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Transformative learning in engineering education: the comfort zone factor

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ABSTRACT: A qualitative study was conducted on transformative learning in engineering education by the authors of this article and its results published earlier [1]. In that study, four outcomes that resulted from transformative learning and three factors that enabled these outcomes were identified. The outcomes were: 1) improved people and relational skills; 2) project management ability becoming second nature; 3) changes in ways of thinking; and 4) increased resilience. The factors that enabled these outcomes were: 1) the need to break out of comfort zones; 2) the need to have crucial learning experiences experiential in nature; and 3) staying motivated throughout the entire process [1]. The present article, by the same authors, focusses on one of these factors that is the need to break out of comfort zones. It expands on the earlier discussion and considers how to facilitate this factor to bring about transformative learning in an engineering education context. The current discussion is based on the data that emerged from the qualitative study. The comfort zone factor was not previously elaborated on.

Keywords: Transformative learning, engineering education, comfort zone, project-based learning, extracurricular activities

INTRODUCTION

A qualitative research study was conducted on transformative learning (TL) in view of its importance in equipping engineering graduates, especially in terms of their non-technical competencies, to confront the increasingly complex challenges of the 21st Century. Non-technical competencies are regarded as crucial for engineering graduates by various engineering educational institutions, among them the International Engineering Alliance [2], the CDIO Initiative [3] and the National Academy of Engineering's (NAE) Grand Challenge Scholars Program [4]. The complex challenges of the 21st Century are articulated by the United Nations Sustainable Development Goals [5] and the 14 Grand Challenges for Engineering by the NAE [6], among others.

A study by Tien et al was performed at a private university in Malaysia, i.e. Taylor's University, and had identified several outcomes resulting from TL and the factors that facilitated these TL outcomes [1]. The TL outcomes identified were: improved people and relational skills; project management ability becoming second nature; changes in ways of thinking; and increased resilience. The factors that enabled these outcomes were identified as the need to break out of comfort zones; the need to have crucial learning experiences experiential in nature; and staying motivated throughout the entire process.

In this present article, the same authors elaborate on the breaking out of comfort zone factor and discuss how to facilitate this factor to bring about transformative learning within an engineering education context. This latter aspect was not previously elaborated on. The educational theory that relates to breaking out of comfort zones is the transformative learning theory. A brief introduction to it follows.

The transformative learning theory (TLT) was introduced by Mezirow [7]. This theory arose from a study that Mezirow performed on women participating in college re-entry programmes. Mezirow's TLT was initially known as *perspective transformation*. Transformative learning according to him *…refers to the process by which we transform our taken for-granted frames of reference (meaning perspectives, habits of mind, mind-sets) to make them more inclusive, discriminating, open, emotionally capable of change, and reflective so that they may generate beliefs and opinions that will prove more true or justified to guide action* [8].

Other researchers have likewise given their definitions of TL. One of them is Hoggan who defined TL as referring to *…processes that result in significant and irreversible changes in the way a person experiences, conceptualizes, and interacts with the world* [9].

TL may, therefore, be considered as a process of learning in which the change undergone is significant and stable, where both the affective and cognitive learning domains are affected, and where the internal transformations experienced are reflected outwardly in corresponding actions.

Mezirow's perspective transformation commences with what he describes as a disorienting dilemma. This will eventually lead to a change either in a person's meaning scheme or meaning perspective. A disorienting dilemma is defined as an experience where a person's current frame of reference is unable to accommodate. When someone experiences a disorienting dilemma, a ten-stage process is supposed to follow that results in a transformed frame of reference [10]. These ten stages are as stated below [10]:

1. A disorienting dilemma.
2. A self-examination with feelings of fear, anger, guilt or shame.
3. A critical assessment of assumptions.
4. Recognition that one's discontent and the process of transformation are shared.
5. Exploration of new roles, relationships and actions.
6. Planning a course of action.
7. Acquisition of knowledge and skills for implementing one's plans.
8. Provisional trying of new roles.
9. Building of competence and self-confidence in new roles and relationships.
10. A reintegration into one's life on the basis of conditions dictated by one's new perspective.

Transformation usually follows some variations of these stages although not all ten stages may be necessary [8]. An individual's actions will change to be consistent with the transformation that has taken place in his or her frame of reference upon the completion of a TL experience. TL will be considered complete when this has occurred.

TL is very a broad field of study and has over the years extended beyond Mezirow. However, it has rarely been applied in engineering education. A brief review regarding its potential for application in engineering education has been provided by Tien et al [11].

METHODOLOGY

A qualitative methodology was adopted, which was consistent with the interpretivist/constructivist paradigm, where participants interpret and give meaning to their own experiences [12]. With this methodology the findings can be expected to emerge from the interview data rather than through testing predetermined hypotheses. This will prevent any unanticipated factors from being excluded.

According to Carter and Little good quality qualitative research must consider all these three elements, i.e. epistemology, methodology and method, and be able to demonstrate internal consistency among them [13]. Epistemology describes …*our assumption of knowledge and what counts as evidence* [14], methodology is the …*philosophical justification for the research design and accompanying methods, while methods are the particular procedures used to collect and analyse data* [14].

The interpretivist/constructivist epistemology does not accept universal laws or the idea of a value-neutral observation. Instead, it focusses on understanding the lived experiences of people from their points of views [15]. It assumes that humans are formed by their lived experiences and that these will always surface in the knowledge that researchers generate, as well as in the data generated by the participants [16].

With regards to qualitative methodologies, the most suitable methodology for this study was what Merriam defined as a basic qualitative study [12]. This methodology is the most common form of qualitative research methodology. It is widely used in the applied fields of practice, such as education, administration, health, social work, counselling, business, etc, and is possibly the most common form of qualitative research methodology used in education research [12].

The basic qualitative study methodology is used to understand the meaning of a phenomenon. With regards to the interpretivist/constructivist epistemology, meaning is not discovered as though it was inherent in an object, but it is constructed by human beings as they engage with the world that they are interpreting. In this study, the phenomenon to be understood is that of transformative learning in engineering education. Therefore, using the basic qualitative study methodology was expected to help interpret and construct meaning from this phenomenon.

Qualitative research uses text data rather than numerical data. It analyses those data in their textual form instead of converting them into numbers for analysis. Its aim is to understand the meaning of human action and asking open questions about the studied phenomena as they occur in their context [13]. Qualitative research methods are suitable for gaining more insight and deeper understanding into a phenomenon through the lived experiences of its participants, even if such an understanding may be bound by its context. Hence, there is an emerging awareness among the engineering education research community regarding the need to undertake qualitative research, and along with that the need to design their studies with careful attention to the appropriate epistemology [17].

Methods

Purposeful sampling was considered as the most suitable sampling method. Purposeful sampling involves recruiting participants based on pre-selected criteria relevant to the research question [12]. The intention was to purposefully identify participants considered to have a high possibility of having undergone the type of transformative learning desired. A brief description of the participants was given by Tien et al [1]. The participants were selected from Taylor's University's School of Engineering and consisted of BEng (Hon) students from its chemical, electrical and electronic and mechanical programmes. The majority of the participants had completed their programmes at the point of interview.

The sample size was not determined in advance as the intent of sampling in qualitative research is to continue sampling one sample after another until data saturation is reached. When the subsequent sampled units, i.e. the new interview participants, do not reveal any new information but instead continue to confirm information already obtained from the previous participants, then the sampling may be discontinued. It is at this point that data saturation is considered as reached [18]. In qualitative research, it is data saturation that determines the sample size rather than statistical considerations.

The semi-structured interview format was used. In this type of interview there is a structured section, where specific information is sought. However, the main part of the interview is guided by a list of questions to be explored. These exploratory questions are flexibly worded, with the exact wording and order of questions not rigidly fixed as to respond to the situation at hand, and to follow any new ideas related to the study as they emerge from participants' responses in real time [19]. Informed consent was obtained from each participant prior to the interview. The participants were given adequate time to understand the purpose of the interview, their rights as a participant and the opportunity to withdraw, regardless of their signed consent. However, none withdrew.

The data analysis began by identifying the segments in the first interview transcript that were responsive to the research questions. These meaningful segments were the units of textual data that could potentially answer or at least partially answer a research question(s). These units of data satisfied two criteria. It revealed information relevant to the study and represented the smallest piece of information that could stand by itself. In qualitative analysis this process is called open coding. These open codes were later grouped into similar categories. This grouping of codes into similar categories is called axial or analytical coding [12].

Through this process of analysis, categories or themes that relate to the research questions gradually emerged and became increasingly apparent. The analysis concluded when data saturation was reached that is new themes stopped emerging, and the existing themes were tested and remained valid against new data.

RESULTS AND DISCUSSION

Three themes or factors promoting TL in engineering students emerged from the data analysis. The first theme was breaking out of comfort zones. This theme is the focus of this discussion. A comfort zone is defined by the Cambridge Dictionary as *…a situation in which you feel comfortable and in which your ability and determination are not being tested* [20]. Everyone has comfort zones which they need to break out of in order to change and to grow.

The comfort zone theme, which emerged from the analysis of the participants' interview data may be defined as follows:

The willingness to venture into and remain in a situation where one feels uncomfortable, and in which one's ability and determination are being tested until one eventually gains mastery over the situation and one's discomfort.

In Mezirow's TLT, the first stage in TL is that of experiencing a disorienting dilemma. This stage very much resembles the experience of leaving a comfort zone. However, Mezirow's TLT is more focused on explaining disorienting dilemmas from a rational cognitive perspective. While in the context of this study, the discomfort of leaving one's comfort zone tended to be largely experienced in the emotional realm.

The subthemes identified from the data that congregated under the breaking out of comfort zones theme included the following: comfort zones related to making cold calls, leading, dealing with difficult people, public speaking, challenging environments, critical situations, difficult tasks and project-related challenges. A sample of participants' interview responses is provided below.

Interview participant 1 (IP1) was a participant who had joined the AIESEC (an international youth organisation with a chapter at Taylor's University). He had to make cold calls to source for partnerships for exchange programmes, and this involved seeking non-governmental organisations and companies in Malaysia to accept international participants. The experience of cold calling was both new and very uncomfortable for him initially.

Like I said I was a very shy person, having my first cold call and I was very scared. I still remember I kept mumbling my way out, trying to think what shall I say, what I had to talk to the guy on the phone I was speaking to. So I still remember, I was so scared, so nervous until that fella was so fed up of me, he started scolding me on the phone so I was like oh my God, this is cold calling, this is so scary, I honestly wanted to give up. - IP1

While he did not consciously reflect on the process, he managed to overcome his shyness, secured some personal appointments and even benefitted from meeting the *strangers* he had cold called. It was noticeable that he was changed by the experience.

In fact, I managed to secure a few personal appointments with them, like a few amazing people honestly, from different fields and so on, and seal the deal myself. - IP1

While not all Mezirow's ten stages were present [10], it can be assumed that the possibility of stages 1, 2, 5, 6, 7, 8, 9, 10 being present is high. These stages are: *a disorienting dilemma*; *a self- examination with feelings of guilt or shame; exploration of new roles, relationships and actions; planning a course of action; acquisition of knowledge and skills for implementing one's plans; provisional trying of new roles; building of competence and self-confidence in new roles and relationships;* and *a reintegration into one's life on the basis of conditions dictated by one's new perspective*.

Interview participant 2 (IP2) shared about being taken out of her comfort zone because of being unable to control the circumstances which required her to work with difficult members in her project group. While IP1 joined the AIESEC on his own initiative, IP2 had the situation forced upon her as group project work was a curricular requirement and she was assigned her group members without being given a choice.

The special thing about group project [work] is you cannot do it on your own. So, when you cannot control everything on your own, it is time for you to actually step out of your comfort zone to adjust everything and make it to the best like how you can make it because you need to work with people, and then, there is a lot of things that happens in group projects. …I mean, during that time I will think, Wah! This is like one of the worst experiences I have ever had. *Because I am the leader of the group, so, I need to like talk to them, I have to take care of how they feel. Sometimes, one gets angry very easily, the other one suddenly just gets depressed … There's one from a foreign country, so, communication is quite hard for us, it may be cultural difference … that group of mine may not be the best group, but it is one of the best experiences I have ever had.* - IP2

This appreciation expressed by IP2 only came from hindsight. Time is often required to process the experience and to eventually notice the changes that had occurred. This change only became evident to IP2 a few semesters later when other students complimented her about being a *nice person who does not argue*.

But what you hear from people I think you are a very nice person, you never actually like argue with people *and stuff like that, but then, when I think back of myself, it is like I think maybe because of the tolerance I have developed during [project-based learning in] Foundation*. - IP2

Even in more technical matters, like learning to code, a student's comfort zone can be challenge. If they willingly accept the challenge instead of leaving it to another team member, a transformative outcome, in the case of interview participant 5 (IP5) - a mechanical engineering student, a different way of thinking can result. While technical learning is not the main objective of this study, it is still an interesting observation in that comfort zone continues to be an important factor regardless of the type of transformative learning sought because it mirrors the concept of Mezirow's disorienting dilemma.

I think all the way starts in semester 1, where … if you do a project, I think that time [I] was doing this robot cars and it involves coding and using Arduino. Now, at that time I had zero knowledge of using Arduino or any knowledge on coding. So, that was quite intimidating. So, trying to go through that learning curve was out of my comfort zone. …So, I feel like immersing myself in a project like that helps to make me remember those things. Not just remember but make me like naturally know what to do in that similar code. I have to start this way and have the flow of a certain… that is for, that is for like coding, you know. I know coding is really out of my comfort zone. - IP5

Interview participant 6 (IP6) joined BEng (Hon) mechanical engineering directly from A-levels, and therefore did not have the opportunity of experiencing project-based learning (PjBL), unlike some who did Foundation in Engineering (FIE) at Taylor's University. Her first PjBL experience in semester 1 took her completely outside of her comfort zone. There is significant emotional discomfort observed in the words she used in recounting her experience, such as *scary* and *angry*. However, it eventually became a transformative learning experience for her.

And then, we realised he is [the lecturer] not going to give us the answer, it was scary, I remember because we felt like we could not accomplish the task … First semester [I] was really like, very angry. I do not know how to do this because you know you are so spoon fed, like in the first 13 years of your studies. When you get to the first semester doing the university degree, all the teachers are not helping us ... That was the experience, very much. - IP6

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. …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. … 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] 3 and 4, it was kind of like getting used to it. By [semester] 5, 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

From IP1, IP2, IP5 and IP6's responses, it can be observed that their comfort zones were affected more intensely at the emotional level compared to the cognitive level. This is in fact a common response across all participants. The capacity to cope with one's emotions is essential, especially in the early stages of the experience. It will take time for them to change and to appreciate the benefit of their experiences because their comfort zones have been challenged. In addition, motivation needs to be present to complete the process. Motivation was the third factor identified [1].

Leading was not something that IP3 enjoyed doing, but he got thrust into leadership roles quite often and was able to demonstrate leadership capabilities whenever he was given the opportunity.

Previously, I only helped out in EMF [a social project under the School of Engineering]. I was not the organising team. So, this is like I organise it, I chair it myself. It was like quite eye-opening. Oh, I have to do this, I have to do this, I have to do this. So, you have to think thoroughly what you have to do and make sure it is done. …Yes, because I am not really into leading but I used to have a lot of leadership positions before but it's not what I like to do. But I still to push myself through the comfort zone to lead. - IP3

While IP3's response appeared contradictory, this can be reconciled by acknowledging that he did not actively seek the leadership roles. Instead, these were either assigned to him or because there was no one to do it, he decided to step in. While transformative learning would have taken place due to overcoming his comfort zone challenges, nonetheless such an experience would have been more effective if he could see a link between the experience and his life mission. Kroth and Boverie recommended incorporating an understanding of life mission into adult learning suggesting that this helps self-directed learning and transformative learning. It may be assumed that such an alignment will provide additional motivation [21].

Near the end of his interview, interview participant 9 (IP9) was asked to summarise what helped transform him. He reiterated the importance of coming out of comfort zones.

Yeah. So, the first one will be the out of the comfort zone. Second thing will be … to apply what you learn and then if it fails, it is okay. So, basically you have to go through the process. I think that process - it is not the result that transforms you, I think it is the process that transforms you. - IP9

In his response it was interesting that he had also alluded to the second factor, which was that of crucial learning experiences which were experiential in nature [1].

In conclusion, it can be acknowledged that breaking out of comfort zones often serves as the precursor for transformation. This appeared to be consistent with Mezirow's TLT which postulated that transformation usually begins with a disorienting dilemma [10]. For Mezirow, critical reflection is a key element in resolving the disorienting dilemma leading to transformation in a person's meaning perspectives, habits of mind, meaning schemes and points of view [8]. Nonetheless, Mezirow admitted that transformative learning may occur outside of awareness with intuition substituting for critical reflection [10].

It is worth noting that in none of the interview responses was there any mention of conscious critical reflection. This is unsurprising considering that Mezirow's elaboration is very cognitively oriented, while the participants' experiences tended to affect them at a deeper level emotionally. Nonetheless, it can be inferred that some reflection would have taken place as the experience had to be processed over time. What is clear is that breaking out of comfort zones is a factor that can lead to transformation, and the parallel to it can be found in Mezirow's TLT.

To Facilitate Breaking Out of Comfort Zones

From the coding of interview data, the sub-codes that congregated under the factor of breaking out of comfort zone were breaking out of comfort zones related to making cold calls, leading, dealing with difficult people, public speaking, challenging environments, critical situations, difficult tasks and project related challenges. From analysing the interview transcripts related to these sub-codes, the experiences related to breaking out of comfort zones were frequently encountered by the participants during PjBL and some during extracurricular activities (ECAs).

PjBL can play a very important role in taking students out of their comfort zones, more so than ECA. As PjBL is a curricular requirement, students have no choice, but to undergo the experience, unlike ECA which is optional. Hence, all students would likely have encountered experiences that took them out of their comfort zones at one time or another through PjBL. This point was underscored by IP9.

Yeah. I think it is the project-based learning. It is because you are forced to do it, so you cannot run from it. So, I think that [it] is the best platform to take you out of your comfort zone rather than you can go to other extracurricular as well but then, you will not be forced to do it. - IP9

It is recommended to include PjBL in every semester of study as this would allow time and ongoing opportunities for the students to develop the desired skills and capacities. Even if they failed the first time around, they still have ample opportunities to make up for it and to learn from their failure. Adequate time should be allowed to overcome comfort zones, develop confidence and ultimately to transform in various areas of TL outcomes. PjBL in every semester would afford sufficient time and opportunity to achieve this objective.

PjBL in the context of this study refers to group projects rather than individual projects, and to standalone modules rather than an assignment part of a module. Because they are full-semester group projects that represent an entire module, it becomes necessary for teamwork, leadership, communication and for some conflict resolution skills to be acquired to carry out these projects successfully. For many students this takes them outside their comfort zones, a point that is conceded by IP5 and many other participants.

I think the other one would be project based, I think just doing projects, I think in general, because I am not really a very project type of person, to begin with. So, learning to really rely on team work or really try to, you know, bring up the group spirit when you do team work, that was something out of my comfort zone, like learning how to cope with the people, delegating tasks, managing project schedules amongst people, so that was something different for me. - IP5

Likewise, there was a similar acknowledgement from IP2 and she contrasted the impact of the group project from the final-year project, which is an individual project. However, if final-year projects were group projects [22], it is likely that the same results could be expected.

As chemical engineering students, we have to take group projects and final-year projects together during semester 7 and 8. So, initially, I thought [a] group project is a bit too difficult and it is not supposed to be in our syllabus because it is very hard for us to tackle 2 big projects at the same time. … The special thing about [a] group project is you cannot do it on your own. So, when you cannot control everything on your own, it is time for you to actually step out of your comfort zone to adjust everything and make it to the best like how you can make it because you need to work with people, and then, there is a lot of things that happen in group projects, yeah, so, it is very different from final-year projects. - IP2

PjBL affords many benefits for engineering students. A study by Chua highlighted that experienced PjBL engineering students have less conflicts in their group [23]. Rouvrais et al emphasised that certain competencies and attitudes are difficult to develop in traditional engineering teaching and recommended the use of PjBL [24]. Uziak argued that PjBL allowed engineering students to be in an environment that is cantered on learning rather than teaching, students have the opportunity to learn to resolve team conflicts, to work with others who are not necessarily their friends and to develop lifelong learning skills [25].

Other benefits included public speaking if the assessment required an oral presentation before an audience, and good presentation skills and persuasiveness if the prototype is presented to external or internal judges as part of a competition. An innovation fair at the end of each semester for students to showcase their prototype would serve this purpose.

It is essential for PjBL modules to be well facilitated. It cannot be left to chance that the learning and the transformative objectives will simply be achieved on their own. To ensure the highest probability of success, the module coordinator or supervisor should be someone capable of guiding the students through their various challenges, but without over-managing them. Students need to learn on their own and work through various challenges by themselves, but there are times when the supervisor would need to step in.

For example, if there was a team conflict that the students cannot resolve by themselves and they brought this matter to the attention of their supervisor. Students usually do not share team conflict situations with their supervisor unless it is serious, they cannot resolve it on their own and it is causing them anxiety that their grades will be affected because of it. Apart from helping to resolve it, the supervisor must be aware of how to convert this into a learning opportunity. At other times, the supervisor may need to give guidance in a way that does not take the initiative away from the students. An experienced lecturer with an aptitude for PjBL is ideal, otherwise a less experienced lecturer can be trained through courses in PjBL supervision or through being mentored by an experienced lecturer.

Extracurricular activities represent another avenue for taking students out of their comfort zones. There is no fixed definition of ECA, although according to Wilson et al, at the precollege level, ECAs are usually regarded as those activities that take place outside of school hours, while co-curricular activities often refer to those activities during school hours [26]. For this article, ECA will refer to all the activities undertaken by the students which are not part of their curriculum, but which still fall within the auspices of the university.

Some interview participants reported being taken out of their comfort zones when participating in various ECAs and had experienced subsequent transformation. However, because ECA is voluntary, it may not be as effective in compelling a student of his/her comfort zone compared to the compulsory PjBL modules. The student can choose to opt out at any time or not join in the first place. ECA appears to be more useful for delivering crucial learning experiences through experiential learning (the second factor) than for the breaking out of comfort zones.

In a study conducted by Ooi and Khor with engineering alumni, employers and students it was found that valuable skills and attributes were developed through ECA participation, such as teamwork, planning and organising, and being proactive in looking for opportunities [27]. They suggested to explore a structured scheme that will foster student engagement in ECA that can gradually encourage students' willingness to leave their comfortable and familiar situations in order to take on demanding roles in various clubs and societies, with the ECA offering skills and knowledge not available in the classroom.

For ECA to be utilised in the breaking out of comfort zones, it must be something that aligns with the life mission or intrinsic motivation of the student. This would make the student persist in the face of comfort zone challenges until his/her objective is achieved and in the process of this transformation can be expected. Offering a variety of ECAs may help because different students have different intrinsic motivations and life missions. One example may be seen in IP1's excerpt concerning his joining the AIESEC to improve himself, and then having to make cold calls despite being a very shy person at the beginning. However, he managed to overcome eventually and was transformed by the experience (which he had mentioned in an earlier excerpt).

So, being me myself I thought I wanted to like improve myself I suppose and I thought if I am going to stick to myself academically, I would not improve myself. So, what I thought you know, just go and join clubs and society and so on. So, there was one, few clubs but this was one of the most, more, I would say more important, the more vital, give me the bigger lift in my you know, in terms of my character and personality. …So, AIESEC was a leadership organisation, it is actually an international NGO. So, during this period I was required to do a lot of things that I have never done before, for example, before I am this person, I was a very, very shy person. I could not speak to people, I could not present, I could not. … I mean I even could not cold call different company, so being in AIESEC my first, I still remember my first task was to cold call someone. - IP1

Another example is interview participant 4 (IP4) who assumed the role of the President of the Student Council, which can be considered as the highest-level leadership position in an ECA for a student at the university.

When I first took up the President of the Student Council, I did not think that it was going to be a lot until I started realising, oh it is affecting a lot in my own studies, in the sense that I am not having enough time to sleep, during classes I had … we have to deal with issues that [are] happening on the university. So, I did not think that it would be that taxing, I thought I could manage it but throughout halfway I thought I really could not, but in the end I still push through, yeah, still manage. … I would say, being part of Student Council, what it has taught me the most is that, how to manage more people, because at the end of the day, if let us say, you are in a leadership position, you are still managing people and you are not actually managing problems, per se, *because you are actually one man cannot solve one problem, but you need the whole team to tackle the problem*. - IP4

Another way to make students stay on or undertake out of comfort zone experiences in ECA may be to link the ECA to a scholarship programme or a certificate attainment. They will be motivated for the sake of obtaining the recognition. IP3 undertook a public speaking challenge in Kuwait because of the global or multicultural competency required by the Taylor's Grand Challenge Scholars Programme (TGCSP) [28]. The TGCSP is offered under the auspices of the NAE Grand Challenge Scholars Program (GCSP) [29]. Consequently, students who managed to complete all the requirements of the TGCSP, and hence the GCSP, will be recognised by the NAE as a GCSP graduate.

There is this one competition I went with my friends during semester 3 or semester 2, where we went to Kuwait for [a] pitching competition. I do not like to do public speaking. I used to do it because I was a prefect [in school] so I had to go speak in front of the stage, but I still have stage fright. …we practiced pitching many times before the competition. … So, while we were pitching, it is like just do what you did when you were practicing, and it went quite well though we did not win any prizes. But, I was quite proud that I did it. So, yeah, pushing yourself out of your comfort zone also is something we learned from. - IP3

From the analysis of participants' interview data, PjBL is the most effective means of taking a student out of his/her comfort zone because it is a compulsory curricular requirement. Ideally, it should be offered every semester to afford time and opportunity for the necessary skills and attributes to develop, to learn from failure and to grow in confidence and self-efficacy. The PjBL modules should be well facilitated to exploit their full learning potential. ECAs are another means of challenging a student's comfort zone. However, these are not compulsory, and consequently effective ways of engaging students in ECA must be found. There is also less control over the type of experience in an ECA, whether they are of the *out of comfort zone* experiences or otherwise.

CONCLUSIONS

A qualitative research study was undertaken to identify transformative learning (TL) outcomes and the factors that helped produce them [1]. One of these factors identified from that study was the need to break out of comfort zones. This factor corresponded closely to that of the disorienting dilemma precursor in Mezirow's TLT [10], although it was experienced at a much more emotional level than in Mezirow's TLT elaboration.

This present article addresses this specific factor in greater detail, and the authors discuss how to facilitate it in a way that leads to TL in an engineering education experience. Project-based learning was identified from the interview

participants' responses as the most effectual means to facilitate such out of comfort zone experiences leading to noteworthy TL outcomes. Hence, PjBL modules should be offered in every semester, if possible, to allow for the necessary skills and attributes to develop and that these group projects should be well facilitated and supervised. With regards to practical recommendations, one way of offering PjBL in every semester is by utilising integrated projects [30], while students' learning and motivation in PjBL can be further enhanced through the judicious use of makerspaces [31].

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