Incorporating the student perspective in designing a virtual team classroom environment: an elaborated action design science research approach

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Diane Kutz
Department of Management and Marketing, University of North Alabama, Florence, Alabama, USA
Barry Cumbie
Department of Computer Science and Information Systems, University of North Alabama, Florence, Alabama, USA, and
Matthew Mullarkey
School of Information Systems and Management, University of South Florida, Tampa, Florida, USA

Abstract

Purpose – This paper aims to address the long-standing problem of suboptimal student team experiences for instructors and students by incorporating the student voice by co-creating a virtual team collaborative environment to improve team collaboration in the online classroom.

Design/methodology/approach – This paper presents a novel design science research approach and relates two elaborated action design science research (eADSR) cycles that design, implement and evaluate the student team experience in online courses requiring teamwork.

Findings – The outcome is a holistic view of a virtual team classroom environment specified with technologies and practices that may be employed to optimize the student team experience. The eADSR process yields non-obvious diagnoses and actionable steps for continually incorporating the ever-changing social aspects unique to students in addition to the evolving technological landscape.

Practical implications – This paper is valuable to faculty members interested in applying eADSR processes to incorporate the student voice to address pedagogical and learning challenges in the classroom. Additionally, it provides a DSR-based model that can be implemented in the classroom to improve student team collaboration as well as transparency for the instructor and the students in terms of team member contributions with the goal to alleviate student and faculty frustrations. This topic is particularly relevant in light of COVID-19 as students and faculty alike are thrust into new online classroom environments.

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Originality/value – Employing eADSR in the classroom is a novel and unique approach to create a replicable model for virtual team collaboration that can be added to the classroom.

Keywords Virtual teams, Online classroom, Collaboration, Elaborated action design science, Co-create

Paper type Research paper

Introduction

The purpose of this paper is to promote effective student teamwork by co-creating with students a *virtual team classroom environment* guided by the elaborated action design science research (eADSR) approach as detailed by Mullarkey and Hevner (2019). Invariably, researchers acknowledge the negative sentiment of students toward teams (Jasswall *et al.*, 2010), in addition to the increased administrative overhead of grading and dealing with freeriders, social loafing and managing peer evaluations (Koppenhaver and Shrader, 2003; Morgan and Stewart, 2017). The preponderance of literature on student groups and teams features instructor-driven pedagogical interventions, inquiries, innovations and approaches. While the *student voice* is frequently captured in these studies, it tends to be the *post hoc* perception of a team experience.

A study of highly consequential peer evaluations recognized this gap and captured the student perspective (Jassawalla and Sashittal, 2017). In the area of student team development, the same underreported student perspective gap exists. Furthermore, COVID-19-related conditions challenge the status quo and preclude a *business-as-usual* mindset. It is important to reassess past notions and gauge current student perception (e.g. Chen *et al.*, 2021; Rizvi and Nabi, 2021). This paper captures the student perspective and offers a different approach to the long-standing pedagogical dilemma of enabling successful student teams while mitigating student and instructor frustrations.

The 2020 National Association of Colleges and Employees Jobs Outlook related that the "ability to work in a team" is the second-highest-rated skill sought by employers (NACE, 2019), which remains unchanged from 2016 (Morgan and Stewart, 2017). Team skills remain essential as the team working environment continues to change considerably. Notions of teams congregating around a whiteboard and ordering take-out food are supplanted with videoconferences, shared screens and accidentally muted microphones.

Virtual teamwork is not new, and the COVID-19 global pandemic has accelerated the transition from outlier instances of telecommuting to widespread work-from-home and virtual team organizational structures. In November of 2020, Hewlett–Packard Enterprise officially embraced remote work for the long term with the Edge-to-Office initiative, emphasizing that employees are connected no matter whether they work in an office or remotely (Al-Jallad, 2020). This is the reality of the current and future work environment of our students. Higher education, to be relevant, must educate students about effectively working on virtual teams.

The COVID-19 pandemic forced a rapid transition from in-person to online learning. Dhawan (2020) stated that "This crisis will make the institutions, which were earlier reluctant to change, to accept modern technology" (p. 7). During this time, students experienced increased emotional, mental and physical challenges at the individual, interpersonal and organizational levels (LaRosa *et al.*, 2021) and grew ambivalent toward digital learning tools (Almendingen *et al.*, 2021). The ability to manage student teams in this fully online environment adds to the pedagogical challenges of this transition.

Singh (2021) applied lean management principles to a pedagogical process of curricula revision and internship placement. We mirror this approach, but instead apply design science research (DSR) principles to the pedagogical process of designing a collaborative virtual team classroom environment. Broos *et al.* (2017) presented a *DSR-inspired* approach to explore the usefulness of learning analytics for students. In the spirit of design science, they recognized that seemingly technology-centric pedagogical designs (e.g. learning analytics dashboards)

are dependent on the broader context (i.e. DSR's socio-technical system). They further allude to an iterative process and co-creation with students. We build upon this to articulate an eADSR approach to pedagogical design. The paper describes the utilization of an eADSR approach to capture the student perspective and co-create a *virtual team classroom environment*. Two DSR cycles that are elaborated with diagnosis, design and implementation phases are conducted. Starting from an initial diagnosis phase, which revealed that *instructor-driven approaches are insufficient to address deficiencies in virtual student team collaboration*, a *conceptual design artifact* was created and subsequently instantiated by graduate students studying high-performance teams. The *instantiated design artifact*, the virtual team classroom environment (VTCE), was then implemented for graduate student teams in another course and evaluated for impact on team effectiveness. The process was then repeated with a second cycle of diagnosis, Design and evaluation, and the *instantiated design artifact* was further refined and evaluated to consolidate the collaborative platform. This process allows for continuous improvement of the student team experience for both students and instructors by engaging with students to co-create their own collaborative environment. The resultant pedagogical approach is an innovative to address pedagogical problems regarding teamwork, to remove blind spots and pain points, and bridges the gap of the underrepresented student perspective.

Team-based research

Instructor-driven team pedagogical interventions

In the first article in *Decision Sciences Journal of Innovative Education* in 2003, Koppenhaver and Shrade's study of 500 students in 130 teams found that small teams, balanced by cumulative grade point average (GPA), with an emphasis on graded peer evaluations, are effective teaching strategies to promote effective student teams. They related their goal to "...provide guidance to instructors in creating a cooperative learning environment for students" (p. 16). The long-standing and widely accepted notion of students working together toward a common goal to achieve higher degrees of learning and career preparation is echoed in the tradition of student team research. A common theme in the literature is employing instructor-driven pedagogical interventions followed by assessing the outcomes on some facet of the *team* concept. The following studies represent this perspective.

A study of 110 students (48 USA and 62 French) in 22 self-organized global teams reported the majority of students experienced positive learning outcomes and offered propositions covering managed expectations, conflict, satisfaction, team outcomes, communication and prior experience, as well as recommendations for forming global teams covering team formation, communication and conflict management (Bartel-Radic *et al.*, 2015). In an empirical study of Wiki technologies in student teams, the control group (195 students in 49 teams) outperformed the treatment group (190 students in 48 teams), leading to the conclusion that Wiki technology may inhibit team performance, yet could lead to higher collaborative decision quality (Heidrich *et al.*, 2015). Recognizing the perennial issues of assessing individual efforts in student team submissions, Morgan and Stewart (2017) related a pedagogical design and efficiency improvement process by way of a Web-based tool to form teams and track individual contributions. Addressing the identified gap of mobile apps among research of technology-driven team development, a study of 273 students in 54 teams explored real-time group feedback via a researcher-created mobile app (Blau *et al.*, 2019). The study reported empirical support for greater team trust and team commitment associated with the use of the app. Looking at team-based gamification in online learning environments, a study of 187 students working in teams found that the students' perceived team cohesion is an important predictor of their concentration, perceived control and perceived enjoyment (Zhao *et al.*, 2021). Recognizing the importance of teams together with the challenges of

forming fair teams, Bergey and King (2014) not only created but also studied the use of a team formation decision support system and found that teams formed using this system outperformed teams created by a subject matter expert.

A common thread of this body of literature is that the pedagogical interventions are largely instructor-originated and produced. Whether created themselves or informed by theory or experience, instructors enacted solutions in their courses to achieve learning objectives and improve the total student and team experience. While undeniably valuable, this predominant instructor-driven perspective may be incomplete. In the area of peer evaluations, the student perspective was recognized as underreported (Jassawalla and Sashittal, 2017). In the area of team development, the student perspective is also underreported.

Virtual team development

Not only do students work in teams to develop requisite skills for their careers, but increasingly, teams break traditional geographical, temporal and relational boundaries, as facilitated by information and communication technologies (Martins *et al.*, 2004). In a 2014 study, 79% of 1,700 knowledge workers reported that they "always" or "frequently" work in dispersed teams (Ferrazzi, 2014); now, employees are considered virtually connected no matter where they are (Al-Jallad, 2020). Virtual teams face different challenges than in-person, co-located teams, including varying leadership skills (Pauleen, 2003) and other methods of building trust (Ferrazzi, 2012).

Kozlowski and Ilgen (2006) distinguished between team development and team building. The former refers to formal efforts to modify existing processes, while team development is an informal process initiated by the members to establish social structures and work processes effective for the team. Team development includes an initial forming process and, because teams are not always static in membership, is a continuous process over the team's life (Bell and Kozlowski, 2002). Tuckman's (1965) stages of team development model identified four distinct phases: forming, storming, norming and performing. Each of these phases includes some degree of relationship building, with most occurring during the forming phase. If a team spends adequate time in the forming phase to establish relationships, their journey through storming and norming will be brief. Hackman (1992) focused on the importance of relationship factors considered "glue" that bond team members to each other.

Aga *et al.* (2016) asserted that team relationship building consisted of four distinct approaches of goal-setting, developing interpersonal relations, clarifying roles and employing problem-solving techniques. Teams progress through these stages naturally in co-located settings as the members interact spontaneously throughout the day; however, leaders must take a more active role to develop relationships in virtual teams where spontaneous communication is rare, and team communication exists over computer-mediated technologies (Liao, 2017). "The importance of relationship-building in a virtual environment and methods to build relationships are significant factors when practitioners engage in virtual work" (Pauleen, 2003, p. 229). Ferrell and Kline (2018) highlighted that using both communication- and coordination-focused technology effectively can lead to virtual team trust via fulfilled commitments, vulnerability, acting for the collective good of the team, sharing personal values and experiences, and frequent communication.

Virtual student team development

The rich body of both team and virtual team literature informs managerial techniques to effectively develop a team's capabilities and navigate the unique pitfalls of virtual teams. The natural tendency for university instructors is to apply these research-driven concepts and practices to student teams and to employ pedagogical approaches that mimic real-world

scenarios and proactively equip students for career-based teamwork. What works in organizations and industry, however, may not align directly to the unique student team context. Arguably, the student team experience and context are markedly different. While there is overlap in student and professional team contexts, the former is undoubtedly more ephemeral and comes with a unique set of challenges. Some of the notable differences are project duration (academic term vs market-driven), time allocation (class time vs full-time job obligation), scheduling (presence of dedicated work block), cultural (organizational onboarding or not), ingrained standards (assignment instructions vs enforced company policy), motivation (optimal effort for grade vs long-term job and career performance), authoritative roles (egalitarian and emergent vs structural), cheating (plagiarism vs encourage reuse), performance and evaluation (hypothetical vs actualized) and implications and consequences (constrained to a course and program vs career shaping and impact to livelihood). Despite the differing context of student teams, graduate students indicated their preference for project-based experiential learning in an online course setting, underscoring the importance of virtual collaboration and teamwork (Chen *et al.*, 2021).

Elaborated action design science research

DSR is a research paradigm with a goal of solving sticky, wicked problems where the solution domain and the problem domain are often poorly understood (Hevner *et al.*, 2004). Research conducted in the DSR paradigm seeks to enhance human knowledge with the creation of innovative artifacts (Hevner *et al.*, 2004; Gregor and Hevner, 2013; Sein *et al.*, 2011; Mullarkey and Hevner, 2019). This literature described the artifacts that embody the ideas, practices, technical capabilities and products through which systems can be efficiently developed and effectively used. Artifacts are not exempt from natural laws or behavioral theories. On the contrary, their creation relies on existing laws and theories that are applied, tested, modified and extended through the experience, creativity, intuition and problem-solving capabilities of the researcher. Thus, the results of DSR include both the newly designed artifact and a fuller understanding of the theories of why the artifact is an improvement to the relevant application context. DSR acknowledges that information systems and technology-enhanced socio-technical systems often result from an iterative approach to the build and evaluation of multiple alternatives (Gregor and Hevner, 2013).

The DSR approach becomes action DSR when conducted *in situ* with participants of the socio-technical system and is ideal for principles of researchers' and participants' reciprocal shaping and mutually influential roles (Sein *et al.*, 2011). The eADSR method is an approach that guides the emergent design of these innovative artifacts. As discussed in detail in Mullarkey and Hevner (2019), eADSR offers a research team the ability to systematically and iteratively move through diagnosis, design, implementation and evolution of an instantiated system, process, product or service that solves a challenging problem where the problem and solution domains were initially poorly understood.

The success of an eADSR approach is dependent upon the principles that guide successful iterations of the action design research iterations within a given stage. For example, each artifact must be practice-inspired (relevant) and theory/research ingrained (rigorous) (Sein *et al.*, 2011). The research team conducts concurrent, authentic evaluation – often *in situ* – with the practitioners. The practitioner and the research scholar occupy co-creative and mutually influential roles in the conducting of the work. The concept of co-creation traditionally refers to companies engaging with end-users in value-creation activities (Von Hippel, 1987) and represents a point-of-exchange between companies and consumers (Prahalad and Ramaswamy, 2002). The end-user consumers may take on specific activities previously controlled by the company (Voorberg *et al.*, 2015), and value-creation may be for some or all participants (Grönroos, 2012).

Virtual student teams and the elaborated action design science research approach

The characteristics of the DSR paradigm and the eADSR approach align with the persistent problems surrounding virtual student teams. As summarized from the literature, DSR is a problem-solving process in a dynamic context to address sticky, wicked problems. Optimizing learning using student teams is context-dependent and is accompanied by a set of difficult problems. Action DSR denotes close interaction with participants of a socio-technical system (Sein *et al.*, 2011), such as the virtual collaborative team environment for virtual student teams. Students rely on information technology to facilitate communication and content-production, which are touchpoints of social interactions that elicit behaviors of freeriding or team conflict. Ascribing to the elaborated phases of the eADSR approach allows for exploration into non-obvious diagnoses of recurring problems (Mullarkey and Hevner, 2019) and co-creation of design solutions of the socio-technical system alongside of students that are implemented and evaluated and lead to continual, cyclical re-diagnoses.

Implementation of elaborated action design science research for student teams

Action design science research cycle one: diagnosis, design and implementation phases

This journey of improving virtual student team collaboration while creating transparency for student team interactions for the instructor was, at first, an informal trial-and-error process. The manner by which educators approach their course of instruction is multi-faceted and represents their breadth of experience, which may include their own education and professional careers. External factors such as practitioner and academic literature and satisfying accreditation requirements further contribute to course development, as do historical factors such as the observations, experiences and feedback from previous terms. Ideally, each course designed and delivered is a well-intended consideration of many tradeoffs and decision points. In terms of incorporating student teams in course design, the decisions are many: team size, teams formation method (random, informed, self-organized), weights of teamwork assignments, peer evaluation process and scoring, same teams or rotating members, full-term projects or smaller projects, team workspaces and requirements, deliverables and contributions, conflict resolution and so on. These decisions may be revisited often for each term and course.

The following narrative relates this long-standing traditional course development pattern that was punctuated by the same nagging problem despite interjecting pedagogical interventions. It was not until this informal process was supplanted by a formal method (i.e. eADSR) that focused on the continual diagnosis and re-diagnosis that the underlying problem became apparent.

The portfolio of courses informing this study was, informally, the cumulative instructor experience spanning undergraduate and graduate-level courses delivered on-campus or online. Formally, two graduate-level Master of Business Administration (MBA), Project Management (PM) concentration courses were examined with the eADSR method over the course of four semesters. Both courses were online, with the primary touchpoint being the Canvas Learning Management System. One course, *Leading High-Performance Teams,* was required for students pursuing the MBA with a concentration in PM. Class size varied between 20 and 40 students; team size of four or five students; membership rotated for four distinct teams throughout the 16-week semester. The first three teams were instructor-assigned to minimize team members working together on more than one team. The final team was self-selected by the students. The other course, *PM,* was required of both those students in the PM concentration as well as students in the Executive MBA Program. Class size varied between 80 and 100 students; team size of four or five students, with self-selected teams. This course featured a semester-long project, delivered in small increments throughout the 16-week semester.

Problem diagnosis, elaborated action design science research Cycle one

At the onset, the recurring problem seemed to be that students working in virtual teams simply divided an assignment among the members, did not engage in further discussion or collaboration and finally, combined their work by copy and pasting into a single digital deliverable; a practice described by Morgan and Stewart (2017) as *integration by stapler*. This piecemeal approach often resulted in team conflict, missed deadlines, low satisfaction with teamwork, disjointed project submissions and poor team performance overall, echoing many of the same concerns from early literature (i.e. Koppenhaver and Shrade, 2003).

Informed by literature and professional experience, the initial solution for this problem was an instructor-directive that all virtual student teams host an initial video conference meeting for the sole purpose of introductions and professional relationship-building to engender team development. This was met with impatience; students wanted to dive in and complete their assigned tasks without an impediment to efficiency and managing their own time. Resultantly, this did not eradicate the freerider problem of underperforming team members.

The following semester, students were required to post meeting minutes to a team homepage in the course management system. This requirement was designed to not only assist the team in collaboration but also to provide transparency for the instructor into the team's working sessions. Adding oversight to the team helped to identify individual contributions but did not mitigate freeriders and further revealed the prevalence of the piecemeal approach. Students work independently and, near the submission date, email their work to one team member who combines the work into a single document. Integration, if it occurs at all, is limited to formatting the document and does not extend to collaborating on overall ideas and concepts.

At this point, the instructor stepped back to develop a holistic, research-informed approach (versus a whack-a-mole or "break-fix" approach) to these problems of poor collaboration, transparency and performance. As summarized in the literature review, research indicated that team performance is improved by both formal team development and informal team-building efforts and developing relationships among team members is paramount. The degree to which team members feel included in the team, their intention of staying with the team, and their team's perception of performance relative to other teams are all indicators of the team's overall cohesion. The level of a team member's commitment and perception of the team's ability to work together further describe a team's effectiveness (Huang *et al.*, 2003). With a core of team cohesion, commitment and the collaborative environment, the instructor developed an artifact, the *conceptual design artifact* (Figure 1), based on experience and literature (e.g. Ferrell and Kline, 2018) to depict the entirety of the virtual student team environment, including the collaborative platforms for both communication and content-production (e.g. PM tools) and communication patterns, including periodic team interactions, in addition to non-working team building activities (Figure 1).

From this starting point, the instructor felt confident that simultaneously addressing each of these areas would get at the root of the problem and finally, fix the problems with team-based assignments; however, when the time came to translate these concepts into the course design, this approach appeared strikingly similar to past attempts with instructor-driven course directives, policies, rules and requirements. *Why would we try the same approach and expect different results?*

Instructor-driven directives to improve the overall virtual student team experience seemed to not get to the core of the problem and, in accordance with the eADSR approach (Mullarkey and Hevner, 2019), complex problems that persist despite efforts to fix them may be lacking an accurate diagnosis. Clearly, there was a disconnect between well-intended instructor actions and their effect on student teams. A conservative problem diagnosis *w*as

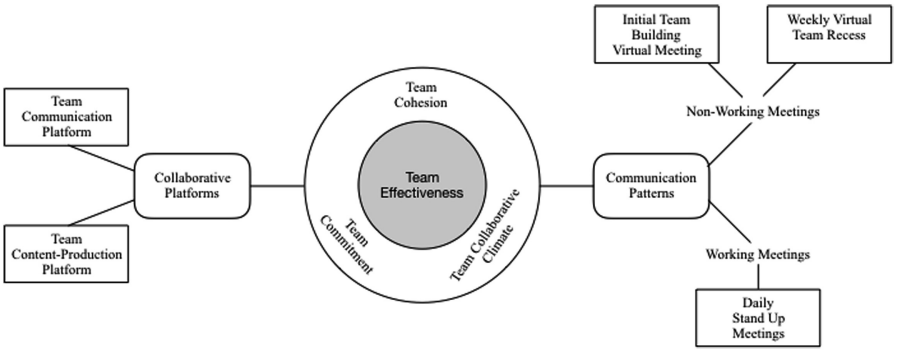

Figure 1.
Conceptual design artifact

that *instructor-driven approaches are insufficient to address deficiencies in virtual student team collaboration*. Following the lead of previous research (Jassawalla and Sashittal, 2017), incorporating the *student voice* may be needed for a greater understanding of the problem at hand.

Co-created design, elaborated action design science research Cycle 1

Following the diagnosis of the problem, according to the eADSR approach (Mullarkey and Hevner, 2019), the instructor sought the student perspective to instantiate the *conceptual design artifact* (Figure 1) established as part of the diagnosis phase via an iterative design process. The *Leading High-Performance Teams* course learning goals are inclusive of building effective teams versus courses where teamwork is utilized but not explicitly taught and, therefore, was a suitable eADSR setting. After three team experiences with rotating members focused on traditional course deliverables, students then self-selected groups for their final team assignment (included in Appendix 1). Acting as subject matter experts, the teams performed a series of iterations to create a complete *instantiated design artifact* for peer students in a later *PM* course. This instantiated design artifact, henceforth referred to as the virtual team classroom environment (VTCE), is summarized below and presented in Figure 2.

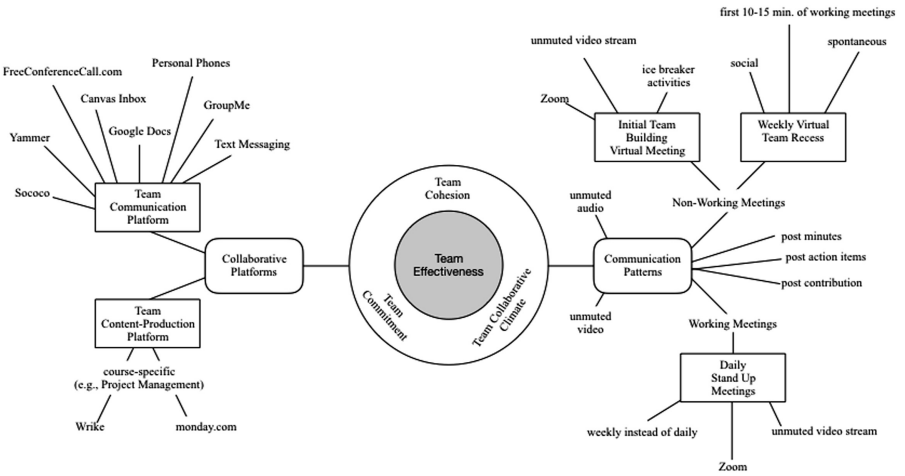

Figure 2.
Instantiated design artifact

Initial team building video conference meeting. Teams were required to hold a non-working meeting focused on socialization and building team rapport, hosted via Zoom with all participants required to share video streams. Team building *ice breaker* activities may include the game "Two Truths and a Lie" where each team member states two true statements about themselves and one false statement, and the other members guess which statement is false [1]. A second activity is an online Kahoot quiz (https://kahoot.it) – also favored by Norwegian students (Almendingen *et al.*, 2021) – with questions like "Where would you vacation if money was not a consideration?" and "If money was not an object, what vehicle would you drive?"

Weekly virtual "Standup" meeting. A virtual working meeting, with emphasis on brevity and where members may choose to stand up so that they are free from other distractions, was required weekly. The meeting format included each member stating their progress since the last meeting, the plan for the work period ahead, and identifying any issues that may hinder progress. Again, Zoom was the preferred virtual meeting platform; however, students opted for weekly meetings instead of the typical daily meeting used in professional practice.

Weekly team recess. Once a week, the first 10 to 15 min of Zoom-hosted working team meeting was designated for non-project conversation topics. Participants were required to share video feeds, and the goal was to replicate the spontaneous interaction communication of co-located teams, where team members see each other in the hallways or stop to chat.

Team communication patterns. Regardless of the working or non-working meetings, team communication patterns included that all team members maintained open voice and video channels when available. For example, when meeting via Zoom, the team members did not mute audio or video feeds, except briefly for background noise or technology problems. This mimics the real-time feedback of in-person meetings. Secondly, teams posted detailed minutes of all meetings that included the percentage of contribution per member, a summary of action items and a list of the next steps to take.

Team communication collaborative platform. The students devised a portfolio of communication technologies that comprised their overall team communication platform. These included basic messaging via text message or via a mobile app (e.g. GroupMe), email communication via the official course learning management system (e.g. Canvas Inbox), voice calls via their shared personal phone numbers, conference calls facilitated by an online tool (e.g. http://freeconferencecall.com), video conferences using the Zoom platform, document creation and revision tracking using a Web- and app-based tool (e.g. Google Docs) and professionally focused social interactions using social media platforms (e.g. Microsoft's Yammer and Sococo). According to Parris (2016), Yammer is similar to Facebook, yet with controlled membership to an organization or a team; Sococo replicates a physical office environment with virtual offices, conference rooms and hangout spots.

Content-production collaborative platform. Depending on the discipline and goals of a particular course, the content-production collaborative platform will vary. In this instance, students looked for viable PM tools needed for teams to track a project, including tasks, schedules and resources. Students vacillated from one cloud-based PM platform (Wrike, https://www.wrike.com) to another (Monday, https://monday.com) to utilize integration with external tools, such as Outlook and Google Docs. Both tools were identified for qualities of flexibility and clear visibility of key information. Monday.com was settled on not only for integration features but also for the no-cost availability to students via an educational program.

Implementation, elaborated action design science research Cycle 1

The specific student VTCE practices developed by *Leading High-Performance Teams* student teams were subsequently implemented in the MBA *PM* course. Team effectiveness

was evaluated using a pre- and post-test online survey instrument measuring dimensions of team collaboration (Appendix 2; adapted from Huang *et al.*, 2003).

Overall, 92% (N = 81) of the invited students completed both pre- and post-survey instruments. Responses were analyzed for statistical differences among aggregated means scores for the three team-effectiveness dimensions: cohesion, commitment and team collaborative climate. The mean scores revealed an increase for cohesion but decreased otherwise.

Shapiro–Wilk test statistics were significant ($p < 0.0001$) and led to employing nonparametric statistical techniques. The Wilcoxon signed-rank test is the nonparametric equivalent to the dependent t-test and was used in this instance to compare data from the same participants from two points in time, i.e. before and after the virtual team interventions. The data met the assumptions of ordinal variables (items are Likert scale) and were matched pairs. The test statistic of interest was the Z statistic and the asymptotic significance (two-tailed) p-value. For p-values < 0.05, the null hypothesis that there is no difference between groups was rejected, and the alternative hypotheses that there is a difference between groups were retained. Table 1 summarizes the results of the Wilcoxon signed-rank tests. The null hypothesis was rejected for team cohesion, indicating a statistically significant ($p < 0.05$) change from the first survey to the next. The null hypothesis was retained for the team commitment and team collaborative climate.

Although exploratory (i.e. lacking structured hypotheses and experimental controls), the results indicated a statistically significant improvement in the students' perceived team cohesion. Qualitative data of student comments indicated satisfaction with a team collaboration framework built into the course assignments (versus all self-organized) and appreciation of the transparency enabled by the collaborative platforms that seemed to bolster team member accountability. Likewise, instructor concerns were reduced by having the ability to review the entirety of a team's body of work from the digital documentation inherent to the VTCE.

Action design science research Cycle 2: diagnosis, design and implementation phases

Cycle 1's initial diagnosis was that *instructor-driven approaches are insufficient to address deficiencies in virtual student team collaboration.* The subsequent design and implementation phases yielded a conceptual design that was translated by students into the specific practices, the *instantiated design artifact*, the VTCE. These practices were used by students and seemed to increase both team cohesion and transparency, thereby alleviating the problem. In accordance with eADSR, processes are continuous due to the ever-changing internal and external environments (e.g. the COVID-19 pandemic accelerated movement to virtual working arrangements).

Problem re-diagnosis, elaborated action design science research Cycle 2

While the VTCE was effective in improving team outcomes and providing more transparency, student and instructor feedback indicated dissatisfaction with the variety of

Table 1.
Team effectiveness: Wilcoxon signed-rank tests results

Dimensions	Item no.	M_{pre}	M_{post}	Z-score[1]	p-value	Decision
Team cohesion (5-point scale)	1–3	4.3977	4.5447	−2.718[2]	0.007	*Difference in groups*
Team commitment (4-point scale)	4–6	3.7737	3.6790	−1.340[2]	0.180	No difference
Team collaborative climate (4-point scale)	7–9	3.8313	3.8066	−0.477[2]	0.633	No difference

Note(s): [1]Wilcoxon signed-rank test, [2]based on negative ranks

tools that were required. The start-up and configuration process for student teams was bulky and disjointed. It required learning and working with a multitude of tools to accomplish the course team collaboration goals while the students were also expected to master the course learning objectives and content-specific tools required in the course. Instructors also had a learning curve with a multitude of tools as well as an administrative burden to establish and coordinate student accounts. Additionally, the majority of these tools were not under the auspices of the university, and some were not available to all students; for example, GroupMe is restrictive for use by international students. Therefore, the problem diagnosis was that *student-created collaborative platforms might lack an overarching, standardized perspective*. The sprawling collaborative landscape from the Cycle 1 process, illustrated in Figure 2, led to the decision to focus on simplification and consolidation of the VCTE.

Design re-invention, elaborated action design science research Cycle 2

Similar to the first cycle, the students' perspective on this issue was sought; however, in a subtle manner, this time by reviewing course evaluations comments. The VTCE specified a long list of online tools, applications and technologies (e.g. GroupMe, Yammer, Sococo, Zoom, Google Docs). Incidentally, COVID-19 pandemic-related shifts in working patterns were emerging and driving students and faculty to virtual presence and collaboration tools. Rizvi and Nabi (2021) identified the overarching digital infrastructure as a factor for online education. The myriad of online tools, platforms and mobile apps identified by student teams to facilitate group collaboration are not universally accessible. For example, GroupMe, a mobile app for posting messages to a group, requires a domestic phone number to use and is unavailable for international students. Consequently, recognizing an overarching digital infrastructure is a vital step to balance student-created approaches with organizational realities. The Microsoft Teams collaborative platform was adopted into the university's supported and freely available portfolio of applications. The confluence of these factors led to the decision to replace nearly all technological parts of the VTCE with the Microsoft Teams platform; effectively maintaining the function and original intent of the students who created them as illustrated in Figure 3. One exception is the VTCE's content creation platform, which is dependent on the course requirements. For example, in a *PM* course, the content-creation platform includes Microsoft Project, while in other courses, it may be Microsoft Word, Excel or a discipline-specific application.

Implementation and future research directions, elaborated action design science research Cycle 2

The revised VTCE using Microsoft Teams was implemented in the *Leading High-Performance Teams* and *PM*. Anecdotally, Microsoft Teams was well received by the student teams to the extent some are voluntarily using it in other courses and contexts.

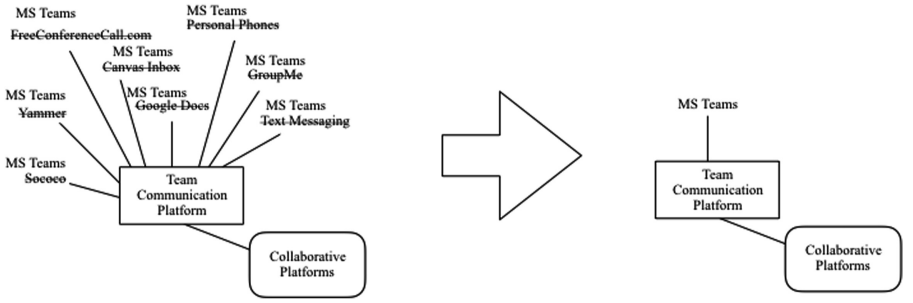

Figure 3.
Re-instantiated design artifact

The next step is to formally evaluate the effectiveness of the VTCE using and consider qualitative measures to best capture the depth of student perspective. The next cycle will begin again with re-diagnosis of the problem, which may focus on any or all aspects of the VTCE, including effective use of technologies (e.g. add-on tools for Microsoft Teams), re-formulation of student team processes (e.g. incorporating agile practices) and emerging areas of study such as Zoom burnout as discussed by Samara and Monzon (2021). Regardless of the specific directions, the eADSR process provides the framework to co-create artifacts with students.

Conclusion

This paper addressed the gap of the unreported student perspective in devising pedagogical approaches to promote cooperative learning environments for students. The highlight of this paper is that it explained a method upon which the voice of the student was not only considered but actively engaged to co-create an effective VTCE guided by eADSR. Additionally, it provided an explanation of how eADSR can serve as a model for continuous improvement to deal with long-standing sticky problems where both students and instructors lament the inequities of teamwork. It presented a feasible approach for student virtual team research as it captures the socio-technical perspective and provided an avenue for continual experimentation and innovation *in situ* with students. There is no substitute for the student experience when determining effective methods of collaborating.

While student solutions may result in unwieldy outcomes, eADSR provided the framework for continuous improvement and innovation to develop an acceptable solution to problems of practice. The eADSR process yielded non-obvious diagnoses and actionable steps for continually incorporating the ever-changing social aspects unique to students in addition to the evolving technological landscape.

This paper is important to practice as it provided a replicable method to incorporate the *student voice* to address pedagogical approaches. Additionally, it provided an *instantiated design artifact* (the VTCE) that can be implemented in a classroom. Not only can the VTCE empower students to collaborate effectively, but it also improved transparency for the instructor and the students in terms of team member contribution with the goal to alleviate the issues of freeriders on team projects. We cannot stress enough the importance of intentionally designed online courses to aid in student learning. This was important pre-COVID-19 and continues to be important as institutions embrace online learning for the long term (Singh *et al.*, 2022).

Note

1. Use "Two Truths and a Lie" at your own risk; it can degrade quickly into inappropriate and uncomfortable territory. The "Fun Fact" technique is a viable substitute, students share an interesting fact about themselves.

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Corresponding author
Diane Kutz can be contacted at: dckutz@una.edu

Appendix 1

Virtual team classroom environment research paper assignment

There are six teams and six interventions, so each team will research one of them. The selection process will be handled on a first-come, first-served basis, and the selection will be handled based on replies to the announcement post. Please do not begin the paper until you receive confirmation that your team was assigned that intervention. Once you have received confirmation, please complete your paper on the intervention of choice by your team.

The team will research and write up a paper meeting the following goals:

(1) Provide an overview of the intervention

(2) Provide a detailed description of the intervention and all that it entails

(3) Discuss the objective of the intervention

(4) Explain the key performance indicators (KPIs) that should be evaluated for the intervention (the measures by which the effectiveness will be evaluated)

(5) Explain the specific objectives and key results (OKRs) of the intervention (the characteristics of the intervention)

(6) Discuss any interventions other than those six listed here that your team feels should be considered in establishing an effective virtual team environment.

(7) Present specific recommendations for the implementation of their intervention in a future PM course.

Initial team building video conference meeting

Note: One of the OKRs should be the video platform for the meeting.

Daily virtual standup meeting

Note: One of the OKRs should be the video platform for the meeting.

Weekly virtual video "Coffee Break"

Note: One of the OKRs should be the video platform for the meeting, and you should also determine a more suitable name than "Coffee Break."

Team collaborative communication environment

Note: This includes, but is not limited to, file sharing, chat, communication guidelines for when to use what form of communication (phone call, email, chat, group message, conference call, video meeting, etc.). This environment may also include a PM tool.

Project management software tool

Note: This may include a team collaborative environment.

Team communication patterns

Note: This should include all team communication guidelines.

Appendix 2

Table A1.
Team effectiveness survey instrument[1]

Team cohesion

1. Do you feel that you are really a part of your student work team?
5 Really a part of my work team
4 Included in most ways
3 Included in some ways, but not in others
2 Do not feel I really belong too much
1 Do not feel I really belong at all
2. If you had a chance to do the same kind of work in another student work team, how would you feel about moving to another team?
5 Would want very much to stay where I am
4 Would rather stay where I am than move
3 Would make no difference to me
2 Would rather move than stay where I am
1 Would want very much to move
3a. How does your work team compare with other student teams on each of the following points? *The way people get along together*
3b. How does your work team compare with other student teams on each of the following points? *The way people work together*
3c. How does your work team compare with other student teams on each of the following points? *The way people work together*
5 Very much better
4 Much better
3 About the same
2 Much worse
1 Very much worse

Team commitment

4. Achieving our team goal(s) is a higher priority than any individual objective
5. Team members believe that personal success is achieved through the accomplishment of the team goal(s)
6. Team members are willing to devote whatever effort is necessary to achieve team success
1 False
2 Partially false
3 Partially true
4 True

Team collaborative climate

7. We trust each other sufficiently to accurately share information, perceptions and feedback
8. We help each other by compensating for individual shortcomings
9. We can trust each other to act completely and responsibly in performing our individual tasks
1 False
2 Partially false
3 Partially true
4 True

Note(s): [1]Survey questions adapted from Huang *et al.* (2003)