INTERNATIONAL DESIGN CONFERENCE – DESIGN 2020
https://doi.org/10.1017/dsd.2020.64

ANALYSING THE EFFECT OF SELF-EFFICACY AND INFLUENCERS ON DESIGN TEAM PERFORMANCE

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Abstract

Social media influencers (SMI) are gaining interest and many are studying their influence on the online audience, little is known about the role played by them in offline teams. One such attempt to study the effect of influencers in co-design team is presented in this paper, where individuals who are confident in their abilities drive the team process. Thus, self-efficacy is considered for determining influencer behaviour. Results expose the relationship between self-efficacy and influencer status on the design process, besides briefly highlighting the effects on above-average teams.

Keywords: co-design, design teams, influencers, self-efficacy, design education

1. Introduction

Recently more and more emphasis is being given to the study of *influencers*. In social media, they are the individuals who have a large number of followers and thus have the capacity to influence others at scale. They are crucial in spreading information, brand awareness and marketing. Many researchers have sought to understand how influencers in social networks like Instagram and Facebook play a role in advertising, changing public opinions, and spreading of rumours (Tsugawa and Kimura, 2018). Similarly, teams engaged in co-design can be viewed as social networks that may harbour influencers. Rather than marketing and advertising, design concepts are the information that flows within this network. The individuals have different relationships and interactions with different members of a team, and it is often observed that some have more capacity to influence their teammates than others (Aries et al., 1983). In this work, these individuals who are relatively more influential than their peers are referred to as *influencers* (Pei et al., 2018). These influencers play a significant role in shaping project performance. However, many questions remain to be answered regarding design team influencers: how do these influencers emerge, what are their qualities, who is influenced by them, and how do they affect the outcome of the design task? Understanding the role of influencers in teams could help to understand the flow of information in design teams, which dictates team performance, which in turn influences project performance. The purpose of this paper is to investigate these issues.

The capacity to persuade others is not necessarily spread evenly among team members (Brown and Pehrson, 2019). There are some individuals who are regarded as more influential than others (Brown and Pehrson, 2019). Many researchers have tried to study the traits, attitudes and behaviours that lead to influence in the past. Self-efficacy, an individual's belief in their capability to achieve goals, is taken as one of the characteristics that determine this behaviour (Bandura, 1977), as individuals who

are confident in their abilities may drive the team process. The purpose of this study is to explore the role of individual differences in determining team performance in order to understand how self-efficacy and influencers in a team impact individual behaviours.

Specifically, this paper presents an exploratory study based on a one-week long observation of student teams in an Alta Scuola Politecnica (ASP) course (A.S.P., 2004). In contrast to a controlled experimental, the *in situ* observations of design teams employed here make it possible to capture real behaviour. The ASP, founded by Politecnico di Milano and Politecnico di Torino in 2004, is restricted to 150 highly qualified students from engineering, design, and architecture. ASP aims to prepare graduates with both detailed disciplinary knowledge and strong interdisciplinary skills that are needed in a multidisciplinary work environment. It is a two-year-long programme composed of (1) ASP courses which take place in the form of intensive, one week long, hands-on activities during winter, spring and summer, and (2) multi-disciplinary project work that takes place in parallel (Cascini et al., 2017). In 2019, the ASP spring course was held in Loano, a small town in the Italian region of Liguria.

The organisation of the paper is as follows. The first section addresses the literature that grounds the study and identifies the research gap and salient research questions. The next section provides an overview of the methodology implemented in conducting this research. The results section presents a detailed analysis of the data, followed by the discussion of these results. The paper concludes by providing a summary of the work, limitations, future work plans and discussing the impact of this research.

2. Background

Many studies are being conducted to investigate influencers in areas like customer network analysis, social network analysis, marketing and information diffusion. The term "influencer" is new, defined as "key individuals who have many people following them, they promote companies' product and are motivated to adopt new information or product" (More and Lingam, 2019). These social media influencers (SMI) blog, tweet, or use other social media to influence the behaviours of their audience. Due to the significant presence and use of social media and viral marketing, many researchers are progressively studying network structures where they are identifying SMI (Zhou et al., 2019; Jun-Lan, et al., 2019; Tsugawa and Kimura, 2018). Some researchers are studying the role of trust on influence in marketing (Liu et al., 2015) and on decision-making (Capuano, 2019). Others are exploring the ways to maximise SMI influence (Taninmis et al., 2019, Yerasani et al., 2019; Hosseinpour et al., 2019). Efforts have been made by some researchers to study the personality traits of these SMI (Oyibo and Vassileva, 2019, Freberg et al., 2011; Erz et al., 2018) . However, the role and effect of online influencers might be different from offline influencers (Solis, 2009), such as those studied here. The personality of an individual who has influential capability on social media might be different from an influencer present in other teams (such as athletes or designers). In comparison to the SMI, the characteristics of an influencer in a design team are less explored. It is currently unclear what characteristics could contribute to the influencing effect in design team. Thus, current notion of studying influencers in flat design teams (self-managed teams with no hierarchy), comes from the work done by Baker (2015). According to Baker, "when a flat structure does not consider a formal leader, other hierarchies emerge which introduce new power dynamics and can undermine the equality afforded in this context". This phenomenon is often seen where some individuals become more influential than others. Thus, for this work, influencers are identified as individuals who have the potential to influence other people in the team. Many factors play a role in determining the status of influencers. For example, how well the two individuals have known each other previously, could contribute to influencing power (Granovetter, 1973). Baker (2015) claimed that individuals' personality, skills and communication could result in such phenomenon. For this preliminary work, individuals' self-efficacy is taken as one of the traits that could affect their personality, skills and communication (Bandura, 1977).

It is known that self-efficacy is important for transformational leadership and improving team performance (Pillai and Williams, 2004), it is unclear how it might affect the degree of influence in teams. Although collaborative teamwork results in the development of transversal competences (skills not related to one particular job/academic discipline but could be used in many different situations), it can often be a challenging experience to individuals in the team. Thus, the aim of the study is to improve individual and team experiences by studying the individual characteristics, behaviour and

https://doi.org/10.1017/dsd.2020.64 Published online by Cambridge University Press

team performance in an educational practice whose results could be further confirmed in the future by their application to any design practice in general.
Due to the potentially high impact of design team influences, and the sparse research on that topic, the following research questions have been identified:

RQ1: What is the relationship between individuals' self-efficacy and influencer status (degree of influence and number of influencers)?
RQ2: How do individuals' self-efficacy and influencer status affect their behaviour during engineering design activities?
RQ3: How do influencer status in teams affect team performance?

3. Methodology

The study is grounded in the theory of organisational creativity, which defines the relationship between individuals, teams, social and contextual influences, environment and project (Woodman et al., 1993). Inspired by Woodman et al. (1993), Figure 1 shows the relationships between individual characteristics and individual performance which is also affected by the social influence (unfortunately, individual performance scores were not assessed for this ASP project). Individual characteristics for this study include self-efficacy, the degree of influence as perceived by the individuals, number of influencers recognised by an individual, and individual actions and behaviour. Additionally, the degree of influence and the number of influencers as perceived by an individual also determines social influence. Self-efficacy itself is shaped by the four self-concepts as recognised by Carberry et al. (2010). It is known from Woodman et al. (1993) that individuals characteristics are responsible for the team performance which, in this case was the final score assigned to the team by the ASP mentors. This is discussed in greater detail in subsequent sections.

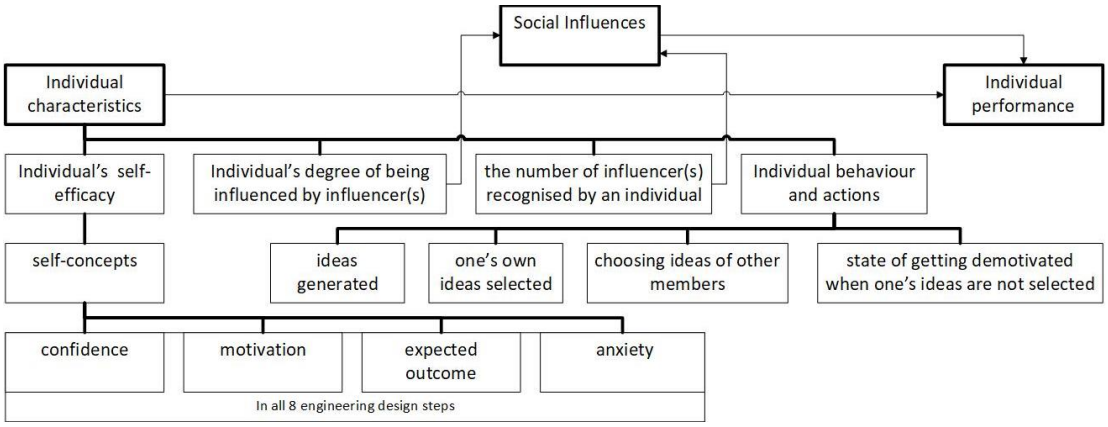

Figure 1. Composition of individual characteristics for this study

3.1. Experiment set up

The ASP spring course in which observations were conducted was focused on Design Methods and Processes. The course activity was directed to deliver hands-on experience on real life problem. Co-design teams were composed of 17-18 students, with the educational objective of improving their communication, ideation and delegation aspects of working collaboratively. The aim of the course is to introduce the ASP students to the wide range of existing design methods, from the descriptive models for analysing design processes and behaviours, to the prescriptive tools that provide a structured and multi-disciplinary approach to design. The course consists of lectures, tutorials and team-working sessions. Lectures were intended to develop a general framework of design theory, methods and approaches, their purposes and key characteristics. The tutorials focused on the organization of collaborative design activities, on the analysis of product and service requirements for a proper organization of the design tasks; on the generation of conceptual solutions with the support of inventive heuristics; and on the assessment of the proposed concepts and the choice of the preferred solution. Collaborative work on a practical design task took in place in the afternoon after the lectures and tutorials in the morning. The design task given to the students aimed at enabling the students to

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work on a product-service system project, where eight teams were involved in a multi-disciplinary design contest. The teams were graded at the end of every day for four consecutive days. The daily review that was provided to the teams was in the form of qualitative recommendations and not any sort of ranking (until the end of the week). The fifth day comprised of the final pitching of the concepts by the teams, intra-team voting for the best concept, and final grading by the mentors.
This edition of the course was attended by 141 master degree students from design, architecture and engineering disciplines. These students were selected based on their merits after passing a highly competitive selection procedure. The ratio of men to women was approximately 1:3.
The International Committee of the Red Cross provided a design task for the teams to work on. Specifically, the task was to design a solution for a hospital in a developing country prone to attacks and calamities. The students had to provide a novel Emergency room service concept with the particular objective to set up an amenity for normal situations and as well with mass casualty incidents.

3.2. Data collection and analysis

Data collection and analysis

The data collected was self-reported, meaning that the degree and the number of influencers reported are as perceived by the individuals in a team. The data is related to the individuals' state of mind when they filled the questionnaire. Since influence is a social construct which is closely tied to perception of power dynamics, self-reporting is a valid approach for collecting this information. Specifically, the data collection was in two parts (pre- and post-course) as shown in Figure 2. The basic demographic information like gender, nationality, education background were common in both the parts. Students were identified by a code composed of the team name plus the last three digits of their university ID, which helped to maintain the anonymity of the participants while still making it possible to link pre-course responses to post-course responses.

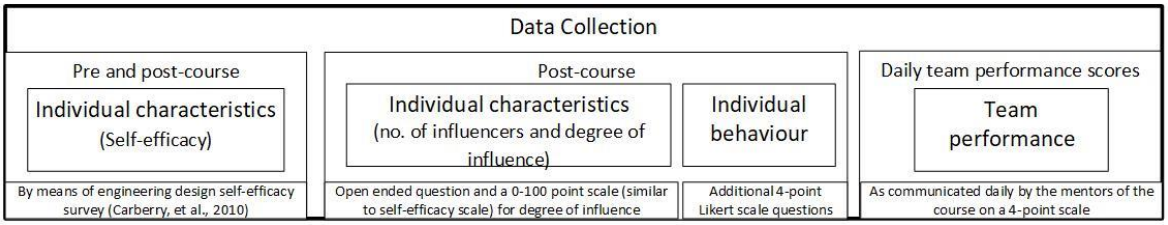

Figure 2. Data collection layout

Figure 2 has pre-course survey, where the participants completed the engineering design self-efficacy instrument by Carberry et al. (2010). As noted in the background, self-efficacy is used here as a measure that could determine the degree of influence perceived by others in a team, as individuals who are confident have greater ability to shape team activities. In this instrument, students rated their self-efficacy across eight common engineering design stages. It offers a systematic approach to collect information related to self-efficacy, and although it was developed for engineering design, it was applicable to the students of all domains who are involved in the design process.
The post-course data collection also shown in Figure 2 was done at the end of the last day of the course after the final presentations of teams' project work and it had questions to record individual characteristic and individual behaviour. The post-course survey aimed at collecting individual characteristics: individuals' self-efficacy and influencer status (degree of influence and number of influencers), to see whether influencer(s) result in any change in self-efficacy.
The post-survey also intended to explore how self-efficacy and influencer(s) affect individual behaviour during the design process. *The individual behaviour in engineering design activity associated with how often the ideas are produced. The amount of ideas generated by an individual is considered as a creative behaviour, which accounts to divergent thinking (*Woodman and Schoenfeldt, 1989*), therefore, it was taken as one the behaviours to report in the paper.*
The questions related to individual characteristics were (1) the self-efficacy instrument used in the pre-course survey, and (2) additional questions to measure the number and degree of influence that each

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individual experienced during the course. Much like the engineering design self-efficacy instrument, the degree of influence was measured in all 8 steps of engineering design. Likert type 100-point scale was used in the intervals of ten, where 0 is the minimum and 100 is the maximum value. The number of influencers was an open-ended question where the participants had to insert a number.

The questions related to individual behaviour during the design process in the post-course data collection were related to the frequency of ideas produced, selection of one's own ideas, choosing ideas from others in the team, whether or not they were demotivated if their ideas were not selected by others, and a self-assessment of team performance. A 4-point categorical scale was used for all the above questions of individual behaviour to maintain consistency with the team performance results as ASP school grading system, classifies students only at 4 levels: excellent, satisfactory, sufficient and insufficient. Team performance in this case was the measure of how well the team understood and applied the demonstrated idea generation/section technique to generate innovative solutions to the given design task. The mentors of courses communicated the team performance results daily on a 4-point grading scale. The data were pooled and analysed for the research questions 1, 2 and 3 as shown in Figure 3, using Python programming language.

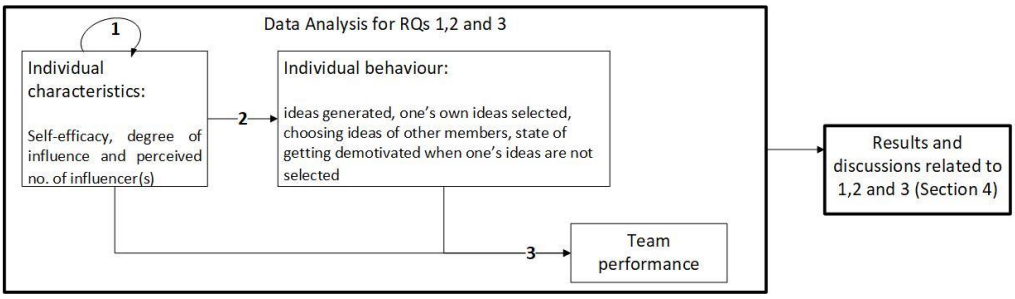

Figure 3. Data analysis layout

4. Results and discussion

Both self-efficacy values, pre and post -course were normally distributed (Figure 4) with a 2-sided chi-squared p-value for self-efficacy before was 0.092 and after was 0.31 (where $\alpha = 0.05$). The statistics value for skewness, for self-efficacy before was 4.7 and for self-efficacy after was 2.4. There was an overall increase in self-efficacy values of the students during the 5-day intensive course (where mean values before and after were 0.4 and 0.6 respectively).However, there is no significant correlation between the self-efficacy values before and after the course (Pearson correlation coefficient = 0.07 and P-value =0.43).This indicates that the self-efficacy of individuals could increase based on the environment, the received training, project characteristics and group performance, irrespective of their initial self-efficacy.

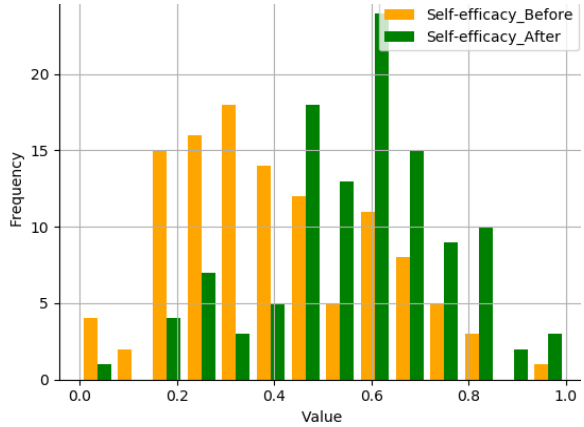

Figure 4. Self-efficacy before and after the workshop

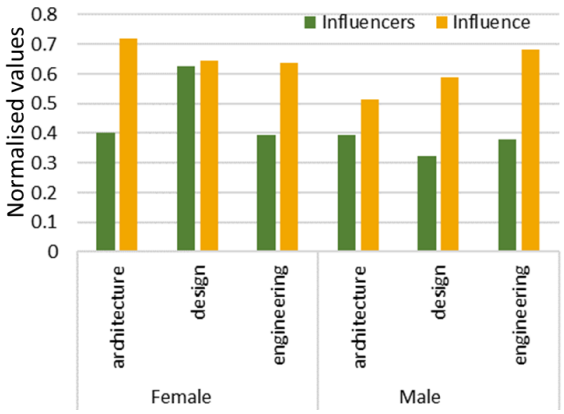

Figure 5. Gender and Educational background with respect to no of influencers and degree of influence

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This change in the self-efficacy could be due to (1) the students were attending this course for the first time, their mastery experience due to the teaching methods and training they received boosted their self-efficacy. (2) Vicarious experiences, by seeing other similar people succeed (Bandura, 2010) could have increased their self-efficacies. In terms of disciplines, design students had higher self-efficacy in all eight design stages; this could be due to their undergrad curriculum, where they are taught about these. However, there was a decrease in self-efficacy in design students (from before mean self-efficacy value of 0.67 to after mean value of 0.48). One possible reason could be that there were more engineering students in all the teams than designers, the team activities might be dominated by engineering students, hence this decrease. Increase in self – efficacies (both male and female) in engineering students (from before mean self-efficacy value of 0.36 to after mean value of 0.58) was observed. As engineers dominated the team population, the positive mastery experience might have increased their self-efficacy, while the designers (who were less in number) might have had negative mastery experience.

The analysed results related to the above-mentioned research questions are discussed below.

RQ1: What is the relationship between individuals' self-efficacy and influencer status (degree of influence and number of influencers)?

The authors found similar relationship between the four self-concepts (confidence, motivation, expectation and anxiety) considered for determining self-efficacy, as proved in the past literature (Carberry et al., 2010; Bandura, 1977). The correlation matrix in Figure 6 shows the Pearson's coefficient, with lighter hues indicating positive correlations and darker hues indicating negative correlations. It clearly shows a positive relationship between the degree of influence and the three self-concepts (confidence $\rho = 0.48$ P-value < 0.001, *motivation* $\rho = 0.56$ P-value < 0.001 *and expectation* $\rho = 0.56$ P-value < 0.001*). The degree of influence has no correlation with anxiety (*$\rho = 0.04$ P-value $=0.6$*). This could signify that individuals with or without anxiety were both influenced by the influencers in the team.*

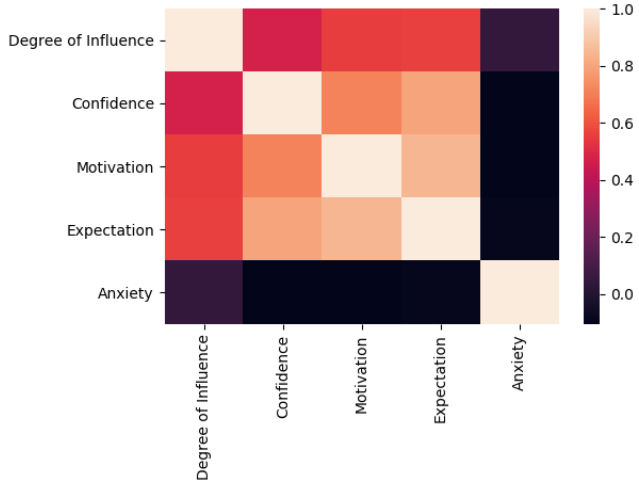

Figure 6. Correlation matrix for the four self-concepts (confidence, motivation, expectation, anxiety) and degree of influence

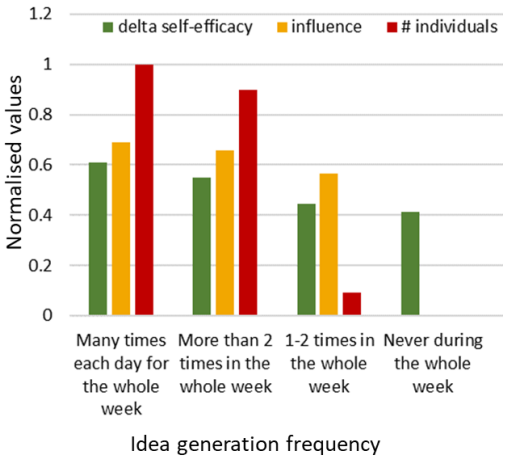

Figure 7. Number of Ideas produced with respect to mean delta self-efficacy, mean degree of influence and no of individuals

A linear relationship was identified between change in self-efficacy and the degree of influence (regression coefficient: 0.22, mean squared error: 0.02, variance score (R- squared): 0.25). The increase in self-efficacy afterwards could be from the degree of influence by the influencers (regression coefficient: 0.504, mean squared error: 0.02, variance score (R- squared): 0.19). However, there is only a very weak positive relationship between the degree of influence and number of influencers (regression coefficient: 0.13, mean squared error: 0.03, variance score (R- squared): 0.12). One reason hypothesized is that one influencer with high degree of influencing power or multiple influencers with influencing powers might have had the same impact on the team processes. However,

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a high negative correlation was found between the change in self-efficacy and the initial value of individual's self-efficacy (Pearson's ρ= -0.717, P-value < 0.001). This means that the individuals with high self-efficacy get have less change in their self-efficacy (increase or decrease) than individuals with low self-efficacy.

RQ2 :How do individuals' self-efficacy and influencer status affect their behaviour during engineering design activities?

The individual behaviour in engineering design activity associated with how often the ideas were generated was self-reported and then analysed. It was observed (Figure 7) *that individuals* with a higher change in self-efficacy and a high degree of influence exerted by influencer(s) *produce more ideas*.

It could mean that the influencers might have components of leaders (Bass, 1985), that encourage others in the team to participate in idea generation, therefore producing ideas more frequently. Similar findings were revealed by (Gist, 1989) whose cognitive modelling method for generating higher creative self-efficacy produced higher quantity and divergence of ideas generated. The individuals with high degree of influence from others in the team in idea generation and selection had high self-efficacy in idea generation and selection at the end of the course. However, no significant relationship exists between pre-course self-efficacy and degree of influence in idea generation and selection (with R- squared values = -0.02 and 0.00 respectively).

Additional relationships between individual characteristics and behaviour in ideation are shown are in Figure 6 (*Pearson's coefficient*). Team members' perceived degree of influence positively correlates with their behaviour to appreciate more ideas (ρ = 0.5, P-value< 0.001). This case could also be explained as Normative Social Influence in which team members conform because they want to be liked or accepted by others in the team (Deutsch and Gerard, 1955). However, it is still unknown whether they accept more ideas only from influencer(s) or not. The degree of influence positively correlates with individuals' self-efficacy after the course (ρ = 0.55, P-value < 0.001).

Figure 8. Correlation matrix for individual characteristics and behaviour during the course

RQ3: How do influencer status in teams affect team performance?

Variations in team performance can often be explained through influence related measures of a team. The variance of the degree of influence could help in revealing, how the influencing power was distributed in the team. It was found that the final team performance is highly positively correlated with mean influence value of a team (Pearson's ρ = 0.72, P-value =0.04).*Interestingly, teams with a*

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high degree of influence perform better. However, it was not very evident if the number of influencers was associated with the team performance ($\rho = 0.2$ P-value =0.6); this could mean that above- average performance teams could have all its individual members equally influencing or a few individuals with high influencing power. Team with a high degree of influence are also less demotivated ($\rho = -0.766$, P-value =0.027).

5. Conclusions

Co-design activities involve working in teams, where it is often observed that some individuals become more influential than others. This paper is motivated by the limited amount of research done to understand the role of influencers in teams and their effect on team performance. The paper provides initial steps towards exploring the emergence and impact of influencers in co-design teams. Specifically, self-efficacy was investigated as one individual characteristic that could be responsible for driving influence dynamics within the team. These metrics were analysed using data from an ASP spring course focused on design. The results related to the above-mentioned questions could be summarized as follows:

RQ1: What is the relationship between individuals' self-efficacy and influencer status (degree of influence and number of influencers)?

Despite an unconvincing weak-positive relationship found between number and degree of influencers, the results from the pre and post-course survey data articulate that self-efficacy before and after the course are unrelated and the individuals who were more influenced in the team tend to have high self-efficacy at the end of the course. Lastly, individuals with high self-efficacies have less change (increase or decrease) in their self-efficacies than those with lower.

RQ2: Moreover, how do individuals' self-efficacy and influencer status affect their behaviour during engineering design activities?

Self -efficacy in individual design stages (as in idea generation and idea selection) after the course also increased with the degree of influence from the influencer during the design process. It was also noticed that individuals with high self-efficacy produced more ideas and had less demotivation. The teams with high degree of influence appreciated more ideas from its members during the design activity.

RQ3: How do influencer status in teams affect team performance?

The results of the degree of influence present in the teams were suggestive of influencing team performance. However, nothing could be said whether these teams had several members with uniform influence or a few prominent influencers with high degree of influence. The above average performance teams were also noticed to get less demotivated due to the degree of influence present in them.

One of the limitations of this study is that it relies on self-reported data collected during an educational course rather than the data from an experimental setup, which casts some doubt on the causation of the results. In addition, cultural differences were not taken into account while forming teams; this could be impactful since an individual who identifies as a minority might experience different self-efficacy changes than majority-identifying students. As the data collected was anonymous, it was not possible to identify the precise characteristics of the influencers and non-influencers. In addition, individual performance data was not accessible, as only team performance data was collected. Thus, the study could not examine any potential relationships between individuals' performance and their characteristics, nor was it possible to determine if there is a relationship between self-efficacy and being an influencer. The results in this paper could lead to improvements for both individual and team experiences in both educational settings and industry, through addressing dynamics of influence and self-efficacy. The current explorative study is an initial attempt to learn about the role of influencers in shaping design team outcomes. Hence, future work will consider formulating an experiment to study the characteristics of influencers (e.g., gender, experience, self-efficacy, etc.). This study would attempt to uncover what qualities of influencers are most impactful, and if influencers perceive themselves as different from others. Since the current study only explored self-efficacy, future research could also explore other characteristics such as trust and team familiarity as predictors of influence. This research specifically contributes to the knowledge of individual characteristics and

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design of environment that involves multidisciplinary teams. These results could help ASP or similar educational programs to re-design their strategies (student intake, design task, course structure) for better collaborative design practices. In general, the research in this area is valuable to practitioners who want to improve employee performance while working in design teams.

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