. The interview data was analysed according to prescribed qualitative procedures. The methodology was discussed and justified in publications by Tien et al [1][7].

RESULTS AND DISCUSSION

The third theme or factor that was found to promote transformative learning was that of staying motivated. This factor supports the other two factors which are the breaking out of comfort zones [7] and crucial learning experiences which were experiential [8]. The motivation factor enables the transformation processes begun by the other two factors to reach completion. Transformation requires the breaking out of comfort zones, undertaking different and challenging assignments and seeing the entire process through. Consequently, motivation is essential.

This motivation theme or factor may be defined as follows:

Finding and sustaining the necessary level of motivation to begin, continue and to complete the entire process of transformation.

The subthemes included the motivation to improve, motivation to learn, motivated by the challenge, motivated by personal goals, motivated by the opportunity presented, motivated to discover one's capacity, motivated by support from others, motivated by grades, by competition and even by the fear of coming last in a competition. A sample of participants' interview responses are analysed below.

Intrinsic motivation [19] was often seen in participants' responses. The following excerpts from interview participant 9 (IP9) is one such example. He was intrinsically motivated by a couple of personal goals. They were a passion for automotive racing and a desire to acquire *sale skills*. They can be categorised as mastery goals related to increasing one's competence and understanding [15][16].

In terms of Taylor's racing team (TRT), I do it because of my goal, I want to be in the Formula 1 team. - IP9

So, the reason why I joined AIESEC (an international youth organisation with a chapter at Taylor's University) was because I know that I have zero sale skills and I want to build on it. - IP9

As IP9 was intrinsically motivated by his own interests, it is likely for him to persist in the face of difficulties and challenges until his goal is achieved. Consequently, any accompanying transformation would have taken place in the process. Intrinsic motivation represents the ideal situation.

Intrinsic motivation was likewise observed in interview participant 1 (IP1)'s response regarding his persistence in making cold calls to source for partnerships for exchange programmes despite embarrassing failures early in the process [7]. His persistence eventually paid off and resulted in his transformation [7].

So, this is not for me I thought, but something inside me told that if I were to give up at the time I may not, I will stay the same guy, I may not improve. - IP1

Individuals are intrinsically motivated to pursue mastery goals. Mastery goals are often consistent with an individual's life mission and knowing one's life mission helps facilitate self-directed learning and transformative learning [22].

Participants' valuation of opportunities with regards to the benefits to themselves represent another source of motivation. According to the EVT, both task value and expectancy of success can independently influence an individual's motivation towards a task [10][11]. This type of motivation was observed in interview participant 4 (IP4)'s response.

I would see what are the benefits that I could get from it, if the benefits are me getting a new skill, and meeting more people or getting to, get more knowledge, and the only disadvantage is me sacrificing some time, then I will go straight into it. But if let us say there is nothing to gain from it and only me wasting my time, then I would not. - IP4

Performance goals are also a source of motivation. They are based on the desire to appear competent or to outperform others [15][16]. They are not considered as effective as mastery goals. However, in Asian cultures, performance goals are fairly common. They are not perceived as negatively in Asian cultures as compared to Western cultures [23].

One example of performance goal was mentioned by interview participant 6 (IP6). She admitted that her primary motivation during the first couple of her project-based learning (PjBL) experiences was mainly to avoid the shame of performing badly at the Engineering Fair (the end of semester project showcase competition). This would be considered as a performance avoidance goal which is a goal that motivates an individual to avoid looking bad [15].

So, what motivated us is not to be shamed, that we cannot even cross our obstacles, but maybe there was competition to it, so that was the reason why. Second semester was also the same, because in engineering fair, we do not want to end up the last team, so, we had to do the project well. - IP6

What IP6 mentioned is considered as a form of extrinsic motivation. According to the SDT, there are four levels of extrinsic motivation. They are external regulation, introjected regulation, identified regulation and integrated regulation [24]. In this instance it is evident that IP6's extrinsic motivation was at the lowest level, i.e., external regulation. External regulation is about performing to earn external rewards or to avoid punishment. According to the SDT, three conditions must exist to increase the quality of motivation from external regulation and move towards integrated regulation. These conditions are autonomy, competence and relatedness [24]. They are also the same conditions that encourage intrinsic motivation.

It appeared that by semester three, IP6's extrinsic motivation had transitioned to the level of identified regulation. This is the level where an individual has identified with the external pressure in that the external source of motivation has become a personally useful and important goal. This transition appeared to be caused by an increase in her competence. She used words like *figure it out ourselves*, *getting used to it*, *get used to the process*, which alludes to increased competence.

Although not explicit, it did seem that relatedness also played a part in her transition to the higher level of extrinsic motivation as she used the pronoun *we* quite often in her responses. Relatedness refers to the need to connect and belong to others. It was obvious that by semester three she had bonded well with her project team members.

But because we were so used to that kind of situations, second semester was the same, nobody could help us, like into detail. So, we came up with the solution ourselves and after the third semester, it is kind of like okay, we need to figure it out ourselves …in the end we get used to the process. - IP6

Moving beyond semester three, her extrinsic motivation had transitioned from identified regulation to the level of integrated regulation as can be seen from her response below. Integrated regulation is the level where the external influences are integrated with internal interests becoming fully assimilated into self [24]. Integrated regulation is the level of extrinsic motivation that is the closest to intrinsic motivation.

Like some people they get into a challenge then they get scared, but for us, okay, we have a challenge, can we do something, yeah. That kind of feeling. - IP6

Hence, competence and relatedness played a role in improving the quality of IP6's extrinsic motivation. The third factor which is autonomy would also have had an effect in this improvement as students were given considerable autonomy in selecting their project, designing and executing it. When an individual's competence improved, he or she would desire greater autonomy. Therefore, it may be concluded that all three conditions of competence, relatedness and autonomy played their part in increasing the quality of IP6's extrinsic motivation.

Competence is similar to the concept of self-efficacy. According to the SCT, self-efficacy is the most important factor in supporting motivation for it is an individual's belief about what he or she can do that underpins all their motivated action [14]. This was also evident in IP6's responses.

Social identity and stereotype threat were observed in interview participant 8 (IP8)'s response. Social identity relates to the social roles that identifies an individual as a member of a certain group, while stereotype threat refers to the unconscious concern that a stereotype about one's social group may apply to oneself [21]. They can hinder motivation.

In the case of IP8, she accepted the challenges of undertaking extracurricular activities (ECA) even those not usually undertaken by female students because of the examples she saw in two senior female students. This created a positive social identity for her and helped her to overcome any stereotype threats to her motivation.

I would say when I was studying with seniors like F, she was very good. I was so like, she can do it and there is always this image where you know, girls are only good at one thing, so I said M was very good also. So, when you are always surrounded by people like this, I find it is okay. - IP8

Self-efficacy beliefs can also be vicariously influenced by people similar to oneself such as a peer [25]. In such cases, individuals may adjust their self-efficacy beliefs based on the model demonstrated by their peer. An example could be seen in IP8's response.

I do not actually look at my friends who are not making an effort. I have friends who throughout the four years were barely involved in any extra-curriculum, because they feel like classes are already overwhelming, projects are overwhelming, they do not have the time. But then, I also can see those who already have this and they are doing beyond. Well, let us join them. - IP8

Receiving social support is crucial to sustaining one's motivation. This need is explained by the relatedness condition of the SDT. Receiving support from others can help lighten the emotional burden and provide emotional strength. An example can be seen in IP6's response.

In some cases, I can see that support from your friends, people you hang out with actually contributes a lot. We motivate each other. It is that mutual support with your peers and then you notice this if you work harder together. - IP6

This type of support was absent from the experience of interview participant 7 (IP7). He was the only participant who seemed to have not acknowledged any transformation of the type sought in this study. He had a falling out with a team member and in retaliation this team member turned the team against him. This sudden loss of relatedness had severely affected his motivation. Unfortunately, IP7's cohort was less than 10 students, so he had to continue in the same team.

Awkward but I just cope with it. Last year was actually quite tough but I just cope with it. - IP7

I know I have learnt something if I survived this long, but right now I am waiting for my results. So, that is the next stage in life. My results and then get a job. Yeah. Yeah. Right now I have mental block, my grades matter a lot to me. It depends on whether I need to re-sit (my exams) or I just move on. - IP7

It may be due to the busyness of academic life and a lack of readiness to fully process his experience. According to the AT if an outcome is unexpected, then an individual's internal consciousness will be activated to search for an explanation or an attribution [26]. IP7's attributions can be expected to have a significant influence on his motivation and consequently the likelihood of any transformation. Attributions are interpreted through the causal dimensions of locus, stability and controllability [27]. Hence, will IP7 attribute the cause to be internal or external to him, is it likely to change or remain fixed and does he consider it to be within or outside of his control.

Staying motivated is necessary to prevent the transformation process from being aborted before it reaches completion. Like all processes the process of transformation requires time. It cannot occur instantly or without effort. Effort that is

required to pursue opportunities, overcome adversities, deal with emotional discomfort, work with difficult people, to refuse to quit when it is easier to do so, etc. This requires both mental and emotional effort. Therefore, staying motivated is vital for transformation and can be regarded as the foundation upon which the twin pillars of breaking out of comfort zones and having crucial learning experiences are supported [1].

To Facilitate Staying Motivated

The SDT can be used as the theoretical platform for the facilitation of the motivation factor. According to the basic psychological need theory, a sub-theory of the SDT, autonomy, competence and relatedness are innate and universal psychological needs which exist across all cultures and individuals [20]. Creating an environment that satisfies these psychological needs is the key.

Intrinsic motivation differs from extrinsic motivation. It is motivation that is already inherent in an individual due to a pre-existing interest or a personal desire to learn or to be competent in a certain area of interest. When intrinsic motivation is present, then what can be done is to provide opportunities for the students to realise their intrinsic goals.

Offering a variety of ECA, free electives, the opportunity to study abroad for a semester, and even minors within their majors would be some suggestions. The aim being to cover as broad a spectrum of interests as possible, thus giving opportunity for as many students to satisfy their intrinsic goals. In the process of reaching for these goals, especially where comfort zones are challenged and/or crucial experiential learning opportunities are presented, transformative learning can be expected to follow. When challenges occur the motivation to persist would usually be found due to the presence of their intrinsic motivation.

According to the cognitive evaluation theory, another sub-theory of SDT [19][20], intrinsic motivation is undermined, when an individual's self-perception of autonomy and competence are undermined. Autonomy can be undermined through the use controlling events, such as bribes, demands, punishments, etc, while perceived competence is undermined by negative or uninformative feedback.

With regards to undermining autonomy, an excerpt from interview participant IP10 will illustrate this. IP10 considered that access to laboratory facilities was somewhat restrictive and this had affected his motivation even though he had an intrinsic interest.

One of the example[s] is, they set up a new computer lab at the ground floor at the time, and then …how do I say, I mean it is just computers, all computer are locked up, it should be able to open for the room for 24 hours but it is not … it is not open for 24 hours because, simply because it is still a computer lab. So, all labs must be closed from 6:00 o'clock (for safety reasons). So, we are student[s], we do not understand this. They are just computers, there is not any hazardous things inside (the system did not differentiate between other labs and computer labs). So, why …why not they just open it for 24 hours and everyone can use the rooms to carry out their projects. - IP10

It is not …it is not human enough, the system. And sometimes, it affects us in a way that it is just do not feel like doing it, even though you're very passionate about it. - IP10.

With regards to undermining the sense of competence, IP7 failed to see the reason for laboratory reports. According to him, laboratory reports was one of the factors that had negatively impacted his learning experience. He appreciated the hands-on laboratory work, but not in having to write the laboratory reports.

No. We just do the lab and then write report on it … It is more of like a criteri[on] to do it, to pass than learning, to make contribution to learning, I do not see any. - IP7

According to IP7 there was no guidance nor was feedback given on his report writing and neither there was any advice on how to write it well. According to the SDT this can have the effect of undermining the need for competence through the absence of feedback.

Educators and education administrators should be mindful to not unintentionally undermine students' intrinsic motivation. Studies have shown that majority of students who pursue engineering do so because of their intrinsic motivation to study engineering [28][29]. Not undermining motivation is as important as facilitating motivation. An audit could be carried out on procedures, methods, delivery modes, etc, throughout the institution's facilities, programme and module requirements in an effort to identify SDT-undermining activities and to rectify them as much as possible. Alongside the audit, a survey to gather feedback from students regarding their experiences of SDT-undermining activities could be conducted.

A greater challenge facing engineering educators is when intrinsic motivation is absent. How would it be possible to create an environment that delivers on autonomy, competence and relatedness in such a way that makes it possible to transition a student without an intrinsic interest about certain matter along the motivation continuum? In such a situation, extrinsic motivation has to be relied upon.

The organismic integration theory, a sub-theory of the SDT, differentiated extrinsic motivation along a continuum. To the extent that an environment satisfied an individual's need for autonomy, competence and relatedness, the individual's extrinsic motivation will progress along a continuum towards an increasing quality of motivation [20][24].

In extrinsic motivation an individual performs an action because of the consequence associated with it rather than for its inherent satisfaction. Extrinsic motivation will have to be assumed as the starting point for many students in various compulsory activities including their initial PjBL experiences. It is often necessary to begin when no intrinsic motivation is present.

The lowest form of extrinsic motivation is easy to deliver. It is merely a matter of making something compulsory be it PjBL, ECA and so forth. External regulation will ensue. The challenge is to move from to external regulation to integrated regulation. The extent of internalisation depends on the ability to satisfy the individual's need for autonomy, competence and relatedness. An environment supportive of these each of these conditions must be provided.

An autonomy-supportive environment should provide for choice and decision-making flexibility. It should also provide the necessary information to help individuals internalise their motivation as opposed to having a person or a system controlling them externally [20]. While this would be the ideal, in practice however, some form of external regulation is usually unavoidable in the interim. Punctuality and attendance would represent a couple of examples. Not all students will progress at the same pace towards integrated motivation (or towards increasing maturity and responsibility). The key is not to let any needed controls dampen their motivation. This can usually be achieved by providing the students with the rationale for the *control* to help them internalise the importance of the activity over time.

Choice and flexibility in decision-making, which supports autonomy, may be readily facilitated through offering a wide a range of ECA, free electives, global mobility, etc. With regards to PjBL, students can be afforded more flexibility in choosing their projects or allowing them to recommend their own projects if their recommendations meet curriculum requirements.

Even providing a diversity of non-compulsory events can be helpful. Interview participant 11 (IP11) despite not being active in ECA nonetheless appreciated the diversity of events available at the university. Some of these events, which he chose based on his interest, could result in crucial learning experiences leading to growth and personal development.

Because some other uni they just focus on studies …somehow like no different with high school. You know, come here to study and then that is all. But in Taylor's there are a lot of events. A lot of like, festival event, workshops …those kinds of events are the spice of life. Sometimes if you are bored you can just take part in any events. I think that is quite important during your four years in uni life. - IP11

A competence-supportive environment should provide students with optimal challenges in contrast to challenges that are too overwhelming or too easy. It also needs to provide structure and feedback for skills and abilities to develop [20].

With regards to competence, PjBL experiences can be useful for pushing students out of their comfort zones, compelling them to develop skills and capacities that they would not otherwise develop if they remained in their comfort zones. Therefore, it is necessary to understand what constitutes an optimal challenge. An overwhelming challenge will certainly take a student outside their comfort zone, but it would be unwise to do so unless some scaffolding is provided so that the challenge is not overwhelming but optimal.

With PjBL, there is a repetitive experiential learning cycle, the Kolb cycle [30] that allows for greater and greater competence to develop if PjBLs are offered each semester. While the project's technical difficulty will increase in the later semesters, nonetheless the soft skills required for project work, such as teamwork, communication, leadership ability and project management skills can be expected to remain constant. Hence, greater competence in these areas can be expected as the students' progress through their semesters (repeating the Kolb cycle) and along with this their corresponding sense of competence and motivation.

Good supervision in terms of providing structure and feedback is important especially in the students' initial PjBL experience. IP6 had spoken about her sense of helplessness [7] and of feeling overwhelmed during her first PjBL experience. However, she had a supervisor in her first PjBL experience who provided his students with the necessary tools to undertake their projects although he did not provide the solutions.

Having a very structured way to go about the projects really helps …how we are going to break down this huge thing into manageable morsels. - IP6

It was these tools when mastered and proven effective in their application that had given IP6 her sense of competence and motivation to take on any manner of project challenges in her later semesters. PjBL in this article refers to standalone modules that are fully project-based, where students work in teams rather than a project assignment within a module.

The first semester it was kind of like still learning you know. Second semester it was like, okay, you kind of get how you are supposed to do it after some trial and error in the first semester. Then [semesters] three and four, it was kind of like

getting used to it. By [semester] five, it is just like it is part of you already. Like some people they get into a challenge then they get scared, but for us, okay, we have a challenge, can we do something, yeah. That kind of feeling. - IP6

It is necessary to provide appropriate support to first time engineering students with regards to their self-directed learning and their PjBL [31]. If this is done effectively, then students will not be expected to feel overwhelmed at the start but in time will be able to cope with increasingly difficult challenges in their later semesters.

A relatedness-supportive environment is one where relationships are nurturing and reciprocal, and it involves others accepting the authentic self of the individual [20]. Students may experience this kind of environment in their family or with their friends. However, at the university this would usually be experienced with their peers (classmates, project team members, ECA colleagues), lecturers and perhaps to a lesser extent the laboratory staff and administration staff.

Lecturers play a very important role but they may often be unaware of their significant influence on their students. A couple of interview participants mentioned negative experiences with lecturers who cannot teach or who did not seem committed to teaching. This can undermine students' motivation and impact on other areas of the students' life at the university. Furthermore, an opportunity is missed for setting a good and perhaps even a *transformative* example for the student. IP9 was one participant who felt that lecturers played a very important role in transforming students.

Yeah. Because I think lecturers play a very main role in transforming us students. I mean like leading us to the right path ... Because in high school I have got this bad teacher that because I am kind of ...not say rebellious stage but I was kind of like, always like to question things and question the methods that my teacher used and I got shunned down just because of that. - IP9

Students appreciated good lecturers and their role in creating a relatedness-supportive environment as IP7's excerpt indicates.

He took the time and effort. He had the patience to explain to my other friend who was lacking. He was very lacking. He was not doing good grades but he (the lecturer) took the time, effort, even patience to teach him until he knows. That to me is very, how I would say ... I will respect, I will respect the man, I respect the man ... We even invited him for two to three of our class outings ... We called him and he went. - IP7

Besides lecturers, an even greater role is played by peers with regards to relatedness.

In some cases I can see that support from your friends, people you hang out with actually contributes a lot, because also people like A in TRT (Taylor's racing team) with me, we motivate each other to do well in that sense ...it is that mutual support with your peers. - IP6

A relatedness-supportive environment is essential for motivation. It is a basic human need which is instinctively understood. Its absence would undermine motivation. Interview participant 3 (IP3)'s excerpt summarises.

Support from people around you, from family and friends, from your supervisors, lecturers, actually it is because if they do not support, then, you have a lot of trouble. They do not understand what trouble you are having or what they are not giving help. Then, this will stop you from trying. - IP3

IP3's response presupposes that the people he mentioned genuinely care about him. *Care* is what underscores relatedness as an SDT construct. Words like *nurturing*, *reciprocal* and *accepting the authentic self of the person* are used to define a relatedness-supportive environment [20]. Therefore, a genuinely caring environment is needed.

People cannot be forced to care. One can only expect to create an environment that will result in the greatest possibility of *caring* happening, while attempting to remove or at least reduce incidences of *uncaring* or perceived *uncaring* from occurring. Perhaps this effort should begin with the top management creating a culture of caring that pervades the university. Along with that relatedness must be given priority and purposefully designed into the student's experience throughout their time at the university from orientation to graduation.

This experience should include both the curricular and the extracurricular activities. Staff, academic, as well as administrative, must be made aware of their role in promoting caring and relatedness, and they need to be trained and supported in this effort, if it is not already an innate attribute. They should also be encouraged and possibly be incentivised to look for ways to create genuine relatedness or remove hindrances to it within the system and within their domains of influence. Policies and procedures should likewise be scrutinised and revised if needed.

CONCLUSIONS

A qualitative study found motivation to be a key factor in engendering transformative learning in engineering students alongside the factors of breaking out of comfort zones and crucial learning experiences which were experiential [1]. The motivation factor supports the other two factors as motivation is required for the transformative learning process begun by these two factors to reach completion.

Motivation theories were used to explain this phenomenon. Contemporary motivation theories were preferred over traditional motivation theories because they represented a more articulate and insightful interpretation of the phenomenon.

The self-determination theory (SDT) was used to undergird the discussion on how to facilitate this motivation factor. This discussion was supported by participants' interview responses. The presence of autonomy, competence and relatedness are key. Hence, the challenge lies in creating autonomy-supporting, competence-supporting and relatedness-supporting environments at the university.

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BIOGRAPHIES
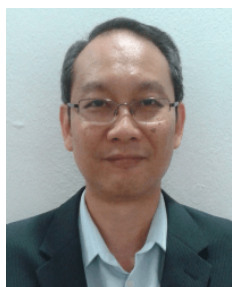
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