Team Performance Management: An International Journal

Teamwork attitudes, interest and self-efficacy between online and face-to-face information technology students

Abdullah Konak, Sadan Kulturel-Konak, Gordon W. Cheung,

Teamwork attitudes, interest and self-efficacy between online and face-to-face information technology students

Abdullah Konak and Sadan Kulturel-Konak
Penn State Berks, Reading, Pennsylvania, USA, and

Gordon W. Cheung
Department of Management and International Business, The University of Auckland, Auckland, New Zealand

Received 21 May 2018
Revised 22 October 2018
Accepted 30 October 2018

Abstract

Purpose – Challenges of teamwork in online classes may adversely affect students' future attitudes toward teamwork. Further, there is a concern about whether online programs foster students' teamwork skills. To answer these questions, the purpose of this paper is to compare online and face-to-face students' attitudes toward teamwork, interest in learning teamwork skills and teamwork self-efficacy.

Design/methodology/approach – The authors developed a conceptual model explaining how students' background, engagement in learning teamwork, teamwork self-efficacy and interest in learning teamwork affect attitudes toward teamwork and rigorously tested the model for a meaningful comparison between online and face-to-face students. Attitudes toward teamwork, teamwork interest and teamwork self-efficacy of 582 online and face-to-face students who attend the same academic program were compared.

Findings – The results suggest that online students have less positive attitudes towards teamwork compared to face-to-face students although online students have a higher level of teamwork self-efficacy. Therefore, online students' relative less positive attitudes toward teamwork cannot be explained by the lack of engagement, teamwork skills or interest.

Research limitations/implications – The homogeneity of the sample population is one of the limitations of the paper although it provides the opportunity for a comparative study of online and face-to-face students by controlling the majors.

Practical implications – Instructors should evaluate the appropriateness of team assignments while incorporating teamwork in online classes.

Originality/value – Concerns about online teamwork are discussed but have not been rigorously investigated in the literature. The authors conducted a comprehensive study involving 582 undergraduate students. The findings of this paper suggest that new approaches are needed to incorporate teamwork in online classes. The results also show that importance of building teamwork self-efficacy.

Keywords Attitudes toward teamwork, Online teamwork, Teamwork interest, Teamwork self-efficacy

Paper type Research paper

1. Introduction

Providing information technology (IT) students with teamwork skills is becoming increasingly crucial for preparing them to succeed in today's complex and knowledge-driven economy and society. Effective teamwork requires knowledge, skills and abilities (KSAs) in a set of diverse areas including leadership, communication, group decision-

Team Performance Management: An International Journal

1352-7592
DOI 10.1108/TPM-05-2018-0035

making, negotiation skills, conflict resolution, team motivation, social skills, understanding of diversity, responsibility and accountability. Teamwork is ubiquitous in engineering and IT classrooms. Instructors use teamwork not only in class projects that aim to mimic real-life problems but also as a learning paradigm (collaborative learning). The accreditation boards, such as the Accreditation Board for Engineering and Technology (ABET), Inc. and the Association to Advance Collegiate Schools of Business (AACSB), require evidence that students are acquiring teamwork KSAs. Employers continuously rank the ability to work in a team setting as among the most important attributes that they look for in new graduates.

Even after a decade of steady growth, enrollments in the US online higher education programs continue to increase according to a report periodically published by Babson Survey Research Group (Allen and Seaman, 2014). The expansion of online education has brought new challenges for teaching and assessing teamwork KSAs. One of the concerns is that online programs emphasize technical skills but overlook the professional skills development of students to some degree (Pienaar *et al.*, 2015; Barberà *et al.*, 2014). While online and face-to-face programs are frequently compared in the literature regarding their educational quality and student learning in their respective academic domains or specific hard skills, the question of whether online and face-to-face students have differences in soft skills development has not attracted the same attention. Meanwhile, employers still have negative perceptions about online programs, which is in part because of the preconception that online students lack soft skills that are cultivated by face-to-face interactions (Adams, 2008; Grossman and Johnson, 2015; Stewart and Khare, 2018). This pre-notion is not grounded in empirical data, as the literature lacks studies comparing soft skills of face-to-face and online students. However, it should be noted that several studies suggest that face-to-face soft skill training programs are more effective than online ones (Doo, 2006; Piyawan *et al.*, 2016).

Researchers discuss that integrating teamwork into online classes can increase students' teamwork KSAs as well as their satisfaction with online learning experiences (Williams *et al.*, 2006; Finegold and Cooke, 2006; Biasutti, 2011; Myers *et al.*, 2014). In online classes, collaborative learning and teamwork can help to reduce the sense of isolation (Brewer and Klein, 2006), which is one of the factors contributing to the low retention rate among online students (Baker *et al.*, 2016), increase students' successes (Kurucay and Inan, 2017) and promote students' engagement with the course content, which is another predictor of dropouts in online programs (Choi and Park, 2018). Effective teamwork can also promote critical thinking in online classes (Tseng and Yeh, 2013).

To the contrary of the compelling benefits of teamwork summarized above, some researchers point out the frustrating effect of teamwork in online classes (Capdeferro and Romero, 2012; Muuro *et al.*, 2014; Robinson, 2013). Common teamwork problems such as social loafing, free-rider and sucker effect can increasingly impede the effectiveness of teamwork in online classes (Piezon and Ferree, 2008). The communication medium can negatively affect online teams' decision-making processes and lead a poor decision-making performance in online teams (Goold *et al.*, 2008; O'Neill *et al.*, 2016). Dissatisfaction with teamwork is also frequently observed in online classes (Smith *et al.*, 2011; Thompson and Coovert, 2003).

With the concerns briefly summarized above, this paper investigates and compares teamwork interest, teamwork self-efficacy and attitudes toward teamwork of online and face-to-face students who attend the same academic program. The paper aims to answer the following research questions:

RQ1. Is there any difference between online and face-to-face in terms of their attitudes toward teamwork?

RQ2. What are the differences in teamwork KSAs self-efficacy between online and face-to-face students?

RQ3. What are the differences between online and face-to-face students regarding their interest in learning teamwork KSAs?

RQ4. What are the relationships between attitudes toward teamwork, teamwork KSAs self-efficacy and interest? How do the backgrounds of students affect these relationships for online and face-to-face students?

2. Research motivations

In the literature, the research on teamwork is extensive and grounded in many different fields. Stevens and Campion (1994) define five major areas of teamwork KSAs: Conflict Resolution, Collaborative Problem Solving, Communications, Goal Setting and Performance Management and Planning/Task Coordination. Instruments to assess teamwork KSAs usually include items related to a combination of these five areas of teamwork KSAs. In engineering and information technology programs, assessment of teamwork KSAs usually focuses on student projects. Teamwork assessment instruments are mainly designed for a summative evaluation of the individual contribution of each team member to the project outcomes and the project process. Peer evaluations play an important part of the assessment of teamwork KSAs, as team members can observe their teammate's performance and behavior that instructors cannot see during a project (Ohland *et al.*, 2012; Smith and Smarkusky, 2005; Van Duzer and McMartin, 2000; Konak *et al.*, 2016; Kulturel-Konak *et al.*, 2014). In addition to peer evaluations, questionnaires, such as Team Diagnostic Survey (Wageman *et al.*, 2005), and tests, such as Teamwork-KSA Test (Stevens and Campion, 1994), are also available to assess students' teamwork KSAs. However, none of these instruments focus on attitudes toward teamwork or teamwork interest.

Attitude is a latent construct that represents a summary of an individual's emotional evaluations about the favorability of an object or a concept (Fazio, 2007). In this sense, attitudes toward teamwork can be defined as how willing a person is to work in a team setting (Ulloa and Adams, 2004). While the literature extensively notes the challenges and pitfalls of teamwork in online classes, only limited work has addressed online students' attitudes toward teamwork. As individuals' attitudes affect their future behavior (Ajzen and Fishbein, 1977), a major concern is that if students develop negative attitudes toward teamwork, then they may transfer this negativity from educational settings to professional settings (Saghafian and O'Neill, 2018). Furthermore, accepting teamwork as an attractive work arrangement is a precursor for effective teamwork. Therefore, understanding online students' attitudes toward teamwork is the first step in formulating interventions for reducing any adverse effects of teamwork in online classes. This paper contributes to the literature in the way that interest in learning teamwork, teamwork self-efficacy and teamwork attitudes of students who go through the same academic program but in two different settings – face-to-face versus online – are contrasted for the first time. In other words, our primary goal is to study the question of whether online students have more

negative or positive attitudes toward teamwork compared to a face-to-face benchmark group and investigate causes of any significant differences between the two groups.

3. Research model and background

In this section, we formulate a conceptual model to study the formulated research questions. The model given in Figure 1 aims to discover the relationships among teamwork self-efficacy, interest and attitudes toward teamwork and how student demographics and experiences impact their relationships in two different contexts, face-to-face and online programs. As the relationships among these latent variables have not been studied in the literature, we justify our model based on relevant earlier work.

Attitude toward teamwork is an internal state that influences a student's decision on whether to participate in group work or not (Gardner and Korth, 1998). Chapman and Van Auken (2001), who conducted one of the first empirical studies investigating students' attitudes toward teamwork, point out that effective teamwork requires that team members perceive the team as an attractive work arrangement to achieve the expected tasks. In their study, they found out that students had slightly positive attitudes toward teamwork, and the students with a high level of positive attitudes were the ones who understood the benefits of teamwork. Chapman and Van Auken (2001)'s findings also supported that positive attitudes toward teamwork could be nurtured by instructors who were actively involved in teamwork by providing students with timely feedback on their team progress, introducing team management techniques and monitoring team performance by peer evaluations. Bacon *et al.* (1999) also identified instructor guidance on team processes as an important factor affecting students' teamwork experiences and attitudes. Pfaff and Huddleston (2003) investigated relationships between students' attitudes toward teamwork and several variables, including team size, expected grade, perceived workload, the existence of peer evaluations, time given in class to work on team tasks. Among these independent variables, expected grade, perceived workload, class time, and absence of free riders were identified as significant factors. Similarly, Beigi and Shirmohammadi (2012) discovered a moderate relationship between team evaluation concerns and teamwork attitude in a study involving students from Iran. Konak *et al.* (2015) reported that engineering students' attitudes toward teamwork were negatively correlated with their Grade Point Average (GPA), which also suggested that students were concerned about their grades being affected by underperforming team members. Ulloa and Adams (2004) reported positive relationships between the characteristics of effective teams and students' attitudes

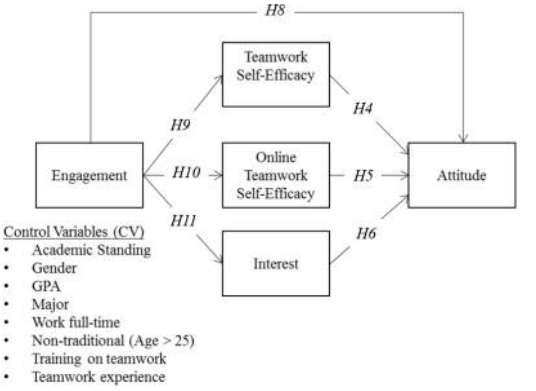

Figure 1.
The conceptual model used to study research questions

toward teamwork. These characteristics included conflict resolution, communication, goal setting, purpose, psychological safety, role clarity and accountability.

Only limited research has investigated student attitudes toward teamwork in online settings. Indeed, many of the factors mentioned above can also play a role in students' teamwork experiences in online settings. Several authors (Bard, 1996; Biasutti, 2011) point out the benefits of teamwork and small collaborative activities in online classes. Hansen (2016) observed a higher level of satisfaction with online teamwork compared to traditional ones. Beranek and French (2011) found no statistical difference in team trust building between online and face-to-face teams.

On the other hand, empirical studies also suggest that communication problems and the lack of trust due to limited face-to-face interactions are likely to exacerbate the adverse effects of teamwork concerns in online settings (Alexander, 2006; Johnson *et al.*, 2002; Ragoonaden and Bordeleau, 2000; Tseng and Yeh, 2013). Capdeferro and Romero (2012) reported that teamwork problems could make students get frustrated with online collaborative learning environments if these concerns were not addressed. Konak *et al.* (2014) reported that students preferred to perform a set of hands-on activities individually in an online class, while they were fond of completing the same activities collaboratively in a face-to-face class. Based on the results of a large empirical study, Poellhuber *et al.* (2011) reported that a high percentage of students were not interested in collaborative work in asynchronous distance learning classes. Poellhuber *et al.* (2011) suggested that teamwork reduced individual freedom and schedule flexibility, which is one of the main reasons that students prefer distance learning. Smith *et al.* (2011) compared group work experiences of students in online versus face-to-face sections of the same graduate course. They reported that the online students had less positive attitudes toward teamwork. Communication problems, group assessment and task delegation were identified as the major factors affecting students' attitudes. Similarly, Hampton and El-Mallakh (2017) reported that online nursing students disliked online group assignments although they acknowledged the value of teamwork. Several empirical studies (Herrmann, 2013; Sang Joon *et al.*, 2016) reported that integrating collaborative work in an online course section did not change students' interactions and satisfaction with an online course. In these studies, online students were also more likely to resent collaborative work. Based on these earlier findings, we formalize the main hypothesis of the paper as follows:

H1. Face-to-face students have more positive attitudes toward teamwork.

Team members' ability of performing team management tasks such as conflict resolution, coordination, communication and cooperation have a profound effect on the team's outcomes (Salas *et al.*, 2015). Self-efficacy refers to the belief in one's capabilities and abilities that he/she can attain the expected performance outcomes of a task (Bandura, 1982). According to Bandura's self-efficacy theory (Bandura, 1982), one's belief in his abilities is a factor in determining how successful he/she will be. In teamwork, collective-efficacy refers to the shared beliefs of the team members in their team's capabilities to achieve the expected outcomes of the tasks assigned to the team (Gibson, 2003). Teamwork self-efficacy can be defined as a team member's confidence in performing the tasks related to team processes (McClough and Rogelberg, 2003). In this respect, teamwork self-efficacy is independent of the efficacy related to the tasks that the team undertakes. In this paper, we define teamwork self-efficacy as a student's belief in hihe/sher ability to perform tasks related to teamwork KSAs. Research shows that self-efficacy affects whether an individual will engage in a task and the level of the effort that an individual is willing to put forward in achieving the task (Bouffard-Bouchard, 1990). Several researchers also note the positive effect of

teamwork self-efficacy on team behaviors/outcomes and emphasize the development of teamwork self-efficacy in students (Gully *et al.*, 2002; Tasa *et al.*, 2007; Chou *et al.*, 2012). Therefore, self-efficacy is an important variable to consider when analyzing the differences in attitudes toward teamwork between face-to-face and online students. The challenges posed by online learning environments may have an impact on the development of teamwork self-efficacy in online students, in turn influencing their attitudes toward teamwork. Again, this research question has not been discussed before. We also consider online teamwork self-efficacy which is defined as a student's belief in hihe/sher ability to work with others in a noncollocated, technology-mediated environment:

H2. Face-to-face students have higher teamwork self-efficacy.

H3. Online students have higher online teamwork self-efficacy.

Overall, research supports that collective-efficacy has a positive impact on team performance (Baker and Salas, 1992; Gibson *et al.*, 2000; Huh *et al.*, 2014; Katz-Navon and Erez, 2005; Tasa *et al.*, 2007; Chou *et al.*, 2012). Tasa *et al.* (2007) developed a research model in which teamwork self-efficacy mediates collective-efficacy, which in turn determines the team performance. A longitudinal study based on this multi-level model showed that teamwork self-efficacy plays a significant role in the formation of collective-efficacy, and both self-efficacy and collective-efficacy are instrumental for team performance. Based on the results of an empirical study in which student teams performed strategic decision-making tasks in a simulation game, Chou *et al.* (2012) also reported that collective-efficacy not only influenced team performance but also mediated the effect of team cognition (i.e. how teams acquire and share knowledge) on team performance. Lent *et al.* (2006) surveyed two groups of engineering students during a team project and asked them to evaluate the overall group's confidence in performing tasks. The results of their survey indicated that self-efficacy and team cohesion were reliable predictors of collective-efficacy. Purzer (2011) reported that the low self-efficacy of students could lead to poor team discourse in a study aimed to investigate relationships among team discourse, self-efficacy and achievement. O'Neill *et al.* (2016) compared the team potency, which is the team's shared belief that the team can be effective (Guzzo *et al.*, 1993), of face-to-face and virtual teams in decision making tasks and reported that virtual teams exhibit lower team potency, mainly when a decision-making task involves discovering the best option. Overall, O'Neill *et al.*'s (2016) findings suggested that face-to-face teams were superior to virtual teams in team decision making. In a study involving only face-to-face teams, Chowdhury and Lanis (1999) found a significant relationship between teamwork self-efficacy and teamwork satisfaction only in the case of low performing teams. Knapp (2016) reported that team efficacy had positive correlations between team efficacy and team learning behaviors in virtual teams. Although the relationship between teamwork self-efficacy and attitudes toward has been previously investigated, we propose the following hypotheses based on the implications of the earlier research:

H4. Teamwork self-efficacy has a positive relationship with attitudes toward teamwork.

H5. Online teamwork self-efficacy has a positive relationship with attitudes toward teamwork.

Interest is another construct that describes the affective relationship between a learner and a domain. Interest influences how frequently a student engages the domain and how much effort the student is willing to exert to master the skills in the domain (Renninger and Bishop, 2017). Interest has been widely studied in the context of student learning in academic domains. In the context of learning, Hidi (2006) described interest as a predisposition of a learner to engage with a particular content. Interest plays a critical role in learning. Several studies (Durik and Harackiewicz, 2003; Harackiewicz *et al.*, 2000; Harackiewicz *et al.*, 2002; Kahu *et al.*, 2017) found empirical evidence that interest is an essential factor determining students' academic performance and success. A review of empirical research (Hidi and Renninger, 2006) supported that interest can help individuals overcome their disadvantages and become life-long learners. In this respect, we define interest in teamwork learning as students' willing to advance their teamwork KSAs. Development of individual interest in teamwork KSAs depends on both individual factors and external factors such as frequent triggering of situational interest by educational interventions (Rotgans and Schmidt, 2017) and types of opportunities that are available to students (Renninger and Bishop, 2017). Different external factors in online and face-to-face programs, as well as the motivations and background of students, can lead to a different level of interest development in these two groups:

H6. Face-to-face students have a higher level of interest in teamwork.

Despite the importance of interest in learning, limited work considers interest as a construct in the study of professional skills development. One exception is the Model of Domain Learning (MDL), which is a developmental model that explains how learners grow academically from novice to expert in a domain (Alexander, 2003; Alexander *et al.*, 1995, 1997, 2004). The MDL states that learners go through three developmental stages – acclimation, competency and proficiency – as they grow in a domain. According to the MDL, learners exhibit different types of domain-specific knowledge, strategic processing abilities and interest in each of these three stages. In the acclimation stage, interest is situational, which means that learners show temporary interest only because of external factors such as the introduction of a new topic or an original demonstration of a concept. Situational interest may lead learners to engage in content, but it is not adequate to sustain learning. As learners are increasingly exposed to and accumulate more knowledge in the domain, they start to develop individual interest, which is the enduring interest that motivates learners to attain more in-depth knowledge in the domain. In the competency stage, interest is the emerging individual interest which motivates learners to re-engage the domain independently (Renninger and Hidi, 2016). In the proficiency stage, learners immerse themselves into the domain and show personal commitment to master advanced concepts and skills related to the domain. Therefore, interest in the proficiency stage becomes an individual interest.

Grounded in the theory of the MDL, Kulturel-Konak *et al.* (2015) proposed an assessment framework in which interest plays a critical role to evaluate teamwork KSAs development. According to this framework, students' professional development in teamwork is considered incomplete if students lack individual interest in advancing their teamwork KSAs. The authors argue that the level of students' interest in improving their teamwork skills is parallel to their teamwork KSAs. In an empirical study involving engineering students, Vance *et al.* (2015) determined that interest had stronger correlations with previous teamwork experience, teamwork training and class standing than self-efficacy had with those variables. Konak *et al.* (2015) reported that engineering students had a higher level of interest in developing their teamwork KSAs in the last two years of the curriculum

compared to the first two years. In a soft skill training program, Piyawan *et al.* (2016) showed that participants who started the program with more willingness in improving their soft skills gained higher levels of achievements as the end of the program. In summary, interest in developing professional skills is, in fact, an indicator of professional development:

H7. Interest has a positive relationship with attitudes toward teamwork.

Students' previous engagement in learning teamwork KSAs can certainly have an effect on teamwork attitudes, teamwork self-efficacy and online teamwork self-efficacy. Learning teamwork KSAs can make a positive impact on students' perceptions of teamwork (Falls *et al.*, 2014). Compared to face-to-face students, online students may not have the same opportunities to learn teamwork KSAs. The differences in the engagement of students in activities related to learning teamwork KSAs may cause the differences in the attitudes toward teamwork. Based on these earlier research, we postulate the following hypotheses:

H8. Students' engagement in learning teamwork KSAs has a positive relationship with their attitudes toward teamwork.

H9. Students' engagement in learning teamwork KSAs has a positive relationship with their teamwork self-efficacy.

H10. Students' engagement in learning teamwork KSAs has a positive relationship with their online-teamwork self-efficacy.

H11. Students' engagement in learning teamwork KSAs has a positive relationship with their interest.

Along with the latent variables attitudes toward teamwork, teamwork self-efficacy, online teamwork self-efficacy, engagement in learning teamwork, several demographical and background variables Academic Standing, Gender, GPA, Major, Full-time Work Status, Non-traditional students (Age > 25 year-old), previous extensive training on teamwork and previous real-life work experience are considered as control variables in the model.

3. Methods

3.1 Participants and procedures

The participants were 582 undergraduate students, including 345 (59.3 per cent) students attending face-to-face programs and 237 (40.7 per cent) students attending online programs. Among the sample, 449 (77.1 per cent) students major in information sciences and 133 (22.9 per cent) major in information security. These two programs have both residential and online versions. Online students take all of their classes in the distance learning mode throughout their education. The course offerings and contents are identical in both versions. Both programs emphasize teamwork, and the majority of the courses include team projects in both online and face-to-face versions. Because of these reasons, the target programs and student population are well suited to study the research questions.

Table I summarizes the per cent of the participants in various background/ demographical categories across the online and face-to-face groups. The ratios in Table I are representative of the overall student population in the respected programs. The overwhelming majority of the online students are non-traditional students (i.e. older than 25) with a current full-time job (working > 40 hours a week). Online students were more likely

		Face-to-face ($N = 345$) (%)	Online ($N = 237$) (%)
Major	Information sciences	78.8	74.7
	Information security	21.2	25.3
Gender	Female	25.0	27.2
	Male	75.0	72.8
GPA group	< 3.5	65.8	43.9
	> = 3.5	34.2	56.1
Class standing	First year	23.2	23.6
	Second year	19.1	19.8
	Third year	24.6	30.4
	Fourth year	33.0	26.2
Non-traditional	No	79.4	25.7
(Age > 25)	Yes	20.6	74.3
Full-time job	No	86.7	19.8
	Yes	13.3	80.2
Job teamwork experience	No	19.4	8.9
	Yes	80.6	91.1
Intensive teamwork training course	No	73.4	53.5
	Yes	26.6	46.5

Table I.
The summary of the participants demographical and background data

to have previous teamwork training. On the other hand, the face-to-face group constituted mainly traditional college students.

Participants were recruited via email. An anonymous URL link pointing to the online survey was emailed to the target population. It should be noted that the survey was not applied after a class project. The survey intended to measure students' overall attitudes, interest and teamwork self-efficacy. The participation in the survey was voluntary without any incentive per our IRB requirements.

3.2 Measures

Students attending face-to-face programs and students attending online programs received the same survey. There was a total of 58 items measuring the five latent constructs, resulting in an estimation of 262 parameters with 3,276 degrees-of-freedom in the measurement model for confirmatory factor analysis. The large degrees-of-freedom typically resulted in poor overall model fit indices because of the parsimonious errors we have imposed in the hypothesized measurement model. That is, we purposefully constrained some small secondary loadings (as in the case in exploratory factor analysis) and small correlated errors to zero to simplify interpretation (Cheung and Rensvold, 2001). One possible way to reduce a large number of indicators in the measurement model is to combine indicators into parcels and use the parcels as indicators in subsequent analysis (Yang *et al.*, 2010). When the latent variable is unidimensional, random parcels can be created by randomly assigning the indicators to three or four parcels, and the mean of the indicators becomes values of the parcels (Kishton and Widaman, 1994). This approach is only appropriate when the indicators are unidimensional and have high Cronbach's alpha values. When the latent construct has multiple aspects, the domain representative approach will be more appropriate, whereas a parcel is created for each aspect by taking an average of the indicators of that aspect (Kishton and Widaman, 1994). In this study, random parcels were created for engagement in learning activities about teamwork, interests in learning about teamwork, online teamwork self-efficacy and positive attitudes toward teamwork. As the latent construct teamwork self-efficacy includes multiple aspects, seven domain

representative parcels were created for the seven aspects of teamwork self-efficacy. The total number of items after parceling was 21.

3.2.1 Engagement in learning activities about teamwork (Engagement). This variable intended to measure the respondents' participation in activities to learn more about teamwork. It was measured by 11 items asking the respondents how frequently they had engaged in certain activities related to learning about teamwork KSAs in the past two years. Sample items include "Attended a workshop about teamwork" and "Performed a web search to learn about effective teamwork". These 11 items were measured on a four-point scale ranging from 1 = "None" to 4 = "Several times or more (> 4)". Four random parcels were created for this construct. Composite reliability was 0.870 for the face-to-face group and 0.903 for the online group.

3.2.2 Interests in learning about teamwork (Interest). This variable was measured by five items with an intention to measure the respondents' interests and willingness to participate in activities to learn more about teamwork. Sample items include "Rate your level of interest in attending a free workshop on teamwork" and "Rate your level of willingness to take an elective course in order to improve your teamwork skills". These five items were measured on a four-point scale ranging from 1 = "Very unlikely" to 4 = "Very likely". Three random parcels were created for this construct. Composite reliability was 0.850 for the face-to-face group and 0.889 for the online group.

3.2.3 Teamwork self-efficacy. This variable measured students' belief in their ability to perform teamwork KSAs defined by Stevens and Campion (1994). Based on teamwork KSAs learning objectives, this construct had seven aspects including goal setting, performance evaluation, team forming, team coordination, communication, conflict resolution and problem-solving. These were measured by a total of 25 items asking the respondents how confident they were in various teamwork activities. Sample items include "Communicating effectively in a team setting" and "Involving team members in the decision-making process". These 25 items were measured on a four-point scale ranging from 1 = "Very unconfident" to 4 = "Very confident". Seven domain representative parcels were created for this construct. Composite reliability was 0.922 for the face-to-face group and 0.946 for the online group.

3.2.4 Online teamwork self-efficacy. This variable intended to measure the respondents' self-efficacy specific to online teamwork activities. It was measured by eight items asking the respondents how confident they are in engaging in online teamwork activities. Sample items include "Communicating effectively with other team members using the available online technologies" and "Developing team goals using the online technologies". These eight items were measured on a four-point scale ranging from 1 = "Very unconfident" to 4 = "Very confident". Four random parcels were created for this construct. Composite reliability was 0.928 for the face-to-face group and 0.937 for the online group.

3.2.5 Positive attitudes toward teamwork (Attitude). This variable was measured by nine items, asking the respondents to indicate their attitude towards teamwork. Sample items include "I would rather work on team projects than on my own" and "Teamwork helps me learn new concepts from others". These nine items were measured on a four-point scale ranging from 1 = "Strongly disagree" to 4 = "Strongly agree". Three random parcels were created for this construct. Composite reliability was 0.904 for the face-to-face group and 0.879 for the online group.

4. Results

4.1 Measurement model

Following the procedures outlined by Cheung (2008), we first conducted confirmatory factor analyses with M*plus* 7.4 (Muthén and Muthén, 1998-2014) using the parcels for the face-to-face group and online group independently. The fit indices for the measurement model in the face-to-face group were: $\chi^2 = 321.79$ ($df = 179$), RMSEA = 0.048, CFI = 0.971 and SRMR = 0.034, indicating that the model fitted the data well. The standardized factor loadings were between 0.681 and 0.940. Average variance extracted for the five constructs were between 0.629 and 0.764, indicating the measurement scales have good convergent validity. The correlation coefficients among the latent constructs were between −0.023 and 0.719, which were lower than 0.85 (Kline, 2015), and all the squared correlations among the latent variables were smaller than the average variance extracted of respective constructs (Fornell and Larcker, 1981), providing evidence for discriminant validity for the constructs. The fit indices for the measurement model in the online group were: $\chi^2 = 365.78$ ($df = 179$), RMSEA = 0.066, CFI = 0.955 and SRMR = 0.041, indicating that the model fitted the data well. The standardized factor loadings were between 0.710 and 0.969. Average variance extracted for the five constructs were between 0.703 and 0.789, indicating the measurement scales had good convergent validity (Fornell and Larcker, 1981). The correlation coefficients among the latent constructs were between −0.082 and 0.743, which were lower than 0.85 (Kline, 2015), and all the squared correlations among the latent variables were smaller than the average variance extracted of respective constructs (Fornell and Larcker, 1981), providing evidence for discriminant validity for the constructs.

4.2 Measurement invariance

To provide unequivocal interpretations of the results from the comparisons across the face-to-face and online groups, we conducted measurement invariance tests to provide evidence that the psychometric properties of the scales were not significantly different across the two groups. As we were interested in comparing the latent means of the constructs between the online and face-to-face group, we established both metric invariance (equivalent factor loadings) and scalar invariance (equivalent item intercepts) across groups (Cheung and Lau, 2011; Cheung and Rensvold, 2000). As the sample came from two different majors, measurement invariance tests were also conducted to provide evidence that the psychometric properties of the scales between students with different majors were not significantly different before combining the students from different majors into larger samples.

Table II shows the results of measurement invariance tests for the face-to-face group across the two majors. The fit indices of the configural invariance model provided evidence that the measurement model fitted the data from the two majors well. After constraining the factor loadings to be equivalent across majors, the change in $\chi^2 = 6.351$ ($df = 16$) between the metric invariance model and the configural invariance model was not statistically

Model	χ^2	*df*	$\Delta\chi^2$	Δdf	$p(\Delta\chi^2)$	CFI	RMSEA	SRMR
Configural invariance	583.880	358				0.955	0.060	0.048
Metric invariance	590.231	374	6.351	16	0.9838	0.957	0.058	0.051
Scalar invariance	614.918	390	24.687	16	0.0755	0.955	0.058	0.054

Notes: $N = 345$ for face-to-face group; $N = 237$ for online group

Table II. Measurement invariance tests: face-to-face students across majors

significant (p = 0.9838), demonstrating the factor loadings were not significantly different across majors among the face-to-face group. After constraining the item intercepts to be equivalent across majors, the change in χ^2 = 24.687 (df = 16) between the scalar invariance model and the metric invariance model was not statistically significant (p = 0.0755), demonstrating the item intercepts were not significantly different across majors among the face-to-face group.

Table III shows the results of measurement invariance tests for the online group across the two majors. The fit indices of the configural invariance model provided evidence that the measurement model fitted the data from the two majors well. The change in χ^2 = 12.526 (df = 16) between the metric invariance model and the configural invariance model was not statistically significant (p = 0.7070), demonstrating the factor loadings were not significantly different across majors within the online group. The change in χ^2 = 22.423 (df = 16) between the scalar invariance model and the metric invariance model was not statistically significant (p = 0.1301), demonstrating the item intercepts were not significantly different across majors within the online group. As measurement invariance across the two majors was established, students in the two majors were combined to form larger samples for the face-to-face group and the online group.

Table IV shows the results of measurement invariance tests between the face-to-face group and the online group. The fit indices of the configural invariance model provided evidence that the measurement model fits the data well in both groups. The change in χ^2 = 21.823 (df = 16) between the metric invariance model and the configural invariance model was not statistically significant (p = 0.1490), demonstrating the factor loadings were not significantly different between the face-to-face group and the online group. The change in χ^2 = 63.895 (df = 16) between the scalar invariance model and the metric invariance model, on the other hand, was statistically significant ($p < 0.001$), demonstrating at least some of the item intercepts were significantly different between the face-to-face group and the online group.

Following the procedures outlined in Cheung (2008), scalar invariance tests at the construct level were conducted in this paper to identify the constructs that have non-invariant intercepts. The results in Table V show that at least one item for engagement in learning activities about teamwork, one item for interest in learning about teamwork and

Table III. Measurement invariance tests: online students across majors

Model	χ^2	df	$\Delta\chi^2$	Δdf	p($\Delta\chi^2$)	CFI	RMSEA	SRMR
Configural invariance	669.354	358				0.928	0.086	0.053
Metric invariance	681.880	374	12.526	16	0.7070	0.929	0.083	0.060
Scalar invariance	704.303	390	22.423	16	0.1301	0.927	0.082	0.062

Notes: N = 345 for face-to-face group; N = 237 for online group

Table IV. Measurement invariance tests: face-to-face students versus online students

Model	χ^2	df	$\Delta\chi^2$	Δdf	p($\Delta\chi^2$)	CFI	RMSEA	SRMR
Configural invariance	687.573	358				0.964	0.056	0.037
Metric invariance	709.396	374	21.823	16	0.1490	0.963	0.056	0.043
Scalar invariance	773.291	390	63.895	16	0.0000	0.958	0.058	0.045

Notes: N = 345 for face-to-face group; N = 237 for online group

one item for positive attitudes toward teamwork had significantly different item intercepts across groups. Then the items with non-invariant intercepts were identified with scalar invariance tests at the item level, and a partial scalar invariance model was established for comparisons of the latent means. In the partial scalar invariance model, all the factor loadings were constrained to be equivalent across the face-to-face group and online group, and the item intercepts of all the items with invariant intercepts were constrained to be equivalent, while the item intercepts of the three items with non-invariant intercepts were allowed to be freely estimated. The fit indices of the partial scalar invariance model were: χ^2 = 737.017 (df = 387); CFI = 0.961; RMSEA = 0.056; SRMR = 0.044, indicating that the model fitted the data well.

4.3 Latent means comparisons

The latent means and standard deviations for the face-to-face group and the online group, the latent mean difference and the associated p-value, the adjusted latent mean difference and the associated p-value for each construct, as well as the correlation coefficients are reported in Table VI. The comparisons of the latent means showed that the online group had

Model	χ^2	df	$\Delta\chi^2$	Δdf	p($\Delta\chi^2$)	CFI	RMSEA	SRMR
Metric invariance	709.396	374				0.964	0.056	0.037
Scalar invariance (Factor)								
Engage in learning activities about teamwork	723.622	377	14.226	3	0.0026	0.962	0.056	0.043
Interests in learning teamwork	734.584	376	25.188	2	0.0000	0.961	0.057	0.044
Teamwork self-efficacy	719.526	380	10.130	6	0.1193	0.963	0.055	0.044
Online teamwork skills self-efficacy	710.773	377	1.377	3	0.7109	0.963	0.055	0.043
Positive attitudes toward teamwork	722.369	376	12.973	2	0.0015	0.962	0.056	0.044

Table V.
Scalar invariance tests: face-to-face students versus online students

No.	Latent variable	Face-to-face Mean (SD)	Online Mean (SD)	Latent mean Difference	Adjusted mean Difference	Correlation 1	2	3	4	5
1	Engagement	1.943 (0.448)	2.048 (0.559)	0.105*	−0.013		0.483	0.311	0.215	0.325
2	Interest	2.380 (0.623)	2.517 (0.733)	0.137*	0.098	0.502		−0.081	0.010	0.539
3	Teamwork self-efficacy	3.310 (0.401)	3.394 (0.444)	0.084*	0.035	0.187	−0.023		0.745	0.155
4	Online teamwork self-efficacy	3.186 (0.557)	3.412 (0.693)	0.226***	0.154*	0.136	0.008	0.719		0.211
5	Attitude	2.946 (0.515)	2.689 (0.517)	−0.257***	−0.187**	0.339	0.493	0.197	0.174	

Notes: SD = Standard deviation; Adjusted mean differences are differences in latent means adjusted for the control variables; Positive adjusted mean difference represents online students have a higher mean; negative adjusted mean difference represents online students have a lower mean than face-to-face students. *$p < 0.05$; **$p < 0.01$; Correlation coefficients below diagonal – Face-to-face group; correlation coefficients above diagonal – Online group; Overall model fit indices: χ^2 = 1215.79 (df = 688); CFI = 0.944; RMSEA = 0.052; SRMR = 0.063; One parcel for Engagement, one item for Interest, and one parcel for attitudes toward teamwork have non-invariant item intercepts; N = 345 for the face-to-face group; N = 237 for the online group

Table VI.
Mean difference between face-to-face and online students

significantly higher frequency in engaging in learning activities about teamwork ($p < 0.05$), significantly higher interests in learning teamwork ($p < 0.05$), significantly higher teamwork self-efficacy ($p < 0.05$) and significantly higher online teamwork skills self-efficacy ($p < 0.001$) than the face-to-face group. On the other hand, the online group had significantly lower positive attitudes toward teamwork than the face-to-face students ($p < 0.001$). As the students were not randomly assigned to the two program types, the latent mean difference may simply be the results of the differences in background between the two groups of students. Hence, the latent mean comparisons were conducted after adjusted for differences in the background variables given in Table I. This procedure is equivalent to Analysis of Covariance (ANCOVA) for latent variables. Table VI shows that online group had significantly higher ($d = 0.154$) online teamwork self-efficacy ($p < 0.05$) when comparing with the face-to-face group. On the other hand, the online group had significantly less ($d = -0.187$) positive attitudes toward teamwork than the face-to-face group ($p < 0.01$). In summary, *H1* and *H3* were supported, while *H2* and *H6* were not supported.

4.4 Multi-group structure equation modeling (SEM) analysis

Finally, we conducted a multigroup SEM analysis to examine the relationships among the latent variables based on the conceptual model given in Figure 1. In addition, Academic Standing, Gender, GPA, Major, Full-time Work Status, Non-traditional Student, Previous Training on Teamwork and previous real-life Work Experience with intensive teamwork were included in the model as control variables. The primary objectives of the multi-group SEM analysis were to investigate the causes of positive attitudes toward teamwork and to find out if the program type moderated the relationships among the latent variables. The fit indices of the overall model fit were: $\chi^2 = 1138.13$ ($df = 646$); CFI = 0.947; RMSEA = 0.051; SRMR = 0.041, indicating that the model fitted the data well. Tables VII and VIII report the unstandardized regression coefficients for the face-to-face students and online group, respectively. The unstandardized regression coefficients were calculated for two different models. In the first model, only the control variables were included to better interpret the effects of the control variables on the latent variables. These unstandardized regressions coefficients are given under column CV. In the second model, the control variables and engagement were considered together. These unstandardized regressions coefficients are given under column (CV + Eng.).

Table VII shows that for the face-to-face group, academic standing had a significant positive relationship with teamwork self-efficacy ($b = 0.054$, $p < 0.01$), indicating students in senior years had higher teamwork self-efficacy. Results also show that male students had significantly lower online teamwork self-efficacy than female students ($b = -0.153$, $p < 0.05$). There was a significant negative relationship between GPA and attitudes towards teamwork ($b = -0.188$, $p < 0.01$) such that students with higher GPA had less positive attitudes toward teamwork. Non-traditional students also had significantly less positive attitudes toward teamwork than traditional students ($b = -0.177$, $p < 0.05$). Face-to-face students with more training on teamwork showed significantly higher engagement in learning activities about teamwork ($b = 0.170$, $p < 0.001$). Finally, face-to-face students with more teamwork experience in job showed significantly higher engagement ($b = 0.126$, $p < 0.05$), higher teamwork self-efficacy ($b = 0.149$, $p < 0.05$), significantly higher online teamwork self-efficacy ($b = 0.190$, $p < 0.05$) and more positive attitudes toward teamwork ($b = 0.220$, $p < 0.01$).

Table VIII shows that for the online group, male students had significantly higher engagement in learning activities about teamwork ($b = 0.128$, $p < 0.05$), and GPA had a positive relationship with engagement in learning activities about teamwork such that

	Engagement	Interest		Team SE		Online Team SE		Attitudes	
	CV	CV	CV + Eng.	CV	CV + Eng.	CV	CV + Eng.	CV	CV + Eng.
Academic standing	0.022	0.034	0.016	0.054**	0.051*	0.024	0.021	0.009	−0.019
Gender	0.036	−0.122	−0.150*	−0.051	−0.056	−0.153*	−0.158*	−0.005	0.054
GPA	−0.018	−0.089	−0.075	0.016	0.018	−0.070	−0.068	−0.188**	−0.155**
Major	−0.016	−0.063	−0.051	0.039	0.040	0.038	0.040	−0.053	−0.037
Work full-time	0.138	0.117	0.009	−0.006	−0.023	−0.047	−0.065	−0.060	−0.114
Age > 25	−0.116	−0.046	0.045	−0.047	−0.033	−0.022	−0.007	−0.177*	−0.138*
Training on teamwork	0.170***	0.069	−0.064	0.032	0.011	0.035	0.012	0.035	−0.014
Teamwork experience	0.126*	0.054	−0.045	0.149*	0.133*	0.190*	0.174*	0.220**	0.149*
Engagement			0.783***		0.125*		0.132		0.082
Interest									0.385***
Team SE									0.244*
Online Team SE									0.017
R^2	0.238***	0.044	0.293***	0.070*	0.085*	0.044	0.053	0.092**	0.359***

Notes: Engagement (Eng.) = Engagement in learning activities about teamwork; Interests = Interests in learning teamwork; Team SE = Teamwork self-efficacy; Online Team SE = Online teamwork skills self-efficacy; Attitudes = Positive attitudes toward teamwork; CV = Control variables; Entries are unstandardized regression coefficients; $N = 343$ for face-to-face group; Model fit: $\chi^2 = 1138.13$ ($df = 646$); CFI = 0.947; RMSEA = 0.051; SRMR = 0.041; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$; Negative value for gender means female students have higher mean than male students

Table VII. Determinants of students' interest level, self-efficacy in teamwork and attitudes for face-to-face students

students with higher GPA were more engaged ($b = 0.142$, $p < 0.05$). Finally, training on teamwork had significant positive relationship with engagement ($b = 0.205$, $p < 0.001$) and significant positive relationship with teamwork self-efficacy ($b = 0.088$, $p < 0.001$).

For the relationships among the constructs in Figure 1, engagement had significant positive effects on interest ($b = 0.783$, $p < 0.001$ for the face-to-face group and $b = 0.852$, $p < 0.001$ for the online group) and teamwork self-efficacy ($b = 0.125$, $p < 0.05$ for the face-to-face group and $b = 0.163$, $p < 0.05$ for the online group) in both groups. Hence, *H9* and *H11* were supported. Results show that engagement had significant positive effects on online teamwork self-efficacy among the online students ($b = 0.183$, $p < 0.05$), supporting *H10*. While the results in Tables VII and VIII supported *H7* that interest had significant positive effects on attitudes toward teamwork in both groups ($b = 0.385$, $p < 0.001$ for the face-to-face group and $b = 0.389$, $p < 0.001$ for the online group), online teamwork self-efficacy had no statistically significant relationships with attitudes toward teamwork. Hence, *H5* was not supported. Teamwork self-efficacy had a statistically significant positive relationship with positive attitudes toward teamwork only for the face-to-face group ($b = 0.244$, $p < 0.05$), and therefore, *H4* was only partially supported.

Finally, we estimated the indirect effects and total effects from engagement to attitudes toward teamwork and the corresponding bias-corrected confidence intervals by 2,000 bootstrap samples. Engagement had significant positive total effects on attitudes toward teamwork for both face-to-face group ($b = 0.416$, $p < 0.01$, 95 per cent CI [0.272, 0.573]) and online group ($b = 0.384$, $p < 0.01$, 95 per cent CI [0.214, 0.560]). Hence, *H8* was supported. Finally, there were statistically significant positive indirect effects of engagement on attitudes toward teamwork through interest ($b = 0.334$, $p < 0.01$, 95 per cent CI [0.228, 0.484])

	Engagement	Interest		Team SE		Online Team SE		Attitudes	
	CV	CV	CV + Eng.	CV	CV + Eng.	CV	CV + Eng.	CV	CV + Eng.
Academic standing	−0.014	−0.006	0.006	−0.013	−0.010	0.017	0.019	−0.004	0.019
Gender	0.128*	−0.003	−0.112	−0.082	−0.102	−0.049	−0.073	0.114	0.133
GPA	0.142*	0.082	−0.039	0.038	0.015	0.127	0.101	0.106	0.055
Major	−0.049	0.024	0.066	−0.017	−0.009	0.009	0.018	0.062	0.055
Work full-time	−0.031	−0.047	−0.021	0.020	0.025	0.085	0.091	0.000	0.008
Age > 25	0.003	−0.031	−0.034	0.036	0.035	0.096	0.095	−0.015	−0.018
Training on teamwork	0.205***	0.043	−0.132**	0.088***	0.054*	0.030	−0.008	0.005	−0.032
Teamwork experience	0.188	0.130	−0.030	0.181	0.151	0.199	0.165	0.230	0.129
Engagement			0.852***		0.163*		0.183*		0.008
Interest									0.389***
Team SE									0.173
Online team SE									0.089
R^2	0.347***	0.015	0.298***	0.110**	0.138**	0.058	0.086	0.046	0.365***

Table VIII. Determinants of students' interest level, self-efficacy in teamwork and attitudes for online students

Notes: Engagement (Eng.) = Engagement in learning activities about teamwork; Interests = Interests in learning teamwork; Team SE = Teamwork self-efficacy; Online Team SE = Online teamwork skills self-efficacy; Attitudes = Positive attitudes toward teamwork; CV = Control variables; Entries are unstandardized regression coefficients; $N = 343$ for face-to-face group; Model fit: $\chi^2 = 1138.13$ ($df = 646$); CFI = 0.947; RMSEA = 0.051; SRMR = 0.041; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$; Negative value for gender means female students have higher mean than male students

and teamwork self-efficacy ($b = 0.031$, $p < 0.05$, 95 per cent CI [0.000, 0.098] for the face-to-face group and through interest only ($b = 0.376$, $p < 0.01$, 95 per cent CI [0.247, 0.553]) for the online group.

We conducted additional analyses to compare the regression coefficients reported in Table VII for the face-to-face group with those in Table VIII for the online group. While the results showed that the relationships among the constructs in our hypothesized model did not have any statistically significant difference between the two groups, GPA had a significantly stronger positive effect on engagement for face-to-face students than online students. On the other hand, results also showed that GPA had a significantly stronger negative effect on attitudes toward teamwork for the face-to-face group than the online group. Finally, the face-to-face group showed significantly stronger positive effects of academic standing and teamwork experience on teamwork self-efficacy than the online group.

5. Discussions

Before discussing the findings, we reiterate that both online and face-to-face students participated in this study went through the same curricula that embrace teamwork. In the target programs, the majority of online and face-to-face classes include team projects to develop students' teamwork KSAs. Concerning *RQ1*, our findings indicated that the online group had less positive attitudes toward teamwork compared to the face-to-face students. As mentioned earlier, several authors (Alexander, 2006; Capdeferro and Romero, 2012; Johnson *et al.*, 2002; Konak *et al.*, 2014; Poellhuber *et al.*, 2011; Ragoonaden and Bordeleau, 2000; Tseng and Yeh, 2013a) raise concerns about negative aspects of teamwork in online

classes without a comparative study. In this paper, the comparison of the attitudes of online and face-to-face students provides empirical evidence for such concerns.

In terms of *RQ2* and *RQ3*, our analyses in Table VI showed that the observed significant difference in the attitudes of the online and face-to-face groups could not be explained by a lack of teamwork self-efficacy or interest by the online group as well as the differences in the control variables between the two groups. We found no significant difference in teamwork self-efficacy between the online group and the face-to-face group (*RQ2*) when we considered the effect of the control variables. The significant differences in the latent means of teamwork self-efficacy and interest between the two groups disappeared when the effects of the control variables were considered, indicating that online education had no effect on teamwork self-efficacy and interest of the students participated in this study, and the differences in the latent means could be explained by the demographical and background differences between the two groups. One statically significant difference was that the online group had much higher online teamwork self-efficacy compared to the face-to-face students. These findings suggest that any preconception of online students' lacking teamwork skills is misleading for the population of the students involved in this study.

The findings regarding *RQ3* showed that there were no significant differences between the online group and the face-to-face group in engagement in teamwork related learning activities and their level of interest in advancing their teamwork KSAs when the effect of the control variables was counted. However, rather low levels of engagement and interests in teamwork for both groups of students are concerning.

The proposed conceptual model investigated the relationships among students' engagement, attitudes toward teamwork, teamwork self-efficacy and interest for the first time in the literature. Our results show that while engagement had a significant positive effect on attitudes for both groups (*H8*), the direct paths from engagement on attitudes were not significant. Hence, the results suggested that interest and teamwork self-efficacy fully mediated the effect of engagement on attitude for the face-to-face group, while interest fully mediates the effect of engagement on attitudes for the online group. In summary, teamwork self-efficacy had a positive significant effect on attitudes toward teamwork for the face-to-face group but not for the online group. Online students' higher level of teamwork self-efficacy did not lead to a higher level of positive attitudes in our study. We postulate that this result is because of the challenges of performing teamwork in online classes. In the following, we also provide a text analysis of student comments to support this argument.

The observed patterns in the SEM analysis imply that teamwork self-efficacy and interest have a significant role in shaping students' attitudes toward teamwork. In other words, students should internalize learning outcomes from previous team experiences and training to develop positive attitudes toward teamwork. Therefore, we recommend that teamwork training programs should focus on building students' teamwork self-efficacy and interest. This objective can be achieved by exposing students to teamwork learning in different situations over time. Training students about how to manage failures is another way for building self-efficacy (Bandura, 2000). Another implication of this finding is that instructors could use teamwork self-efficacy to form student teams. The collective-efficacy of a team has a significant effect on team outcomes and performance especially when team tasks are highly interdependent (Katz-Navon and Erez, 2005; Lent *et al.*, 2006). To have high performing student teams, it is recommended to form teams whose members have a diverse set of abilities (Oakley *et al.*, 2004). Team formation models usually consider students' abilities in the project domain and/or their personality traits (Spoelstra *et al.*, 2015). An interesting further research would be studying the merits of forming student teams considering complimentary teamwork self-efficacies of team members.

To better understand possible causes of the online group's negative attitudes toward teamwork, we analyzed student responses to the open-ended question – "Please state any final comments about teamwork and teamwork knowledge, skills, and abilities that should be learned in college". Although this open-ended question did not specifically ask students about their teamwork experiences, many students expressed their concerns and problems related to teamwork. A total of 172 students (85 face-to-face and 87 online) responded to this question with a negative or positive response. First, we identified common themes in the student responses and then assigned student responses to the identified themes. Table IX

Theme	Face-to-face ($N = 85$) (%)	Online ($N = 87$) (%)	Example
Social loafing/free rider	29	26	The unfortunate reality of team projects in the online setting is that some people slack off and wait until the last minute, or they do nothing at all
Grades being negatively affected/ performance evaluation	13	15	My grade is affected by other's poor performance; I think this is due to differences in levels of motivation of students
not representing real-life	5	21	I have worked in team environments throughout my career, however I have not observed any meaningful correlation between teamwork in real-world and class -Teamwork in classes has no real and present, permanent consequence. Once the class is over, poor performance in the team does not matter
Communication/time zone/schedule differences	11	15	It is often very difficult to get everyone on the same page without attending class together, or seeing them often to hold them accountable for their portion of the work
Not contributing to my learning of knowledge	5	15	I feel as though team projects are ineffective learning tools in the classroom ". . .I really do enjoy genuine teamwork accomplishing a real goal (like projects at work). Class teamwork is contrived and pointless to me."
Personal and cultural conflict	5	8	It is not the concept of working in a team that needs to be emphasized; it is more so the tolerance it will require to handle numerous personality types at any one time
No connection to course learning objectives	8	5	Basic skills courses should not focus on learning teamwork skills but the content -For example, [xxxx] course has a group project component that was not necessary
Lack of input from the professor	1	11	I find team projects not adequately managed by instructors. I also find they do not thoroughly evaluate each person's teamwork skills
No appropriate task to the teamwork	4	5	Most tasks are easy and do not require multiple people working on it
Lack of student knowledge of the importance of teamwork	4	3	It would be more efficient to have one class that teaches effective teamwork with many team building exercises
Positive Feedback	32	11	Teamwork enhances a groups' strengths and covers up deficiencies

Table IX.
Per cent of the students whose comments are categorized under each theme

presents the extracted themes, a sample student response in each category and the per cent of the students whose comments include specifics themes. Not surprisingly, concerns about social loafing\free-rider problems topped the list of the negative themes in Table IX for both groups.

The main difference between the two groups was their perception of teamwork. A high percentage of the online group stated that teamwork in college settings did not reflect real-life and teamwork did not contribute to their learning of the course content. These students mentioned that they already had real-life teamwork experience but teamwork in online classes was quite different from real-life teamwork. Many online students indicated the lack of accountability in teamwork in online classes compared to real-life teamwork. Another primary concern of the online group was that teamwork was required for class assignments that did not indeed require a team effort to complete. Several online students mentioned that teamwork made such assignments unnecessarily complicated. In addition, many online students pointed out the lack of instructor input and interaction during team processes. Interestingly, this point did not seem to be an issue for the face-to-face group. Although the literature identifies forming trust as the highest-ranked issue in online teams (Levasseur, 2012), the online group in this study did not raise this concern. Therefore, we could conclude that the online group's major concern was about the context of teamwork and its execution in online classes. Although this concern did not appear in the comments of the face-to-face group, non-traditional face-to-face students also indicated less positive attitudes toward teamwork as given in Table VII.

These findings have several implications for online instructors and course designers. Although teamwork could reduce isolation in online classes, it may also complicate tasks for students. Performing a team activity in a face-to-face class is cognitively and logistically quite different from performing the same activity online. In face-to-face team activities, students can exchange information and learn from one another. Based on the student comments in this study, not only communication and scheduling challenges but also the structure of team assignments seemed to impede the effectiveness of teamwork in online classes. Instructors should be cautious about that such frustrations are not turned into negative attitudes toward teamwork in the long run. Therefore, instructors and course designers should weigh the benefits and challenges of teamwork as well as consider student background while incorporating team assignments in online courses. Our findings suggest the need for a different approach to design team assignments in online classes where the majority of students are non-traditional. Certainly, further research is needed to understand which team assignments are more appropriate for online classes and non-traditional students, and how team assignments should be designed to maximize teamwork learning outcomes while minimizing students' frustrations. In particular, the online groups' comments about "teamwork is being used for unworthy tasks" require further investigation.

Our findings showed that GPA and positive attitude toward teamwork were negatively correlated, that is, students with lower GPA had more positive attitudes toward teamwork. A similar result was reported by Konak *et al.* (2015) based on a study involving engineering students. Camiel *et al.* (2017) note that students in lower GPA teams are overall more satisfied with their team members than their counterparts in higher or mixed GPA teams. Students with high GPA are concerned that their grade would be negatively affected by inadequate performance of their teammates as discussed in the earlier research (Pfaff and Huddleston, 2003; Beigi and Shirmohammadi, 2012). Peer evaluations with clear criteria can not only reduce this concern but also teach students what constitutes good teamwork. To be effective, peer evaluations should be conducted at multiple phases of a team project, and students should be provided with feedback on their team performance. Peer evaluations can

also promote the timely involvement of instructors in team processes. Through multiple peer evaluations, instructors can address possible team problems in early stages before they become significant problems.

While a significant percentage of the online students voiced their dissatisfaction with a lack of instructor involvement and input into team processes, only a small per cent of the face-to-face students made such a comment. Instructor guidance and feedback on team processes is an important factor affecting students' teamwork attitudes (Chapman and Van Auken, 2001; Bacon *et al.*, 1999). Therefore, online instructors should be more proactive in engaging with project teams. For example, Noguera *et al.* (2018) describe an agile project management approach in which the instructor becomes a member of student teams as the team facilitator. Peer evaluations performed at multiple milestones of an online project can also promote more effective instructor involvement in online teamwork.

In this study, we observed positive relationships between engagement in learning activities about teamwork and the latent variables interest in learning teamwork, teamwork self-efficacy, online teamwork skills self-efficacy and positive attitude toward teamwork. The positive relationships indicate the importance of extracurricular activities in building students' teamwork KSAs. Our findings in this area support the notion that engaging students in learning experiences outside of the classroom is beneficial to their professional development in soft skills as recommended by the experiential learning literature (Kolb, 1984; Terenzini *et al.*, 1996).

6. Limitations of the research

There are several limitations of the research. The empirical study involved students attending two academic programs in a college that offers both face-to-face and online versions of the target programs. The homogeneity of the sample population is one of the limitations of the research although it provides the opportunity for a comparative study of online and face-to-face students by controlling the major. To generalize the findings of the paper, however, a broader study that includes other academic programs can be performed as further research. Another limitation of the study is that the survey intended to measure students' overall teamwork experience throughout their education. The survey did not target a specific class or project. Therefore, several variables such as team size and average team GPA, which can affect attitudes toward teamwork, could not be controlled. Furthermore, some demographic variables such as race and social-economic status were not collected. Finally, self-efficacy is a self-reported variable that may not indicate the true teamwork KSAs of the participants.

7. Conclusion

In this paper, we compared teamwork interest, teamwork KSAs self-efficacy and attitudes toward teamwork of online and face-to-face students who attend the same academic program. Our analyses indicated that online students had less positive attitudes toward teamwork compared to face-to-face students despite the fact that online students had higher teamwork KSAs self-efficacy and interest in learning teamwork KSAs than face-to-face students. These differences seemed to be caused by the differences between the online and face-to-face students' background and experience combined with the challenges of online teams. Therefore, instructors and instructional designers should consider students' background and the appropriateness of tasks while incorporating teamwork in online classes. Student comments suggested

the importance of active instructor involvement and peer evaluations in online teamwork. Further research is needed to investigate the best strategies for designing, integrating, and managing teamwork in online classes.

References

Ajzen, I. and Fishbein, M. (1977), "Attitude-behavior relations: a theoretical analysis and review of empirical research", *Psychological Bulletin*, Vol. 84 No. 5, p. 888.

Alexander, P.A. (2003), "The development of expertise: the journey from acclimation to proficiency", *Educational Researcher*, Vol. 32 No. 8, pp. 10-14.

Alexander, P.M. (2006), "Virtual teamwork in very large undergraduate classes", *Computers and Education*, Vol. 47 No. 2, pp. 127-147.

Alexander, P.A., Jetton, T.L. and Kulikowich, J.M. (1995), "Interrelationship of knowledge, interest, and recall: assessing a model of domain learning", *Journal of Educational Psychology*, Vol. 87, pp. 559-575.

Alexander, P.A., Murphy, P.K., Woods, B.S., Duhon, K.E. and Parker, D. (1997), "College instruction and concomitant changes in students' knowledge, interest, and strategy use: a study of domain learning", *Contemporary Educational Psychology*, Vol. 22 No. 2, pp. 125-146.

Alexander, P.A., Sperl, C.T., Buehl, M.M., Fives, H. and Chiu, S. (2004), "Modeling domain learning: profiles from the field of special education", *Journal of Educational Psychology*, Vol. 96, pp. 545-557.

Allen, I.E. and Seaman, J. (2014), *Grade Change Tracking Online Education in the United States*, Babson Survey Research Group and Quahog Research Group, LLC, New York, NY.

Bacon, D.R., Stewart, K.A. and Silver, W.S. (1999), "Lessons from the best and worst student team experiences: how a teacher can make the difference", *Journal of Management Education*, Vol. 23 No. 5, pp. 467-488.

Baker, D.P. and Salas, E. (1992), "Principles for measuring teamwork skills", *Human Factors: The Journal of the Human Factors and Ergonomics Society*, Vol. 34 No. 4, pp. 469-475.

Baker, M., Chiasson, K., Mahar, P., Schroeder, S. and Terras, K. (2016), "Students' desired and experienced levels of connectivity to an asynchronous, online, distance degree program", *Online Learning*, Vol. 20 No. 3, pp. 244-263.

Bandura, A. (1982), "Self-efficacy mechanism in human agency", *American Psychologist*, Vol. 37 No. 2, pp. 122-147.

Bandura, A. (2000), "Cultivate self-efficacy for personal and organizational effectiveness", *Handbook of Principles of Organization Behavior*, Vol. 2, pp. 0011-0021.

Barberà, E., Layne, L. and Gunawardena, C.N. (2014), "Designing online interaction to address disciplinary competencies: a cross-country comparison of faculty perspectives", *The International Review of Research in Open and Distributed Learning*, Vol. 15 No. 2.

Bard, T.B. (1996), "Cooperative activities in interactive distance learning", *Journal of Education for Library and Information Science*, Vol. 37 No. 1, pp. 2-10.

Beigi, M. and Shirmohammadi, M. (2012), "Attitudes toward teamwork: are iranian university students ready for the workplace?", *Team Performance Management: An International Journal*, Vol. 18 Nos 5/6, pp. 295-311.

Beranek, M.M. and French, M. (2011), "Team trust in online education: Assessing and comparing team-member trust in online teams versus face-to-face teams", *International Journal of E-Learning and Distance Education*, Vol. 25 No. 3, pp. 1-18.

Biasutti, M. (2011), "The student experience of a collaborative e-learning university module", *Computers and Education*, Vol. 57 No. 3, pp. 1865-1875.

Brewer, S. and Klein, J.D. (2006), "Type of positive interdependence and affiliation motive in an asynchronous, collaborative learning environment", *Educational Technology Research and Development*, Vol. 54 No. 4, pp. 331-354.

Camiel, L.D., Kostka-Rokosz, M., Tataronis, G. and Goldman, J. (2017), "Performance and perceptions of student teams created and stratified based on academic abilities", *American Journal of Pharmaceutical Education*, Vol. 81 No. 3, p. 47.

Capdeferro, N. and Romero, M. (2012), "Are online learners frustrated with collaborative learning experiences?", *The International Review of Research in Open and Distributed Learning*, Vol. 13 No. 2, pp. 26-44.

Chapman, K.J. and Van Auken, S. (2001), "Creating positive group project experiences: an examination of the role of the instructor on students' perceptions of group projects", *Journal of Marketing Education*, Vol. 23 No. 2, pp. 117-127.

Cheung, G.W. (2008), "Testing equivalence in the structure, means, and variances of higher-order constructs with structural equation modeling", *Organizational Research Methods*, Vol. 11 No. 3, pp. 593-613.

Cheung, G.W. and Lau, R.S. (2011), "A direct comparison approach for testing measurement invariance", *Organizational Research Methods*, Vol. 15, pp. 167-198.

Cheung, G.W. and Rensvold, R.B. (2000), "Assessing extreme and acquiescence response sets in cross-cultural research using structural equations modeling", *Journal of Cross-Cultural Psychology*, Vol. 31 No. 2, pp. 187-212.

Cheung, G.W. and Rensvold, R.B. (2001), "The effects of model parsimony and sampling error on the fit of structural equation models", *Organizational Research Methods*, Vol. 4 No. 3, pp. 236-264.

Choi, H.J. and Park, J.-H. (2018), "Testing a path-analytic model of adult dropout in online degree programs", *Computers and Education*, Vol. 116 No. Supplement C, pp. 130-138.

Chou, H.-W., Lin, Y.H. and Chou, S.B. (2012), "Team cognition, collective efficacy, and performance in strategic decision-making teams", *Social Behavior and Personality: An International Journal*, Vol. 40 No. 3, pp. 381-394.

Chowdhury, S. and Lanis, T. (1999), "Importance of self-efficacy of working in team environment in determining individual satisfaction and performance: Does it depend on the team performance?", available at: www.sbaer.uca.edu/Research/asbe/1999/08.pdf;www.sbaer.uca.edu/index.php/research-archive/1999toc/

Doo, M.Y. (2006), "A problem in online interpersonal skills training: do learners practice skills?", *Open Learning*, Vol. 21 No. 3, pp. 263-272.

Durik, A.M. and Harackiewicz, J.M. (2003), "Achievement goals and intrinsic motivation: coherence, concordance, and achievement orientation", *Journal of Experimental Social Psychology*, Vol. 39 No. 4, pp. 378-385.

Falls, I., Bahhouth, V., Chuang, C.M. and Bahhouth, J. (2014), "Factors influencing students' perceptions of online teamwork", *Sage Open*, Vol. 4 No. 1, pp. 1-9.

Fazio, R.H. (2007), "Attitudes as object–evaluation associations of varying strength", *Social Cognition*, Vol. 25 No. 5, pp. 603-637.

Finegold, A.R. and Cooke, L. (2006), "Exploring the attitudes, experiences and dynamics of interaction in online groups", *The Internet and Higher Education*, Vol. 9 No. 3, pp. 201-215.

Fornell, C. and Larcker, D.F. (1981), "Evaluating structural equation models with unobservable variables and measurement error", *Journal of Marketing Research*, Vol. 18, pp. 39-50.

Gardner, B. and Korth, S. (1998), "A framework for learning to work in teams", *Journal of Education for Business*, Vol. 74 No. 1, pp. 28-33.

Gibson, C.B. (2003), "The efficacy advantage: factors related to the formation of group efficacy", *Journal of Applied Social Psychology*, Vol. 33 No. 10, pp. 2153-2186.

Gibson, C.B., Randel, A.E. and Earley, P.C. (2000), "Understanding group efficacy: an empirical test of multiple assessment methods", *Group and Organization Management*, Vol. 25 No. 1, pp. 67-97.

Goold, A., Craig, A. and and Coldwell, J. (2008), "The student experience of working in teams online", Paper presented at the Ascilite, Melbourne.

Guzzo, R.A., Yost, P.R., Campbell, R.J. and Shea, G.P. (1993), "Potency in groups: articulating a construct", *British Journal of Social Psychology*, Vol. 32 No. 1, pp. 87-106.

Hansen, D.E. (2016), "Cohesion in online student teams versus traditional teams", *Journal of Marketing Education*, Vol. 38 No. 1, pp. 37-46.

Hampton, D.C. and El-Mallakh, P. (2017), "Opinions of online nursing students related to working in groups", *The Journal of Nursing Education*, Vol. 56 No. 10, pp. 611-616.

Harackiewicz, J.M., Barron, K.E., Tauer, J.M. and Elliot, A.J. (2002), "Predicting success in college: a longitudinal study of achievement goals and ability measures as predictors of interest and performance from freshman year through graduation", *Journal of Educational Psychology*, Vol. 94 No. 3, p. 562.

Harackiewicz, J.M., Barron, K.E., Tauer, J.M., Carter, S.M. and Elliot, A.J. (2000), "Short-term and long-term consequences of achievement goals: predicting interest and performance over time", *Journal of Educational Psychology*, Vol. 92 No. 2, pp. 316.

Hidi, S. (2006), "Interest: a unique motivational variable", *Educational Research Review*, Vol. 1 No. 2, pp. 69-82.

Hidi, S. and Renninger, K.A. (2006), "The four-phase model of interest development", *Educational Psychologist*, Vol. 41 No. 2, pp. 111-127.

Huh, Y., Reigeluth, C.M. and Lee, D. (2014), "Collective efficacy and its relationship with leadership in a computer-mediated project-based group work", *Contemporary Educational Technology*, Vol. 5 No. 1, pp. 1-21.

Johnson, S.D., Suriya, C., Won Yoon, S., Berrett, J.V. and La Fleur, J. (2002), "Team development and group processes of virtual learning teams", *Computers and Education*, Vol. 39 No. 4, pp. 379-393.

Kahu, E., Nelson, K. and Picton, C. (2017), "Student interest as a key driver of engagement for first year students", *Student Success*, Vol. 8 No. 2, pp. 55-66.

Katz-Navon, T.Y. and Erez, M. (2005), "When collective – and self-efficacy affect team performance: the role of task interdependence", *Small Group Research*, Vol. 36 No. 4, pp. 437-465.

Kishton, J.M. and Widaman, K.F. (1994), "Unidimensional versus domain representative parceling of questionnaire items: an empirical example", *Educational and Psychological Measurement*, Vol. 54 No. 3, pp. 757-765.

Kline, R.B. (2015), *Principles and Practice of Structural Equation Modeling*, Guilford publications, New York, NY.

Kolb, D. (1984), *Experiential Learning: Experience as a Source of Learning and Development*, Prentice-Hall, Englewood Cliffs, NJ.

Konak, A., Jungwoo, R. and Kulturel-Konak, S. (2014), "Student perceptions of a hands-on delivery model for asynchronous online courses in information security", Paper presented at the ASEE Mid-Atlantic Section Fall 2014 Conference, Swarthmore, PA, 14-15 November.

Konak, A., Magluilo, S. and Kulturel-Konak, S. (2016), "Behaviorally anchored rating scales for teamwork peer assessment", Paper presented at the 2016 IEEE Integrated STEM Education Conference (ISEC), Princeton, NJ, 5 March.

Konak, A., Kulturel-Konak, S., Kremer, G.E.O. and Esparragoza, I.E. (2015), "Teamwork attitude, interest, and self-efficacy: their implications for teaching teamwork skills to engineering students", Paper presented at the 2015 IEEE Frontiers in Education Conference (FIE), El Paso, TX, 21-24 October.

Kulturel-Konak, S., Konak, A., Okudan, Kremer, G. and Esparagozza, I.E. (2015), "Professional skills assessment: is a model of domain learning framework appropriate?", *International Journal of Quality Assurance in Engineering and Technology Education (IJQAETE)*, Vol. 4 No. 1, pp. 33-60.

Kulturel-Konak, S., Konak, A., Kremer, G.E.O., Esparragoza, I. and Yoder, G. (2014), "Peer evaluation and assessment resource (PEAR) to assess students' professional skills", Paper presented at the Proceedings of the 2014 Industrial and Systems Engineering Research Conference.

Kurucay, M. and Inan, F.A. (2017), "Examining the effects of learner-learner interactions on satisfaction and learning in an online undergraduate course", *Computers and Education*, Vol. 115, pp. 20-37.

Levasseur, R.E. (2012), "People skills: leading virtual teams – a change management perspective", *Interfaces*, Vol. 42 No. 2, pp. 213-216.

Lent, R.W., Schmidt, J. and Schmidt, L. (2006), "Collective efficacy beliefs in student work teams: relation to self-efficacy, cohesion, and performance", *Journal of Vocational Behavior*, Vol. 68 No. 1, pp. 73-84.

McClough, A.C. and Rogelberg, S.G. (2003), "Selection in teams: an exploration of the teamwork knowledge, skills, and ability test", *International Journal of Selection and Assessment*, Vol. 11 No. 1, pp. 56-66.

Muthén, L.K. and Muthén, B.O. (1998/2014), *Mplus User's Guide*, Seventh edition, Muthén and Muthén, Los Angeles, CA.

Muuro, M.E., Wagacha, W.P., Kihoro, J. and Oboko, R. (2014), "Students' perceived challenges in an online collaborative learning environment: a case of higher learning institutions in Nairobi, Kenya", *The International Review of Research in Open and Distributed Learning*, Vol. 15 No. 6, pp. 132-160.

Myers, T., Blackman, A., Andersen, T., Hay, R., Lee, I. and Gray, H. (2014), "Cultivating ICT students' interpersonal soft skills in online learning environments using traditional active learning techniques", *Journal of Learning Design*, Vol. 7, pp. 38-53.

Noguera, I., Guerrero-Roldán, A.-E. and Masó, R. (2018), "Collaborative agile learning in online environments: strategies for improving team regulation and project management", *Computers and Education*, Vol. 116, pp. 110-129.

Oakley, B., Felder, R.M., Brent, R. and Elhajj, I. (2004), "Turning student groups into effective teams", *Journal of Student Centered Learning*, Vol. 2 No. 1, pp. 9-34.

Ohland, M.W., Loughry, M.L., Woehr, D.J., Bullard, L.G., Felder, R.M., Finelli, C.J., . . . Schmucker, D.G. (2012), "The comprehensive assessment of team member effectiveness: development of a behaviorally anchored rating scale for self-and peer evaluation", *Academy of Management Learning and Education*, Vol. 11 No. 4, pp. 609-630.

O'Neill, T.A., Hancock, S.E., Zivkov, K., Larson, N.L. and Law, S.J. (2016), "Team decision making in virtual and face-to-Face environments", *Group Decision and Negotiation*, Vol. 25 No. 5, pp. 995-1020.

Pfaff, E. and Huddleston, P. (2003), "Does it matter if I hate teamwork? What impacts student attitudes toward teamwork", *Journal of Marketing Education*, Vol. 25 No. 1, pp. 37-45.

Piezon, S.L. and Ferree, W.D. (2008), "Perceptions of social loafing in online learning groups: a study of public university and US naval war college students", *The International Review of Research in Open and Distributed Learning*, Vol. 9 No. 2.

Pienaar, J., Wu, P. and Adams, N. (2015), "Development of virtual teamwork skills for distance students through simulated global virtual team projects", *Journal of Professional Issues in Engineering Education and Practice*, Vol. 142 No. 1, p. 05015003.

Piyawan, C.K., Lauren, B., Mallory, L. and Megan, T. (2016), "Evaluation of a soft skills training program", *Business and Professional Communication Quarterly*, Vol. 79 No. 2, pp. 154-179.

Poellhuber, B., Anderson, T. and Roy, N. (2011), "Distance students' readiness for social media and collaboration", *The International Review of Research in Open and Distributed Learning*, Vol. 12 No. 6, pp. 102-125.

Purzer, Ş. (2011), "The relationship between team discourse, self-efficacy, and individual achievement: a sequential mixed-methods study", *Journal of Engineering Education*, Vol. 100 No. 4, pp. 655-679.

Ragoonaden, K. and Bordeleau, P. (2000), "Collaborative learning via the internet", *Educational Technology and Society*, Vol. 3 No. 3, pp. 361-372.

Renninger, K. and Bishop, A. (2017), *Interest and Interest-Driven Learning in the SAGE Encyclopedia of out-of-School Learning*, Vol. 1, Sage, New York, NY, pp. 376-379.

Renninger, K. and Hidi, S. (2016), *The Power of Interest for Motivation and Learning*, Routledge, New York, NY.

Robinson, K. (2013), "The interrelationship of emotion and cognition when students undertake collaborative group work online: an interdisciplinary approach", *Computers and Education*, Vol. 62, pp. 298-307.

Rotgans, J.I. and Schmidt, H.G. (2017), "The role of interest in learning: knowledge acquisition at the intersection of situational and individual interest", in O'Keefe, P.A. and Harackiewicz, J.M. (Eds), *The Science of Interest*, Springer, New York, NY, pp. 69-93.

Salas, E., Shuffler, M.L., Thayer, A.L., Bedwell, W.L. and Lazzara, E.H. (2015), "Understanding and improving teamwork in organizations: a scientifically based practical guide", *Human Resource Management*, Vol. 54 No. 4, pp. 599-622.

Saghafian, M. and O'Neill, D.K. (2018), "A phenomenological study of teamwork in online and face-to-face student teams", *Higher Education*, Vol. 75 No. 1, pp. 57-73.

Spoelstra, H., Van Rosmalen, P., Houtmans, T. and Sloep, P. (2015), "Team formation instruments to enhance learner interactions in open learning environments", *Computers in Human Behavior*, Vol. 45, pp. 11-20.

Smith, H.H., III. and Smarkusky, D.L. (2005), "Competency matrices for peer assessment of individuals in team projects", Paper presented at the Proceedings of the 6th Conference on Information Technology Education.

Smith, G.G., Sorensen, C., Gump, A., Heindel, A.J., Caris, M. and Martinez, C.D. (2011), "Overcoming student resistance to group work: online versus face-to-face", *The Internet and Higher Education*, Vol. 14 No. 2, pp. 121-128.

Stevens, M.J. and Campion, M.A. (1994), "The knowledge, skill, and ability requirements for teamwork: implications for human resource management", *Journal of Management*, Vol. 20 No. 2, pp. 503-530.

Tasa, K., Taggar, S. and Seijts, G.H. (2007), "The development of collective efficacy in teams: a multilevel and longitudinal perspective", *Journal of Applied Psychology*, Vol. 92 No. 1, pp. 17-27.

Terenzini, P.T., Pascarella, E.T. and Blimling, G.S. (1996), "Students' out-of-class experiences and their influence on learning and cognitive development: a literature review", *Journal of College Student Development*, Vol. 40 No. 5, pp. 610-623.

Thompson, L.F. and Coovert, M.D. (2003), "Teamwork online: the effects of computer conferencing on perceived confusion, satisfaction and postdiscussion accuracy", *Group Dynamics: Theory, Research, and Practice*, Vol. 7 No. 2, pp. 135-151.

Tseng, H.W. and Yeh, H.T. (2013), "Team members' perceptions of online teamwork learning experiences and building teamwork trust: a qualitative study", *Computers and Education*, Vol. 63, pp. 1-9.

Ulloa, B.C.R. and Adams, S.G. (2004), "Attitude toward teamwork and effective teaming", *Team Performance Management: An International Journal*, Vol. 10 No. 7/8, pp. 145-151.

Van Duzer, E. and McMartin, F. (2000), "Methods to improve the validity and sensitivity of a self/peer assessment instrument", *IEEE Transactions on Education*, Vol. 43 No. 2, pp. 153-158.

Vance, K., Konak, A., Kulturel-Konak, S., Kremer, G.O. and Esparragoza, I. (2015), "Teamwork efficacy attitudes and interest: insights on their relationships", Paper presented at the Proceedings of ASEE Mid-Atlantic Section Spring Conference.

Wageman, R., Hackman, J.R. and Lehman, E. (2005), "Team diagnostic survey: development", *Of an Instrument. The Journal of Applied Behavioral Science*, Vol. 41 No. 4, p. 373.

Williams, E.A., Duray, R. and Reddy, V. (2006), "Teamwork orientation, group cohesiveness, and student learning: a study of the use of teams in online distance education", *Journal of Management Education*, Vol. 30 No. 4, pp. 592-616.

Yang, C., Nay, S. and Hoyle, R.H. (2010), "Three approaches to using lengthy ordinal scales in structural equation models: parceling, latent scoring, and shortening scales", *Applied Psychological Measurement*, Vol. 34 No. 2, pp. 122-142.

Further reading

Lewis, M.D. (2016), "Demographics of online students", in Danver, S.L. (Ed.), *The SAGE Encyclopedia of Online Education*, SAGE Publications, New York, NY, pp. 311-313.

Corresponding author

Abdullah Konak can be contacted at: auk3@psu.edu