The presence of empathy in entrepreneurial subject outlines for IT and software engineering students

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CONTEXT

Technology startups are playing an increasingly important role in developed and developing economies. As well as technical expertise, the founders (and other employees) should possess social competencies such as communication, collaboration and empathy. A growing body of literature has identified empathetic behaviours as progressively important for the success of a technology startup. At universities, more entrepreneurial subjects are being introduced increasingly to IT and software engineering students. However, empathy as a phenomenon and its development may not be a common inclusion in engineering and information technology (IT) curricula.

PURPOSE OR GOAL

This paper reports on an investigation of the literature for indicators of an empathetic behaviour or mindset, i.e. how can we know it when we see it? These indicators are then used to examine subject outlines available to engineering and IT students at an Australian university to assess what exposure these students have to the development of empathetic behaviours and mindset.

APPROACH OR METHODOLOGY/METHODS

A systematic literature review was undertaken to identify the key categories or indicators of empathetic behaviours/mindset. Using these indicators, a content analysis of subject outlines was undertaken to identify if and where they exist in the curriculum at UTS.

ACTUAL OR ANTICIPATED OUTCOMES

The key outcomes of this study include that the term empathy itself was almost never encountered, but more than a third of subject outlines have various empathy indicators mentioned. The indicators are mostly related to concepts of empathetic design and problem seeking or ethical behaviour and communication. These concepts relate to the increasing popularity of the design thinking concept or other related frameworks such as human-centred or user-centred design methodologies.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

This paper offers a framework for evaluating the presence of empathy indicators in entrepreneurial subjects within the engineering curriculum. The main objective is to determine the overall picture of the development of empathy in future technology entrepreneurs. In order to make recommendations for improving the curriculum, it is important to investigate the life experiences of students and academics and to study the effects of specific practices on the development of empathy.

KEYWORDS

Empathy, technology entrepreneurship, engineering curriculum.

Introduction

Over the past twenty years, technology startups have begun to play an increasingly important role in both developed and developing economies. According to a report by StartupAus, 7 of the 10 biggest companies globally (based on total market cap) are technology organisations. Software-based and internet companies form a significant portion of these (McCauley & Gruszka, 2020). In recent years, a particular trend has been identified whereby in order to create a tech startup, the founders should possess technical expertise – hence why most software startup founders have a technical background such as a software engineering or an IT qualification. Technology startups develop in a dynamic and uncertain environment, encountering various challenges associated with product design, market trends, team formation, fundraising, and so on (Giardino et al., 2015). However, to address existing challenges, technology startup founders should also possess social competencies, such as empathy, communication, and collaboration skills.

Taking into consideration this trend, growing attention has been placed on the development of students' capabilities and skills for technology entrepreneurship in engineering settings (Kleine et al., 2019). Universities and other educational institutions have responded by establishing specific subjects and programs focused on developing entrepreneurial skills, many of which are integrated into the engineering curriculum. Some institutions have responded by increasing their focus on the development of "T-shaped" engineers" – that is, those with well-developed social competencies. For example, the Engineering futures 2035 Scoping Study by the Australian Council of Engineering Deans (ACED) highlights that apart from technical and entrepreneurial skills, future engineers must also have the following competencies - people skills and emotional intelligence (EQ), ethical behaviour and mindset, and collaborative, multidisciplinary and integrative capabilities (Crosthwaite, 2019). Korte et al. (2018) support this inference, declaring that the ability to emphasise with other people can be considered as one of the key competencies. However, despite the benefits to which empathic behaviours and mindsets can lead, as well as the growing interest in the interrelationship between empathy and engineering and entrepreneurship from the academic community, explicit consideration of this phenomenon is far less common (Strobel et al., 2013).

In this paper, we report on what concepts or behaviours can be used as indicators of the development of an empathetic mindset and use these to examine the curricula available to engineering and IT students at UTS to address the questions of how do we know it when we see it and have we got any.

Empathy in software engineering and IT

The formed trend for innovation in all technological fields such as engineering, information technology, design, or entrepreneurship has influenced the development of interdisciplinary approaches such as design thinking, which can help to drive innovations (Dym, 2012). One of the main principles of design thinking is empathising with potential customers or users, who should be the main beneficiaries of innovation implementation (Zoltowski et al., 2012). The principles of empathetic design underlie such approaches as user-centred design or human-centred design. These methods are focused on investigating people's emotions, motivations, and needs through immersion in their lives and understanding the situation from different perspectives (Zoltowski et al., 2012; Battarbee et al., 2014).

After realising that empathy can lead to the creation of innovative human-centred products, researchers have identified other benefits to which empathy can lead, such as improving the quality of communications with teammates and mitigating conflicts (Walther et al., 2012; Usprech & Lam, 2020); making ethical decisions (Hess et al., 2017; Levy & Hadar, 2018); and caring for stakeholders (Strobel et al., 2013). These advantages have been influenced by the fact that empathy has begun to be perceived as the core competency in the fields of both engineering and entrepreneurship. For example, Korte et al. (2018) emphasises the important role of empathy, highlighting it as a key competency of the entrepreneurial mindset, adding

that it is also essential to develop empathy as part of engineering education. Walther et al. (2017) support the position that empathy can be considered as a core skill in engineering. However, the current research trend is mainly aimed at investigating the influence of empathy on certain parameters, while avoiding the formation of a holistic understanding of empathy characteristics that empathetic or technology entrepreneurs must possess. The holistic understanding of the empathy characteristics or indicators of behaviour that are inherent in technology entrepreneurs should help to create developing programs and theoretical frameworks that could assist with the assessment of how empathy is positioned in these programs and materials. Hess (2015) proposed to use outcome-centric categories as characteristics of an empathic engineering process, which can be used when forming an image of empathetic engineers. However, in his work, he focuses on perspective-taking characteristics, without taking into consideration some other potential outcomes that can be achieved through empathetic behaviour or mindset. Taking into account the existing research, this paper aims to investigate empathy indicators that can be attributed to software startup founders according to the literature. This analysis will help to build a holistic understanding of the image of empathic entrepreneurs, and answer the first research question that is: What are the key empathy indicators that can be attributed to software entrepreneurs according to the most cited articles?

In 2014, Cech published a paper where the author noted that technical education has a negative tendency of forming cultural disengagement in students, thus reducing their interest towards public welfare. At the same time, the media has raised a concern that engineering education puts technical problem-solving above social and individual needs (Marcus, 2013). Since then, researchers have begun to pay closer attention to the development of social competencies in technical specialists. In other research, Tang (2018) draws attention to the fact that the number of articles related to empathy presented at the annual conference of the American Society for Engineering Education (ASEE) almost tripled from 2013 to 2018. However, at the same time, a very important question remains open: "Have the outcomes of this research been applied in order to change the existing educational approaches in engineering education?"; or, more simply, "Has the situation with the development of social competencies of technical specialists changed since the publication of the Cech study?". Marquis et al. (2017) declared that course and subject outlines could be considered as a snapshot of the current situation representing the trends in educational practices. In this paper, we are focused on the entrepreneurial subject outlines available to engineering students.

This will inform the examination of the second research question: To what extent empathy indicators manifested in entrepreneurial subject outlines available to software engineers?

Methodology

The current study has been conducted in three stages. These included a systematic literature review, a directed content analysis of entrepreneurial subject outlines, and a statistical analysis with SPSS software.

Stage 1

At stage one of this study, a systematic literature review was conducted with the implementation of a snowballing technique as a search strategy. The main purpose of this stage was reviewing the most cited articles on the topic of empathy in entrepreneurial and engineering education and collecting empathy indicators from the literature. A snowballing approach was incorporated for the systematic literature review at this stage, which helped to identify relevant papers on a topic by reviewing citations and reference lists of a starting set of articles. Citations were identified using Google Scholar and Scopus databases. Following the snowballing procedure, 63 materials were analysed. As a result of the systematic literature review, a list of empathy indicators was collected and divided into five categories: empathy for team managing, empathy for opportunity recognition, empathy for communication, empathy for design, and empathy for ethical decision. These indicators and categories constituted a

categorisation tool (Table 1) that addressed the first research question and helped to conduct the further directed content analysis of subject outlines.

Table 1: Empathy indicators

Empathy category	Empathy indicators
Empathy for team managing (Köppen, & Meinel, 2015; Hess et al., 2016)	• Understand teammates' feelings and viewpoints; • Delegate teammates work that they can handle; • Trust teammates.
Empathy for opportunity recognition (Hess et al., 2015)	• Take the user's perspectives; • Take the stakeholders' perspectives; • Interpret and predict customers actions; • Identify latent/unmet user needs.
Empathy for communication (Walther et al., 2012; Hess et al., 2017)	• Understand cultural differences; • Connect emotionally; • Understand what others are feeling; • Understand what emotions others may experience; • Influence others' emotions.
Empathy for design (Kouprie & Sleeswijk Visser, 2009; Battarbee et al., 2014; Fila & Hess, 2015)	• Become immersed in the lives, environments, attitudes, experiences of the future users to design the product; • Internalize the requirements of users; • To engage personally; • Practice the design thinking; • Practice the human-centred approach.
Empathy for ethical decision-making (Hess & Strobel, 2017; Levy & Hadar, 2018)	• Address users' privacy concerns; • To balance conflicting stakeholder claims; • To consider important privacy concerns when designing products.

Stage 2

After conducting the systematic literature review and developing the tool with empathy categories and indicators, the directed content analysis was applied to trace empathy indicators in the entrepreneurial subject outlines available at UTS. The chosen subject outlines are retrieved from the official and publicly available university database (www.handbook.uts.edu.au). A directed approach to content analysis was chosen because it allowed the use of predefined categories for the identification of a certain phenomenon in texts (Assarroudi et al., 2018). Prior to the study, the categorisation tool was tested by another coder, who also repeatedly analysed 15 subject outlines with the purpose of verifying the analytical tool and seeing differences in the interpretation of units of analysis and codes. As a result, some codes were modified based on the pre-testing in order to ensure the reproduction of the same results and increased trustworthiness of the study. During stage 2, in total, 76 subject outlines from three faculties (the Faculty of Transdisciplinary Innovation (FTDI), the UTS Business School (BS), and the Faculty of Engineering and Information Technology (FEIT)) were analysed. The particular subjects were chosen for analysis because software engineering and IT students can select them as electives as a part of their studies. This research demonstrates the initial step in understanding how empathy is manifested in educational materials. The authors approached the research by assessing all entrepreneurship-related subjects available to technical students across all UTS faculties. Each subject outline has been individually examined with the aim of identifying all empathy indicators. It is worth noting that several of the indicators are similar in meaning, and therefore the context in which they present was taken into consideration. For example, the phrase "engage empathetically with different stakeholders to understand their needs", falls into the 'opportunity recognition' category because of its context. The same process was

performed when students were asked to analyse "cultural contexts". In this case, the indicators were classified as 'empathy for communication'.

Stage 3

Stage 3 involved the statistical analysis of the collected data with the purpose of reflecting trends in the presence of empathy in UTS entrepreneurial subject outlines. The analysis was conducted via SPSS, a statistical analytical tool. The statistical analysis represented the distribution of references to each category of empathy in entrepreneurial subject outlines. The presence or an absence of empathy categories in entrepreneurial subject outlines was considered as a variable and coded with "yes" or "no" codes. As a result, a percentage of variables within the set was described. The descriptive statistics are presented below.

Results

Table 2 shows the distribution of empathy categories within the set of analysed subject outlines. Above half of the subject outlines have some empathy traces (53% of outlines have some coding). However, the number of references to each category is not distributed in an equal manner. The most represented category, "empathy for design", was indicated in 36% of subject outlines, while the categories such as "empathy for communication", "empathy for opportunity recognition", and "empathy for ethical decision-making" were addressed in 18%, 17%, and 16% of subject outlines respectively. The least presented category is "empathy for team managing", which was traced in 11% of the analysed subject outlines. These findings provide some evidence for a better understanding of how empathy indicators are manifested in the entrepreneurial subject outlines available to software engineers in UTS, as well as which empathy categories and outcomes they address.

Table 2: Descriptive statistics

	empathy for team managing	empathy for opportunity recognition	empathy for communication	empathy for design	empathy for ethical decision-making	**Total empathy presence**
FTDI	6	9	13	18	12	**29**
%	15%	23%	33%	45%	30%	**73%**
BS	0	3	1	6	0	**7**
%	0%	11%	4%	22%	0%	**26%**
FEIT	2	1	0	3	0	**4**
%	22%	11%	0%	33%	0%	**44%**
Total	**8**	**13**	**14**	**27**	**12**	**40**
%	**11%**	**17%**	**18%**	**36%**	**16%**	**53%**

Discussion

The results of the study demonstrate that more than a third of subject outlines have various empathy indicators associated with empathic design. One of the reasons for this level of empathic indicators being present in entrepreneurial subjects may be attributed to the increasing popularity of the design thinking concept, and other related types of designs such as human-centered or user-centred design methodologies. Dam & Siang (2018) declare that

this popularity in entrepreneurship and engineering is due to the fact that design thinking not only leads to a deeper understanding of the future user and customer's needs but also contributes to the development of creative and innovative thinking among entrepreneurs and engineers, which in turn is an important trend in both sectors. Also, the design thinking model includes a stage that encourages empathy with future clients and users. Therefore, this model allows the combination of human or society desirability with the economic viability and technical feasibility, which are essential benefits when creating software or internet start-ups (Gasparini, 2015). The reasoning as to why the 'team managing' category is less apparent in the subject outlines analysed is not clear. This is potentially due to the fact that the analysed subject materials do not indicate the specific requirements for the creation of different roles within teams where managerial attributes can be displayed. As a result, there is less chance for the presentation of empathic indicators. As well as this, most of the indicators in this category are affective components, which generally aren't included in subject outlines and learning objectives.

It should be noted that, based on the results of the analysis, the term empathy was almost never encountered, which in turn leads to the conclusion that empathy per se lacks in educational materials. Empathy in entrepreneurial subjects is mostly hidden behind concepts of empathetic design and problem seeking, or ethical behaviour and communication. It is also worth noting that this study had the goal of tracking empathic indicators and did not have the goal of understanding how the development of empathic behaviour or intelligence occurs in subjects. In this regard, future research may focus on investigating empathy development approaches through the analysis of assessment criteria, and comparing it with development methods such as simulations, empathetic interviews, and so on.

Another limitation that should be noted is that whilst in this study there was an attempt to take into account all the possibilities for software engineers to learn the basics of entrepreneurship, subjects were considered from not only from FTDI but also from the UTS BS and FEIT. For example, the Business School has standardised course intended learning outcomes (CILOs), and one of them is directly related to design. This is: work within the different community, organisational or cultural contexts to design and develop ideas, strategies and practices for the betterment.

Therefore, the data from this faculty influence the final picture and creates a more socially oriented image of educational materials. Additionally, because that study had a goal of understanding the presence of empathy indicators in all available entrepreneurial subjects, this analysis includes some subject outlines that have the goal of developing specific skills, such as knowledge of specific software or financial literacy, which means that these courses do not have the goal of developing social competencies. That is why different faculties have different attitudes towards cultural and social aspects that should be inherent in future graduates. A more detailed analysis of the situation at each faculty may be a recommendation for future research.

As a part of this study, the authors developed the categorisation tool with the purpose of tracing empathy indicators in entrepreneurial subject outlines that provide a holistic approach towards empathy in entrepreneurial and engineering education. Due to the fact that the tool was designed based on literature about empathy in entrepreneurial and engineering education, it can be implemented for the analysis of a variety of educational programs, guides, and materials for entrepreneurial, as well as software engineering and information technology students. Moreover, despite the entrepreneurial focus of this tool, it also can be adapted for other sectors where empathy is an essential work component, such as social work, health, or design.

Recommendations for future research

Within this work, an attempt was made to address the research problem that was highlighted by Kouprie and Sleeswijk Visser (2009) and Hess (2015). It is vital to create techniques for evaluating empathic development within the engineering curriculum. The main emphasis was

placed on the analysis of entrepreneurial subjects available to engineers and IT specialists due to the fact that many researchers have repeatedly noted the need for empathy for designing and developing products and effective interaction in project teams. In addition, this study is focussed on the entrepreneurial subject outlines as they can be considered as a snapshot to build up the strategic vision for the development of core competencies considering the market demand and the main requests of stakeholders. Even though the educational documents include the description of learning practices and potential outcomes, it is obvious that the picture which is reflected in the documents might be different from the real situation. Thus, future research should concentrate on exploring the development of empathy, focusing not only on documents but also on life experiences of both students and academics. This purpose can be achieved using ethnographical or case studies paying close attention to the representation of outlined indicators in actions (through observations) and participants' discourses (through interviews).

Additionally, this paper addresses empathy in the educational context where the main goal is aimed at the formation of effective and sustainable practices that will be able to develop empathic behaviour and intelligence in future technology entrepreneurs. This study provides a general picture of the presence of empathic indicators in educational materials. However, to highlight successful practices that can be implemented in engineering and IT curriculum, it is essential to investigate the impact of specific learning practices and activities on empathy and understand how empathy indicators manifest themselves throughout the developmental process. Besides, Hess (2015) states that it is essential to determine the impact of practices on empathy in different contexts across engineering and educational demographics., Moreover, the impact of professions across institutions on empathy is also highlighted. After the identification of successful practices, it is important to track the way these practices are correlated within assessment activities. This understanding of the impact of specific practices on the development of empathy, as well as the juxtaposition of these practices with assessment activities, will help to make specific recommendations for improving engineering and IT curriculum for future technology entrepreneurs.

References

Assarroudi, A., Heshmati Nabavi, F., Armat, M. R., Ebadi, A., & Vaismoradi, M. (2018). Directed qualitative content analysis: the description and elaboration of its underpinning methods and data analysis process. *Journal of Research in Nursing*, *23*(1), 42-55.

Battarbee, K., Suri, J. F., & Howard, S. G. (2014). *Empathy on the edge: scaling and sustaining a human-centered approach in the evolving practice of design*. IDEO.

Cech, E. A. (2014). Culture of disengagement in engineering education? *Science, Technology, & Human Values*, *39*(1), 42-72.

Crosthwaite, C. (2019). Engineering futures 2035: A scoping study. Retrieved August 26, 2020 from http://www.aced.edu.au/downloads/Engineering%20Futures%202035_Stage%201%20report %20for%20ACED_May_16_2019.pdf

Dam, R., & Siang, T. (2018). What is design thinking and why is it so popular. Interaction Design Foundation. Retrieved August 27, 2020 from https://www.interaction-design.org/literature/article/design-thinking-get-started-with-prototyping.

Dym, C. L. (2012). Engineering design @ HMC: A testament to innovation and entrepreneurship. *International Journal of Engineering Education, 28*(2), 240–248.

Fila, N. D., & Hess, J. L. (2015). Exploring the role of empathy in a service-learning design project. In R. S. Adams & J. Siddiqui (Eds.), *Analyzing Design Review Conversations* (pp. 135-154). West Lafayette, IN: Purdue University Press.

Gasparini, A. (2015). *Perspective and use of empathy in design thinking*. Paper presented at the eight-international conference on advances in computer-human interactions, Lisbon, Portugal.

Giardino, C., Bajwa, S. S., Wang, X., & Abrahamsson, P. (2015). *Key challenges in early-stage software startups*. Paper presented at International Conference on Agile Software Development, Springer, Cham.

Hess, J. L. (2015). *A multi-phase exploration of conceptualizations, perceived importance, and the development of empathy within engineering* (Doctoral dissertation, Purdue University).

Hess, J. L., Fila, N. D., Purzer, Ş., & Strobel, J. (2015). *Exploring the relationship between empathy and innovation amongst engineering students.* Paper presented at the American Society of Engineering Education Annual Conference, Seattle, WA.

Hess, J. L., Strobel, J., & Brightman, A. O. (2017). The development of empathic perspective-taking in an engineering ethics course. *Journal of Engineering Education, 106*(4), 534-563.

Hess, J. L., Strobel, J., & Pan, R. (2016). Voices from the workplace: practitioners' perspectives on the role of empathy and care within engineering. *Engineering Studies*, *8*(3), 212-242.

Kleine, K., Giones, F., & Tegtmeier, S. (2019). The learning process in technology entrepreneurship education—Insights from an engineering degree. *Journal of Small Business Management*, *57*(1), 94-110.

Korte, R., Smith, K. A., & Li, C. Q. (2018). The Role of Empathy in Entrepreneurship: A Core Competency of the Entrepreneurial Mindset. *Advances in Engineering Education*, 7(1), n1.

Köppen, E., & Meinel, C. (2015). Empathy via design thinking: creation of sense and knowledge. In *Design thinking research* (pp. 15-28). Springer, Cham.

Kouprie, M., & Sleeswijk Visser, F. (2009). A framework for empathy in design: Stepping into and out of the user's life. *Journal of Engineering Design, 20(*5), 437-448.

Levy, M., & Hadar, I. (2018). *The importance of empathy for analyzing privacy requirements*. Paper presented at IEEE 5th International Workshop on Evolving Security & Privacy Requirements Engineering, Canada.

Marquis, E., Radan, K., & Liu, A. (2017). A present absence: undergraduate course outlines and the development of creativity across disciplines. *Teaching in Higher Education*, *22*(2), 222-238.

McCauley, A., Gruszka, A. (2020). Crossroads 2020: An action plan to develop a world-leading tech startup ecosystem in Australia. In StartupAus (Ed.): StartupAus.

Strobel, J., Hess, J. L., Pan, R. C., & Wachter Morris, C. A. (2013). Empathy and care within engineering: Qualitative perspectives from engineering faculty and practicing engineers. *Engineering Studies, 5(*3), 137- 159.

Tang, X. (2018). *From 'Empathic Design' to 'Empathic Engineering': Toward a Genealogy of Empathy in Engineering Education*. Paper presented at 2019 IEEE Frontiers in Education Conference, Covington, USA.

Usprech, J., & Lam, G. (2020). *Self-awareness and empathy as tools to mitigate conflict, promote wellness, and enhance performance in a third-year engineering design course*. Paper presented at Proceedings of the Canadian Engineering Education Association, Canada.

Walther, J., Miller, S. E., & Sochacka, N. W. (2017). A model of empathy in engineering as a core skill, practice orientation, and way of being. *Journal of Engineering Education*, *106*(1), 123-148.

Walther, J., Miller, S. I., & Kellam, N. N. (2012). *Exploring the role of empathy in engineering coummunication through a trans-disciplinary dialogue*. Paper presented at the American Society for Engineering Education Annual Conference, San Antonio, TX.

Zoltowski, C. B., Oakes, W. C., & Cardella, M. E. (2012). Students' ways of experiencing human-centered design. *Journal of Engineering Education, 101*(1), 28–59.