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From the Editor

What do the Pittsburgh Steelers and the *Journal of Technology Education* have in common? The Steelers have had only three different head coaches since 1969, and *JTE* has had three editors since 1989. As some of you likely know, I am a Steelers fan. My first pet (a Labrador Retriever) was named Steeler. When my three children were born between 1999 and 2004, I was pictured in the hospital wearing the same Steelers hat. When I went on my first pheasant hunt, I was wearing an appropriately colored Steelers hat. Today, I write this editorial wearing a Steelers hat. This one is camouflage but still maintains its iconic Steelers' logo. Our profession, even with its different names, has maintained its iconic mission. Like the technology and engineering education profession, the *JTE* has changed in scope but maintains its overall mission and the vision of its founders.

Since 1989, the *JTE* has provided a forum for scholarly discussion on topics relating to technology and engineering education and has more recently provided a research-based examination of STEM education as it relates to integrated technology and engineering education. Articles have focused on technology and engineering education research, philosophy, and theory. Finally, *JTE* has published book reviews, editorials, guest articles, comprehensive literature reviews, and reactions to previously published articles. In the opening editorial in the *JTE*, Mark Sanders (1989) wrote, "We hope this inaugural issue of the *JTE* begins an ongoing discourse on issues and concerns of importance in the field of technology education" (p. 3). I believe that through the focused approach of the *JTE*, we, as a profession, have maintained the intended mission of the journal.

All of us have likely heard that history repeats itself. In their comments following Sanders' editorial in that inaugural issue, the ITEA (then International Technology Education Association) Board of Directors wrote:

> We initiate this publication at a time when the state of teacher preparation institutions in the field is at one of its weakest points in history. The need for additional thought-provoking articles and issues could not be greater. Also, the expansion of one's thoughts beyond current boundaries into the sciences, engineering, liberal arts, and more are needed to communicate and promote the study of technology far beyond the narrow perspective envisioned by educators and the general public. (1989, p. 4)

Technology and engineering teacher preparation institutions in 2020 are likely at their all-time low; however, the expansion of research beyond technology education has come to fruition through the addition of engineering education and STEM education. Yes, history can repeat itself, but history also moves us toward innovation.

While completing a targeted literature review for my final "from the editor," I discovered an editorial by Lee Smalley in the inaugural edition of the 1989 *JTE* titled "Images of Schools: 2020 Possible, Probable or Preferable?" The editorial is thought-provoking, and I would encourage all of you to read it; however, I wanted to highlight the overarching questions that Smalley used in the editorial:

- What are we going to do about the school as a helping place?
- What are we going to do about the school as a democratic place?
- What are we going to do about the teacher as director?
- What are we going to do about recognizing the importance of talent?
- What are we going to do about teaching higher order thinking skills?
- What are we going to do about including the future in schools?

I would like to see multiple editorials from professionals in technology and engineering education submitted to the *JTE* that either address these questions from 1989 or propose new questions that can guide us for the next 10 years.

Through the vision of the International Technology and Engineering Educators Association, the Council on Technology Teacher Education (now the Council on Technology and Engineering Teacher Education), Mark Sanders (Editor 1989–1997), and James LaPorte (Associate Editor 1989–1997 and Editor 1997–2010), the *Journal of Technology Education* was developed, and it has served as one of the flagship research-based journals in our profession. I have been honored to serve as the third editor of the *JTE* from 2010–2020.

When I took over as *JTE* editor in 2010, I really had just one internal mission for myself with a few subpoints. First, I wanted to make the former editors and the editorial board members proud. Second, I wanted the readers and subscribers to feel that the work they were reading was worthy of their time. Third, I wanted the authors of the manuscripts to know that I worked for them to make their manuscripts better. In a nutshell, I told myself, "Don't screw it up! The profession is counting on you." As I transition out of my role as editor, I know that the new editors, Dr. Mary Annette Rose and Dr. Jim Flowers from Ball State University, will carry the journal forward because they are both professionals beyond rebuke. *JTE* is in fantastic hands! I wish Drs. Rose and Flowers nothing but the best of luck in their new role, and I am excited to see not only how *JTE* history repeats itself but also the innovation that they will bring to it.

In closing, I want to thank Mark Sanders, Jim LaPorte, ITEEA, CTETE, and Amanda Fain, the technical editor for *JTE*. I would also like to thank the *JTE* editorial board members for their relentless professionalism and all of the professionals who are conducting research and submitting their work to *JTE*.

Chris Merrill

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Selected Stakeholders' Views on the Use of Tablets for University Learning: A South African Case Study

Simon Christopher Fernandez & Kuttickattu John Mammen

Abstract

The popularity of mobile technologies has greatly influenced people of all ages, especially adolescents. The purpose of this research was to determine the views of students, lecturers, and managers as selected stakeholders to assess the effectiveness of tablet computers in learning at a South African university. Using a mixed-methods approach, this case study focused on Extended Stream students who were enrolled in a degree program in Information and Communication Technology or Electrical Engineering. Survey participants consisted of 155 students and 25 lecturers, and interviews were conducted with 18 students, 5 lecturers, and 9 managers. Data collected from closed-ended questionnaires were entered manually into the Statistical Package for Social Sciences (Version 24) and then analyzed using descriptive and inferential analyses, using an independent samples *t*-test. Data collected from interviews were transcribed and analyzed using thematic analyses to generate major themes and subthemes. Findings from the statistical analyses of quantitative data revealed that there was no significant difference between the views of students and lecturers on the effectiveness of the use of tablet computers for learning. The thematic analyses of qualitative data revealed that students, lecturers, and managers all concurred that tablets have a positive impact on student learning.

Keywords: tablet computers, learning, mobile technology, stakeholders' views, university

Students in the 21st century have transformed drastically in terms of finding new learning methods and exploring technologies (Prensky, 2005). In order to maximise the potential of technology in student learning, effective ways of integrating the latest technology in the classroom must be found (Geist, 2011). Institutions in this era are improving radically by incorporating advanced technologies in the classroom (Kyzym, Petukhova, & Kaidalova, 2017). Brown (2000) states that students are utilizing technologies such as the internet successfully, thereby discovering a new method of obtaining knowledge and learning.

Mobile learning devices such as smartphones and tablets can greatly enhance students' interest in their studies at both the pre-university (Popović, Marković, & Popović, 2016) and the university level (Lin & Lin, 2016). These devices also aid in mobile learning, allowing students to learn at a convenient place and time (Menkhoff & Bengtsson, 2012). It is absolutely necessary to

integrate tablets into learning and teaching for the purpose of switching from the chalk and talk approach to a blended learning approach (de Figueiredo & Afonso, 2005). Meurant (2010) postulates that the tablet is a game-changing device that is probably going to modernize education.

Many institutions all over the globe have already spent a large amount of money on purchasing bulk quantities of tablet computers for the benefit of their students (Vu, McIntyre, & Cepero, 2014). Foresman (2010) and Miller (2012) emphasize that many universities around the world are integrating tablets into the curriculum as a cost-saving, interactive, and collaborative tool.

The effectiveness of technology in institutions can be seen only if it is incorporated with curriculum standards (Debele & Plevyak, 2012). In a study designed to assess the need for technology in the classroom, Sugar (2005) found that technology had a positive impact on teachers. Another study conducted by Roschelle et al. (2010) revealed that technology in the classroom enhanced students' learning capabilities.

A study conducted by Percival and Claydon (2015) in Canada to determine the views and attitudes on tablet use for learning revealed that students had mixed opinions. Generally, students appreciated the portability and easy access of tablets, but some were concerned with the distractions caused by those who use tablets for non-learning purposes. In Mango's (2015) study, students had a very positive perception of tablets as learning tools. Using tablets in the classroom not only boosts students' interest in attending lectures (Rossing, Miller, Cecil, & Stamper, 2012) but also improves their confidence (Shen, 2016).

Although many educational institutions around the globe have already started using tablets in the classroom, there is also a dearth of empirical research on how to implement tablets in the classroom (Pegrum, Howitt, & Striepe, 2013) and how tablet use affects students' learning (Wakefield, Frawley, Tyler, & Dyson, 2018). Even though tablets are the latest tool for learning, there are some serious gaps in this area of research that need to be addressed, such as how well students are using tablets in the classroom and whether tablets can increase students' motivation, engagement, and participation. Such investigations have been done in developed countries such as Canada (Karsenti & Fievez, 2013), Australia, (Clarkson, 2018), and the United States (Chou, Block, & Jesness, 2012, 2014; Mango, 2015; Shen, 2016). However, very little research has been done in developing countries like South Africa. Therefore, research on the views of stakeholders such as students, lecturers, and managers on students' use of tablets for learning in university classrooms is needed.

Literature Review

In a study investigating the perceptions of university students in the United States on the use of iPads in their learning, Mango (2015) found that "students not only enjoyed using the iPads but also saw them as effective learning tools"

(p. 56). A mixed-methods approach study conducted by Rossing, Miller, Cecil, and Stamper (2012) with 209 students from Indiana University – Purdue University Indianapolis revealed that some students felt that tablets were a hindrance to their learning. However, the majority of students felt that tablets were a motivational tool to learn the topics, attend classes, and actively participate. Ağir (2015) conducted a study in Turkey to evaluate how well tablets were used in a classroom and whether they increased students' motivation to learn. Findings showed that students did not use tablets to read e-books or create presentations but did use them to gather information. Overall, students reported positively on synchronizing smart boards and tablets in education. A study conducted by Hahn and Bussell (2012) explored the experiences of undergraduate students at the University of Illinois regarding their use of iPad 2 tablets for their course work. Using focus groups and survey data, they found that students used the device as a learning tool, "particularly for in-class use . . . [and] to connect with course-specific content" (p. 42). In a quantitative study using a 5-point Likert-scale questionnaire, Diemer, Fernandez, and Streepey (2012) explored how tablets had impacted undergraduate students' perceptions of learning and their engagement in active and collaborative learning during tablet-centered activities. Their findings showed that the adoption of tablets had enhanced collaborative learning and engagement between students. In a qualitative pilot study conducted in the Midwestern United States with a total of 237 students, Chou, Block, and Jesness (2014) found that students had more openings to work together in groups for the project and brainstorm with their peers to be more creative. The students were also interested in attending classes to perform tablet activities, which makes them productive. The purpose of Rossing's (2012) study was to determine the perceptions of university teachers on student tablet use when tablets were incorporated into communications courses. He used observations, discussions, and experiences to capture the teachers' perceptions of tablet use. The findings indicated that the use of mobile devices invited collaboration and cooperation as well as changed the way that students interacted with one another and applied their knowledge.

Conversely, the findings from an online survey conducted by Long, Liang, and Yu (2013) in China showed that although students agreed that tablets could be used as a learning tool, students who owned tablets used them for entertainment purposes only. Similarly, the study conducted by McBeth, Turley-Ames, Youngs, Ahola-Young, and Brumfield (2015) also indicated that although tablets enhanced students' critical thinking and collaboration, the use of tablets created some pedagogical challenges. A research study conducted by Ağir (2015) warns that students must pay attention to their work instead of being distracted. However, Ağir (2015) and Mango (2015) fount that tablets facilitated students' participation and collaboration when they worked on projects in a group.

The purpose of this study was to gather the views of stakeholders such as students, lecturers, and managers to assess the effectiveness of using tablets in learning at a university in the Eastern Cape Province of South Africa. This study was guided by the following research question: How do students, lecturers, and managers differ in their views on the effectiveness of tablet use for learning in university classrooms?

Research Methodology

The instruments used in the mixed-methods research consisted of closed-ended questionnaires and interviews. A mixed-methods approach was used in this study because the different instruments used to collect the data offered valuable and pertinent information about the phenomenon in this study. The researchers used a case-study research design with elements of descriptive survey research and interviews. Although structured survey questionnaires were given to university students and lecturers, interviews were conducted with all stakeholders: students, lecturers, and managers. Data were collected from all participants at the end of 2017.

Study Site and Context

The selected university is situated in the Eastern Cape province of South Africa. The researchers chose this university for the study because it was the only university in this province where students and lecturers used tablets for learning and teaching. At the university, there are two divisions of diploma programs: Main Stream (MS) and Extended Stream (ES). The ES division is designed to assist students who have great potential but have inadequate knowledge to succeed in their diploma programme. Diploma programme applicants are required to take the Standardized Assessment Test for Access and Placement (SATAP), and students' SATAP scores determined which division of they will be placed in. A bulk quantity of tablets was purchased from the fund allocated for the betterment of ES education. These tablets were supplied to all ES students and lecturers in the Department of Information and Communication Technology (ICT) and the Department of Electrical Engineering (EE) in 2014. As such, this study focused exclusively on the ES students' use of tablets in the university classroom.

Population and Sample

The targeted participants for this study were students, lecturers, and managers. A total sample of 155 students (89 male and 66 female) comprised of ICT and EE students from a population of 254 and a sample of 14 lecturers (nine male and five female) comprised of ICT and EE lecturers from a population of 25 voluntary participated in the survey. A total of 18 students from the ICT and EE cohorts were interviewed. A total of five lecturers from the ICT and EE departments were interviewed. Additionally, a total of nine managers were

interviewed. Because the EE department was located in the same building as the ICT department, where the main researcher works as a lecturer, it was convenient for him to approach the lecturers and students in both departments.

Data Collection Instruments

The researchers created two 5-point Likert-scale questionnaires, one for students and one for lecturers. The scale ranged from *strongly disagree* (1) to *strongly agree* (5). The questionnaire for students and lecturers consisted of two sections each. The first section of each questionnaire was used to collect demographic data for participants. A total of six items were included in each questionnaire. In order to create the questionnaire, the researchers used various sources. Because the ways students were learning using tablets at the university level and at the pre-university level was similar, the researchers started with an in-depth study on the literature at both levels, which assisted in the development of the questionnaire. Some of the items in the questionnaire were modified from studies in the literature review, including Ağir (2015), McBeth et al. (2015), Rossing et al. (2012), Diemer et al. (2012), Shen (2016), and Mango (2015). The Likert-scale questionnaire of the current study was checked for content validity after the pilot study. The Cronbach's alpha reliability of students and lecturers was calculated, and the results were 0.807 and 0.733, respectively.

A total of three, five, and four key interview questions were used to collect the data from students, lecturers, and managers, respectively. A thematic approach was used to analyze the interview responses, and the results were triangulated to confirm the findings. The data were analyzed using some major themes and subthemes to understand in-depth knowledge on the use of tablets for learning in the classroom.

Data Collection Procedures

Before the commencement of the main study, the main researcher conducted a pilot study for the survey with five students and five lecturers. He also conducted pilot interviews with three students, three lecturers, and three managers to practice questioning, listening, and recording to ensure the accuracy, consistency, and smooth running of the interviews. The participants who participated in the pilot study were not involved in the main study.

Ethical clearance was obtained from the university to collect data from participants. The main researcher arranged a few qualified, trained academics to administer the questionnaire to students in order to decrease bias. Before all trained academics started administering the questionnaire, the main researcher visited the classroom and explained the consent form and the study, emphasizing that their participation was voluntary and that the data collected would be confidential and anonymous. All of the students completed the questionnaire before the specified time, and the response rate was 100%. The main researcher emailed the questionnaire to all the lecturers and collected the responses from

them after sending reminders through WhatsApp, personal messages, and phone calls (the response rate was 64%).

Because the main researcher was located on-site, his office was used to conduct the interviews of students, lecturers, and a few managers such as heads of various departments and deans. Remaining managers such as e-learning specialists, e-learning administrators, extended programme coordinators, and institutional head of extended programme coordinator were interviewed in their offices for their convenience. Interviews were recorded using a high-quality smartphone. Professional audio-recording software installed on a laptop was also used as a secondary measure to ensure that no information was lost. The researchers followed all ethical research practices to ensure that respondents were not mistreated emotionally or physically during the interview.

Data Analysis

Quantitative data were entered manually into Statistical Package for Social Sciences (Version 24) and were analyzed using descriptive and inferential analysis. Categorical variables of quantitative data were compared and tested using an independent samples *t*-test to compute frequency tables and descriptive statistics. A *p*-value of < 0.05 was considered to be statistically significant. Qualitative data were transcribed and analyzed using thematic analysis to generate major themes and subthemes for the research question.

Findings

Quantitative Findings

Table 1
Triangulation of Descriptive Analysis of Students' and Lecturers' Survey Responses for Learning

Item	Item description	*n*	Disagree	No opinion	Agree
S1	Tablet activities motivated me to learn the course material more than the class activities that did not use tablet.	152	41 (27%)	28 (18.4%)	83 (54.7%)
L1	Tablet activities motivated students to learn the course material more than the class activities that did not use tablet.	14	5 (35.7%)	3 (21.4%)	6 (42.8%)
S2	Tablets helped me to participate more in class during the tablet activities than during activities	155	53 (34.2%)	29 (18.7%)	73 (47.1%)

	that did not use tablet.				
L2	Tablets helped students to participate more in class during the tablet activities than during activities that did not use tablet.	14	3 (21.4%)	1 (7.14%)	10 (71.4%)
S3	Tablets made it easier for me to understand the topics using tablets when I learn in a group.	154	21 (13.6%)	8 (5.2%)	125 (81.1%)
L3	Tablets made it easier for students to understand the topics using tablets when they learn in a group.	13	1 (7.6%)	4 (30.7%)	8 (61.4%)
S4	Tablet activities helped me to participate in quiz as a team.	154	39 (25.3%)	34 (22.1%)	81 (52.6%)
L4	Tablet activities helped them to participate in quiz as a team.	14	2 (14.2%)	5 (35.7%)	7 (50%)
S5	Tablets helped me to gather information for the group project work.	155	11 (7.1%)	8 (5.2%)	136 (87.7%)
L5	Tablets helped them to gather information for the group project work.	14	0 (0%)	4 (28.5%)	10 (71.3%)
S6	Tablets helped me in group discussion.	155	13 (8.4%)	6 (3.9%)	136 (87.8%)
L6	Tablets helped them in group discussion.	14	1 (7.1%)	4 (28.5%)	9 (64.2%)

Note. Responses from the questionnaire were collapsed into three categories: disagree (*strongly disagree* and *disagree* responses), no opinion, and agree (*agree* and *strongly agree* responses). Because not all participants (155 students and 14 lecturers) responded to every item, the *n* for each item is included above.

It was observed that 54.7% of students and 42.8% of lecturers agreed for Items S1 and L1, respectively. About 18.4% of students and 21.4% of lecturers were uncertain. Around 1.8% of students did not answer Item S1. The percentage of lecturers who agreed for Item L2 was 71.4%; however, only 47.1% of students agreed for Item S2. About 18.7% of students and 7.14% of lecturers were uncertain. Around 81.1% of the students and 61.4% of the lecturers agreed to Items S3 and L3, respectively. About 5.2% of students and

30.7% of lecturers were uncertain. However, 7.2% of lecturers did not respond to Item L3. The percentage of students and lecturers who agreed for Items S4 and L4, respectively, was around 50%. About 22.1% of students and 35.7% of lecturers had no opinion. Additionally, 87.7% of students and 71.3% of lecturers agreed for Items S5 and L5, respectively. About 5.2% of students and 28.5% of lecturers were uncertain. Likewise, 87.8% of the students and 64.2% of the lecturers agreed for Items S6 and L6, respectively. About 3.9% of students and 28.5% of lecturers had no opinion.

An independent sample t-test was conducted to compare the views of students and lecturers at a 5% level of significance (i.e., $\acute{\alpha} = 0.05$). The results showed that there was no significant difference (t (167) = 0.566, p (2-tailed) = 0.572) in the views of students ($M = 25.12$, $SD = 4.926$) and lecturers ($M = 24.36$, $SD = 3.835$). The difference in the means was 0.765 with 95% CI (-1.907 to 3.437). Therefore, the views of students and lecturers were the same on the effectiveness of tablet use for learning in university classrooms, and it had an equal effect on all participants.

Qualitative Findings

In order to refer to interview participants, the 18 students are referred to as Students 1–18, the five lecturers are referred to as Lecturers 1–5, and the nine managers are referred to as Managers 1–9. The major theme that was generated after data collection was the effectiveness of tablet use for learning. The three subthemes that emerged from the major theme after triangulation were engagement and collaboration, curriculum change for tablets, and enhancement of skills.

Regarding the first subtheme, engagement and collaboration, students engaged and collaborated with their classmates using different social networking applications for learning purposes. Students 1, 3, 6, and 17 stated that they communicated and collaborated with their classmates only when they could access wi-fi or the internet. Even though they were in group discussions, most of them had issues accessing the internet because of the inability to use SIM cards in their tablets. Internet or wi-fi was accessible to them only when they were on campus. Student 11 stated, "We are discussing some topics that we have been given by the lecturer so that we will be getting some new things from one another with the help of tablets." Unlike their peers, Students 2, 5, and 18 did not believe that there was active collaboration between classmates. The lecturers all agreed that tablets helped students to engage and collaborate with their classmates for the purpose of learning. Lecturer 1 indicated that students created a WhatsApp group for their class; thus, even if students were not on campus, they could still communicate with each other and share the handouts in WhatsApp. According to Lecturer 2, if the lecturer gave a task to one student to pass on to the others, they would share and discuss the task on WhatsApp using tablets and later meet physically as a group.

Regarding the second subtheme, curriculum change for tablets, most of the lecturers suggested that changes must be made in the way that topics were delivered using tablets in class but not in the curriculum. Lecturer 3 stated, "No. No need to make changes in the curriculum. Whatever we are using that must be in line with the technology." Lecturer 1 stated, "It is a tool that is not changing the content. So if needs for the content to be changed, then it should be for the other reasons but not for tablets." On the other hand, Lecturer 2 thought that the curriculum needed to be changed for the tablets. The majority of the managers were also in agreement with the lecturers that the curriculum need not be changed but that the change should be in the way that the curriculum was delivered. Manager 4 stated, "I don't think that curriculum needs to be changed. Because I think the curriculum has its own learning outcomes. I think what needs to change is the way that the curriculum is delivered and also the way it is accessed." Manager 3 also had a similar view: "I don't think curriculum needs to be changed, but because [the] tablet is just a tool to learn just like a book, which you have lot textbooks or a reading material." Conversely, two respondents, Managers 5 and 8, thought that the curriculum needed to be slightly modified.

Regarding the third subtheme, enhancement of skills, the majority of students had a positive experience because it had enhanced their skills and learning capabilities. Student 4 stated, "I start learning how to connect to wi-fis; I start learning to access other applications through the internet. So I think I do learn something when you get those tablets." Students 2, 5, 6, 7, 10, and 16 corroborated the view of Student 4: that their learning was enhanced by using tablets to access the internet. Student 3 was fond of reading notes on tablets. However, Students 8 and 18 had a negative impression of tablet use. Student 8 stated that because tablets did not have SIM card slots, it was difficult to access the internet all the time. Moreover, Student 18 preferred using hard copies to read notes. All the lecturers thought that tablets had enhanced students' learning capabilities and developed their skills after the adoption of tablets. Lecturer 1 stated, "They can do the assignments in their comfort zone." Lecturer 3 corroborated with the view of Lecturer 1 by mentioning that "they are having the blackboard, or in other words Wiseup, so it's easy for them to access their assignment, and they can respond." Whereas Lecturer 4 stated that students had started reading e-books using tablets, Lecturer 2 emphasized that the tablet was a tool that had not only advantages but also disadvantages. Managers also had a positive response regarding the enhancement of students' skills. Manager 3 stated, "I would like to think that it has enhanced students' skills. Because it has also shown the throughput rate has improved. So it should have definitely improved students' skills." Managers 4 and 6 also supported the view of Manager 3.

Discussion

Survey Responses

The survey responses revealed that both students and lecturers agreed that tablet activities motivated students to learn the course material more than the class activities that did not use tablets (Items S1and L1). Diemer et al. (2012) and Rossing et al. (2012) indicated that tablet activities motivated students to learn the course material. Mango (2015) averred that the use of iPad tablets motivated students to participate in class activities. Ağir (2015) and Chou et al. (2012, 2014) stated that the use of tablets increased motivation to learn. Therefore, findings of the current study were stable with the views of Diemer et al. (2012), Mango (2015), Ağir (2015), Chou et al. (2012, 2014), and Rossing et al. (2012). Most of the students in the current study felt that tablets helped them to participate more in class during the tablet activities than during activities that did not use tablets (Items S2 and L2). This is similar to the results found by Rossing et al. (2012) and Diemer et al. (2012), who found that tablets helped students to participate more than usual in the classroom. There was unanimous agreement from students and lecturers that tablets made it easier for students to understand the topics when they learn in a group (Items S3 and L3). The findings of this study coincide with the findings of Rossing et al. (2012) and Diemer et al. (2012), who stated that students found it easier to learn in a group using tablets. The study found that tablet activities helped students to participate in online quizzes as a team (Items S4 and L4). The majority of the students and lecturers agreed that tablets helped students to gather information for the group project work (Items S5 and L5). Although Ağir's (2015) findings were similar to the findings of the present study, Hahn and Bussell's (2012) findings were not because the students in that study had difficulty using tablets to access course content due to compatibility issues. Furthermore, this study showed that tablets helped students in group discussion (Items S6 and L6). Rossing et al. (2012) also indicated that students' participation in class discussion and group discussion increased after the adoption of iPad tablets. Ağir (2015) asserted that tablets helped students to join in the discussion. Therefore, the results of the current study are similar to studies by Rossing et al. (2012) and Ağir (2015).

Interview Responses

In the interviews, students' and lecturers' responses echoed the survey findings that students engaged and collaborated with their classmates by making use of different social networking applications such as Facebook, Twitter, and WhatsApp for the purpose of learning. Chou et al. (2012) concurred that "mobile devices such as iPads increase student engagement; teachers have commented that the students were 100% on tasks and engaging in classroom discussions" (p. 21). McBeth et al. (2015) indicated that 56% and 63% of the respondents' concurred with the notion of engagement and collaboration, respectively. Therefore, the results of the present study are consistent with the

findings of Chou et al. (2012, 2014) and McBeth et al. (2015). Lecturers and managers disagreed with the idea of changing the curriculum for the use of tablets. They stressed that changes must be made in the delivery of lectures but not in the curriculum. This is contrary to Ağir's (2015) findings that current curricula should be changed for effective iPad use. All of the stakeholders in this study agreed with the statement that tablet use had enhanced the skills of students. This finding is consistent with Rossing et al. (2012) and Diemer et al. (2012), who found that the use of tablets enhanced the skills of students.

Conclusion

All stakeholders in this study showed positive attitudes about students' use of tablets for learning in the classroom. The findings also showed that there was no significant difference between the views of students and lecturers on the use of tablets for learning. Students' motivation to learn increased after the adoption of tablets. Tablets enabled students to be active in the classroom. Students also began to communicate actively with their peers and lecturers, both inside and outside the classroom. Overall, students and lecturers felt that learning was enhanced significantly after the implementation of tablets.

Limitations and Recommendations for Further Research

This study was not without its limitations. The students and lecturers in the study were only from the ICT and EE departments. There was no study conducted with groups of students from other departments in the same university to evaluate the difference in the results. It is expected that the findings from this study will stimulate further research in other areas such as the strengths and weaknesses of tablet use by students and lecturers in universities as well as learners and teachers in the schools.

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Peer-Prompted Engineering Design: How Do Adolescents Interact and Strategize?

Kristin M. Strong, Oenardi Lawanto, & Amy Wilson-Lopez

Abstract

Engineering design was integrated into K–12 science education in the *Next Generation Science Standards* (NGSS Lead States, 2013), but teaching design remains a challenge for educators. Design problems are ill-defined, ill-structured, and complex problem-solving tasks. Their solutions require creativity and recursive, metacognitive processes that cannot be taught with simple algorithms. Moreover, adolescents do not demonstrate fully developed metacognitive skills because they are undergoing profound developmental changes. In this comparative case study, we explored how peer-delivered metacognitive prompts supported adolescents during a design challenge. We investigated how scripted prompts sparked reflection and stimulated design changes and identified which prompts were most effective. We also observed four interaction patterns between paired peers. The interaction patterns influenced the quantity of design changes and shaped the strategies that students used during revisions.

Keywords: adolescents, collaborative learning, engineering design, metacognition, middle school, prompts

In 2009, the Committee on Engineering Education and the National Research Council (Katehi, Pearson, & Feder) issued their report, *Engineering in K–12 Education: Understanding the Status and Improving the Prospects*, which outlined the benefits of K–12 engineering education to science, technology, engineering, and mathematics (STEM) education. In addition to widening the STEM pathway and improving technology literacy, the committee believed that engineering education could act as a catalyst to integrate all the STEM disciplines and make them more effective.

The committee also gave general principles for the implementation of engineering education. Their first key principle was that "K–12 engineering education should emphasize engineering design" (Katehi et al., 2009, p. 4). In 2013, developers of the *Next Generation Science Standards* (NGSS Lead States, 2013) implemented the directive and elevated engineering design to the level of scientific inquiry.

Teaching design, however, presents a challenge to educators because of the fundamental nature of design:

- Design is an ill-structured, ill-defined, and complex problem-solving task (Christiaans & Venselaar, 2005; Cross, 2004; Goldschmidt & Weil, 1998);
- Design is a recursive feedback process of "action and reflection" (Christiaans & Venselaar, 2005, p. 217);
- Design requires the regulation and integration of multiple forms of knowledge, and it relies heavily on metacognition (Christiaans & Venselaar, 2005; Jonassen, 2000); and
- Design requires the simultaneous "'co-evolution' of the problem space and the solution space" (Maher, Poon, & Boulanger, 1996; as cited in Dorst & Cross, 2001, p. 434; see also Cross, 2001, 2004).

Because of these characteristics, design problems do not lend themselves to simple solutions via algorithms that can be easily implemented in a K–12 classroom (Goldschmidt & Weil, 1998; Jonassen, 2000). Although educational researchers may study the "science of design," Cross (2001) argues that a "design science" with logical, systematic, and rigid algorithms for solving design problems is not congruent with the process of design. Instead, the pedagogy for solving design problems requires a more reflective and creative approach that emphasizes metacognitive skills to help students "know what they know" and regulate their knowledge (Lawanto, Butler, Cartier, Santoso, Goodridge, et al., 2013; Lawanto, Butler, Cartier, Santoso, Lawanto, et al., 2013; Pintrich, 2002).

Metacognition must be emphasized because design problems and other ill-structured problems are dominated by metacognitive processes (Christiaans & Venselaar, 2005; Jonassen, 2000). During the design process, students must repeatedly identify and define subproblems, generate solutions, and then return back to the original top-level problem (Sheppard, Macatangay, Colby, & Sullivan, 2009). Thus, design is distinctly nonlinear and requires the awareness, management, and integration of many forms of knowledge through metacognitive skills (Christiaans & Venselaar, 2005; Jonassen, 2000; Mawson, 2003).

Educational researchers (Lawanto, Butler, Cartier, Santoso, Goodridge, et al., 2013; Lawanto, Butler, Cartier, Santoso, Lawanto, et al., 2013; Luo, 2015; Wilson, Smith, & Householder, 2014) have shown, however, that students' metacognition may be insufficient for them to engage successfully in all phases of the design process. Cognitive neuroscientists (Casey, Jones, & Hare, 2008; Choudhury, Charman, & Blakemore, 2008) have also reported that adolescents have immature metacognitive skills because of profound developmental brain changes. Consequently, a need exists to support adolescent metacognitive skills in the context of design. One promising method of support is prompting.

Literature Review

Invoking Metacognition

Metacognitive skills are considered to be more difficult to develop than cognitive skills (Vos & de Graaff, 2004). Lin (2001) noted that students do not automatically employ their metacognitive skills unless they are actively encouraged to do so. Peteranetz (2016) developed a taxonomy of metacognitive instruction that subdivided instructional methods into two broad categories: implicit and explicit. The explicit approaches identified were direct instruction and teaching benefits. The implicit approaches were modeling (when an instructor shows metacognition in action) and prompting (when students are encouraged or reminded to engage in metacognition). This study adopted the implicit prompting approach.

Delivering Prompts via Peer Tutoring

Prompts can be delivered in a myriad of ways: through teachers, in written questions (on paper or on-screen), or via peers. Prompts delivered via peers can evolve into peer tutoring, a form of collaborative learning, and take advantage of natural brain development. During adolescence, peers become especially important and influential because of changes that take place in three regions of the brain (Choudhury, Blakemore, & Charman, 2006). Peer tutoring capitalizes on the natural affinity of adolescents for peer interaction.

During peer tutoring, students may question, assess, explain, and give feedback to their peers. These interactions between peers provide multiple opportunities for invoking metacognition (Choi, Land, & Turgeon, 2005). During explanations, students must organize their knowledge and express it in ways that a peer can understand, making explicit what they know and do not know (Bargh & Schul, 1980). They may discover holes in their knowledge when they cannot explain something fully or when they realize that something they have said does not make sense. Explanations to peers, like self-explanations, are piecewise events that provide many opportunities for structuring knowledge, revising mental models, or repairing misconceptions (Chi, De Leeuw, Chiu, & LaVancher, 1994).

Questions that arise during peer tutoring are another way to stimulate metacognition. Questions may be provoked by inconsistencies between incoming knowledge and existing knowledge. Questions can act as an "epistemic probe" or a "heuristic tool" (Chin & Osborne, 2010, p. 884), sorting out what a student knows and does not know and supporting argumentation. Like explanations, questions also make visible a student's knowledge and reasoning, setting the stage for peers to co-construct knowledge by offering confirmations or corrections of knowledge, or by filling in gaps. Questions are essential to developing the metacognitive skills involved in critical reasoning (Chin & Osborne, 2008, 2010).

The feedback or assessment that may arise from a peer during peer tutoring is also instrumental in promoting metacognition. Many researchers (Butler & Winne, 1995; Greene & Azevedo, 2007; Labuhn, Zimmerman, & Hasselhorn, 2010) have described how feedback from an external source, including peers, sets in motion self-regulatory processes. For example, Butler and Winn (1995) described how feedback can act as a "catalyst" for metacognitive activities such as monitoring.

Enhancing Peer Tutoring Efficacy

Peer tutoring efficacy can be enhanced through structure or guidance (Ismail & Alexander, 2005; King, Staffieri, & Adelgais, 1998; Roscoe & Chi, 2007; Topping, 2005). Researchers have observed that without structure, peer tutors often resort to low-level, "knowledge-telling" rather than "knowledge-building" explanations. Or they ask only low-level, factual knowledge questions. Structuring or guiding a peer tutoring session with prompts is one way to elevate the quality of the peer tutoring and to reach higher knowledge construction (King et al., 1998; Lin, 2001; Roscoe & Chi, 2007).

Purpose and Objectives

The purpose of this research was to explore how scripted, peer-delivered prompts invoked metacognition in middle school designers. Our primary objective was to see how the prompts encouraged paired students to make design changes—to see how paired students interacted in a script-guided environment—and what metacognitive strategies they used to make changes. Additional objectives were to see which prompts and which types of peer-to-peer verbal phenomena were most effective at inciting design changes.

Context of the Study

Our study focused on the early design process. In early design, students first interpret the design problem and create a design brief, a written document capturing essential design information, in which students set their goal, criteria (features), and constraints (Cross, 2000). Then, they can begin generating design solutions (sketches).

Sampling

Reflecting the desire to develop a pragmatic intervention, we conducted the study in a public middle school in the Western United States with the potential for variation in STEM exposure and socioeconomic status. We employed a mixed, "purposeful" (Patton, 1990) sampling strategy, selecting participants using (a) typical sampling and (b) criterion sampling by grade and course. Students received token compensation ($10) for their participation.

The research site was a career and technical education classroom with 32 seventh-grade students. Because career and technical education was a required

course for all seventh graders, the demographics of the classroom likely reflected those of the school: approximately 61.1% Caucasian, 29.3% Hispanic, 3.8% Asian, 1.7% African American, 1.9% Native American, 0.7% Pacific Islander, 1.5% two ethnicities, and 23% English language learners (school demographics came from the National Center for Education Statistics Common Core of Data for the 2016–2017 school year). Sixty percent of the students received free or reduced-price school lunch.

Research Protocol

Over the course of three days, a graduate student researcher introduced students to the engineering profession as well as the concepts of design, design briefs and sketches, and animal enrichment. As part of the curriculum, all 32 students engaged in a design-challenge activity during which data were collected from the 21 students who had agreed to participate in the study.

The design challenge was based on the K–12 engineering fair project *The Cat's Meow: Designing an Enrichment Toy*, developed for the nonprofit educational organization Science Buddies in 2008 (https://www.sciencebuddies.org/science-fair-projects/project-ideas/Zoo_p051/zoology/cat-enrichment-toys).

The design challenge was chosen because animals and pets appeal to a wide variety of children and are motivating (Chen, Chou, Deng, & Chan, 2007). In addition, we felt that this challenge would yield designs with great variability, as opposed to challenges in which students designed for the same user or users.

On Day 1, students were told to select a zoo animal or pet and do background research to find out about their chosen animal's characteristics. On Day 2, students worked independently and developed an initial design brief and sketch of their toy.

On Day 3, each student was paired with a peer. Using scripts with metacognitive prompts, each student presented his or her initial design to a peer partner. The scripts guided students to ask each other about how their designs worked and inquired about design strengths and weaknesses. One script (read by a presenting student's partner) contained seven questions prompting the presenting student to explain his or her design. The other script (read by the presenting student) contained two questions asking his or her partner for feedback. After both students had presented their designs and received feedback, they worked on their own redesigns while sitting together as a pair.

Methodology

The study was conducted using a qualitative methodology, specifically a comparative case-study approach in which comparisons were made within and across multiple, comparable, "information-rich" (Patton, 1990) cases to look for patterns (Levy, 2008; Wilson et al., 2014). Within the study, a case was defined as a pair of seventh-grade students engaged in a design-challenge activity guided by peer-delivered metacognitive prompts.

Data Sources

In each case, we focused on the students' verbal responses to prompts and their subsequent design revisions. Therefore, the data sources were: (a) the students' conversational turns, which were audio recorded; (b) their written design briefs (initial and revised); and (c) their sketches (initial and revised).

Data Analysis

We analyzed the design changes between the revised and initial design briefs and sketches quantitatively and qualitatively. Quantitatively, we looked at how many design changes were made. Qualitatively, we looked at how the criteria and constraints changed between the initial and revised designs. For example, was a new criterion simply altered from the original one, making it more refined? Was a new criterion a completely new, enhanced feature in the design? Was a new or altered criterion critical—not just nice to have but essential to its function? How did labeling change? How did sketch detail change? All qualitative attributes were coded.

The next step was to analyze the verbal interactions between student pairs while the students read and responded to the prompts and then worked on their redesigns. Two researchers coded the transcripts of student conversations using a codebook (Strong, 2018) containing definitions of explanations (simple or user-centered), questions, feedback, and other codes. The researchers engaged in rounds of coding and codebook modifications until an interrater reliability statistic (Cohen's kappa) greater than 0.85 was achieved (Hruschka et al., 2004).

The final step in the data analysis was to link the design changes (analyzed design briefs and solution sketches) to the analyzed and coded transcripts (e.g., questions, explanations, or feedback) to determine how the design changes arose. Linking the design changes to the code categories created a chain of evidence (Yin, 2009) and answered the research objective regarding how the students made design changes (i.e., the metacognitive strategies that they used). We created link maps for each one of a student's design changes and for each student participant, as shown in Figure 1.
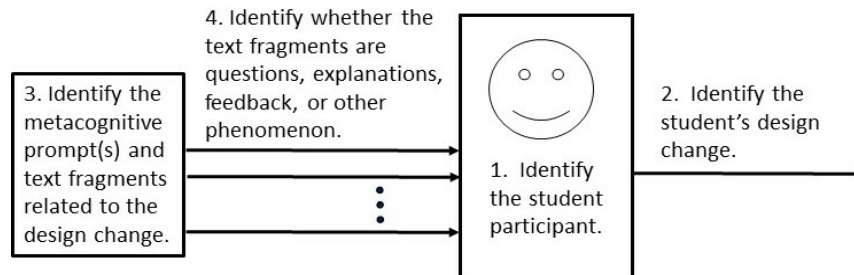
Figure 1. Process for mapping links between a student's design change and peer-to-peer verbal phenomena.

Comparing Within and Across Cases

In comparative case studies, comparisons are made within and across multiple cases. Researchers analyze each case individually and then analyze the entire set of cases, looking for patterns of similarities and differences in the phenomenon under study (Goodrick, 2014; Wilson et al., 2014). Results from comparative case studies are considered to be more robust and compelling than single case studies (Yin, 2009), enhancing transferability (Polit & Beck, 2010).

We first analyzed coded link maps for each pair of students, looking for patterns of interactions (e.g., questions, explanations, or feedback) that drove design revisions. We then synthesized patterns across all case pairs and observed distinct interaction patterns that influenced how the designs came to be modified.

Limitations

The study's characteristics—its methodology, sampling, and curriculum—imposed limitations. As a qualitative study, the findings may have variable interpretations. Seven student participant pairs (four male and three female) fully completed the entire 3-day curriculum. The time in which each participant engaged with the research curriculum, surveys, and design activity was limited to approximately 2 hours total. We have attempted to provide a "thick description" of the cases (Strong, 2018) so that readers may determine for themselves the transferability of the findings to adolescent populations of their interest (Polit & Beck, 2010).

Findings for Peer Interactions

Four interaction patterns emerged from the analysis of the case pairs. The patterns are depicted in Figure 2, which illustrates, metaphorically, the dynamics of the peer-to-peer interactions during the design challenge. The climbers in each drawing represent the pair of students in each case. The challenge to climb the mountain represents the redesign task. Note that in two instances, the climbers are at the same approximate level on the mountain, representing

seemingly similar abilities in metacognitive practices. In two other patterns, the climbers are at different levels on the mountain, representing disparate metacognitive practices. Also, if the climbers are on the same side of the mountain, that indicates they are following a similar design path with similar design features; however, if they are on opposite sides, that illustrates an independent design path with independent design features. The rope or flag in three drawings is a representation of social or emotional support. Note that in one interaction pattern (Soloists), there is none.
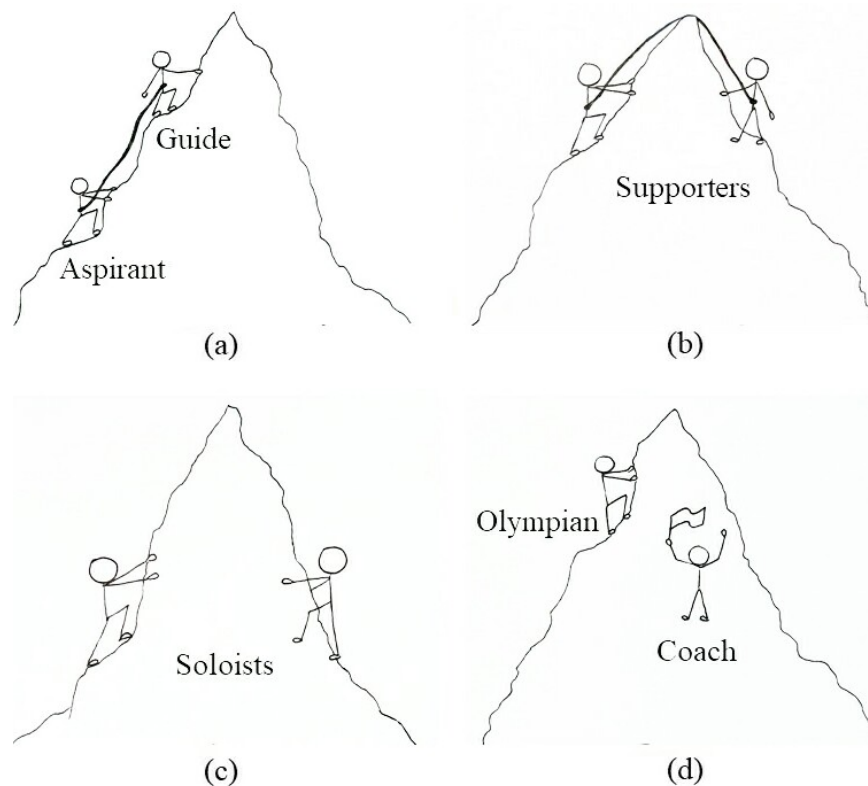

Figure 2. Observed peer interaction patterns during the design challenge: (a) Guide and Aspirant, (b) Supporters, (c) Soloists, and (d) Olympian and Coach.

The Guide and the Aspirant

One pair of boys and one pair of girls were exceptionally good at eliciting design changes in both partners. In each case, the pair had a student who was a Guide—a self-regulated learner who used metacognitive strategies to guide the redesign of both students.

The partner to the Guide was a student who was an Aspirant—a student who was unsure but very motivated to improve. The motivation came from observing the Guide's design and redesign. As depicted in Figure 2a, the students were linked together and followed a similar redesign path. The pairing of a Guide with an Aspirant was a highly effective and dynamic combination, yielding the most design changes per pair.

The metacognitive strategies used by the Guide partner included vocalized private speech, questioning (e.g., "What would make this better?"), checking task instructions, and explanations that contained simulations of how the user would interact with the design or what the user was thinking or feeling. The metacognitive strategies used by the Aspirant partner included explanations (with and without simulations) and requests for feedback. After redesigning, the Aspirant's design became more like the Guide's with similar design features.

The Guide and Aspirant cases are shown in Figures 3 and 4 for the male and female pairs, respectively. The top row in each case shows the initial designs for the Guide (on the left) and for the Aspirant (on the right). The second row shows the revised designs after the student pairs have read and responded to the scripted prompts and then interacted informally.

For the boys, the Guide, Leo,[1] designed an enrichment toy—a play area—for cats, and the Aspirant, Javier, designed a toy for dogs. Note that Leo's designs contain many "stations" where cats could have different forms of entertainment or pleasure (e.g., a feeding station, a napping room, a viewing room, and a slide).

Although Javier's initial design was solid (a squeaky ball suspended from a weighted arm), the transcript revealed that he was dissatisfied with it after seeing his partner's design. For example, when Leo read the prompt asking Javier what he thought was the best part of his design, Javier responded glumly that he didn't know. And later, Javier asked Leo for support, saying, "I don't even know what to put in mine." Javier ended up abandoning his initial design completely and instead, with Leo's support (e.g., "You should probably have a shoe room. A room full of shoes. Dogs love shoes"), made a play area for dogs with different stations (e.g., a ball room, a sock room, a shoe room, and a feeding station). Javier's redesign features echoed Leo's. The boys followed a similar redesign path.
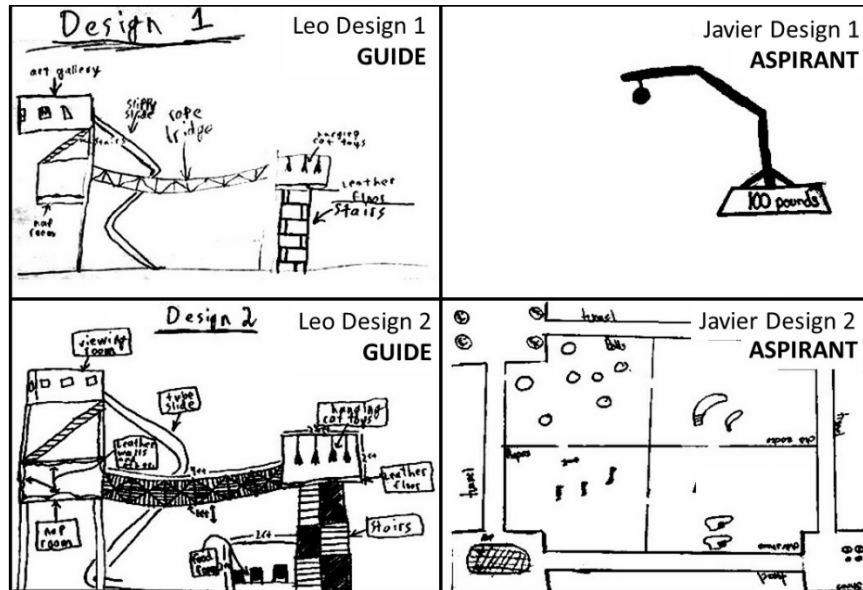
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[1] All names are pseudonyms.

Figure 3. Initial (top row) and revised (bottom row) sketches from the Guide and Aspirant boys.

For the girls, the Guide, Jade, designed an enrichment toy for hippos—an underwater rattle that was powered by waves. Like the male Guide, Leo, in the previous case, Jade displayed excellent metacognitive skills. One of Leo's metacognitive strategies was to utilize vocalized private speech, but Jade's strategies relied on questioning (e.g., "What would make it better?") and verbalizing task instructions. Like Leo, Jade displayed a strong ability to simulate how the user would interact with the design. She also imagined what the user would think or feel while using the design. "I think it will help them because they can have not just each other to play with, but something other than each other." "I think the best part is that it triggers that thing in your brain where it's like: What is that? Should I be scared of it? Should I like it? Or what?" "When the tides move, the water moves, and it makes [the beads] move. The hippos will hear it and be like, 'Wait, what is that?'"

Her initial rattle shape was a cylinder filled with beads (Figure 4, upper left). During revision, the cylinder shape changed to a sphere, and she added more noises by mixing pebbles with the beads (Figure 4, lower left). Upon receiving partner feedback to make the hippos "feel at home," she modified the toy to look "more natural" and "like a rock." In addition, upon asking herself and her partner a broad question ("Okay, what else would make it better?"), Jade thought about the safety of materials in her redesign: "For me, the biggest thing is I don't want it to decompose underwater. I don't want it to get into the hippo's

digestive system. I don't want them to eat [plastic]. But wood softens underwater, so it could break underwater."

The Aspirant, Luisa, like Javier in the previous case, was more hesitant and unsure of the design task. Although she was never negative about her initial design in the way that Javier was, her dog toy design appeared hesitant and tentative—a small ball in the far upper left corner of the page with no detail or labeling. Her Guide partner, though, was positive and offered ample constructive feedback: "So, we could fix any flaws that it has. Or make it better in some way. Well, I think . . . instead of just squeaking, it could maybe have bits of food or treats inside . . . . When they squeak it, it opens up and drops the treat out, and they're like, 'Oh my gosh, what was that?'"

Luisa agreed that treats sounded like a good idea and wondered if the shape should be "a little bit more square." Jade affirmed her suggested shape, visualizing "a split in a tennis ball." Luisa then worried about the design (or decoration) of the toy, saying, "I'm not sure about the design." Jade offered, "Maybe it could have bones on it or something because dogs like bones." Luisa brightened and drew a bone decoration on the toy.

Jade continued to pressure Luisa gently for more changes: "Okay, is that all you want to do? Or do you want to add something else?" This questioning led Luisa to an idea that echoed one of Jade's features: "I think it would be cool to make noises once it starts rolling around." Jade enthusiastically agreed, "Yeah, that'd be cool!" So, upon interacting with her Guide partner, Luisa's redesign became expansive and sure, filling the page and even providing written details about its features (Figure 4, lower right). The Guide, Jade, led Luisa on a design path similar to her own.
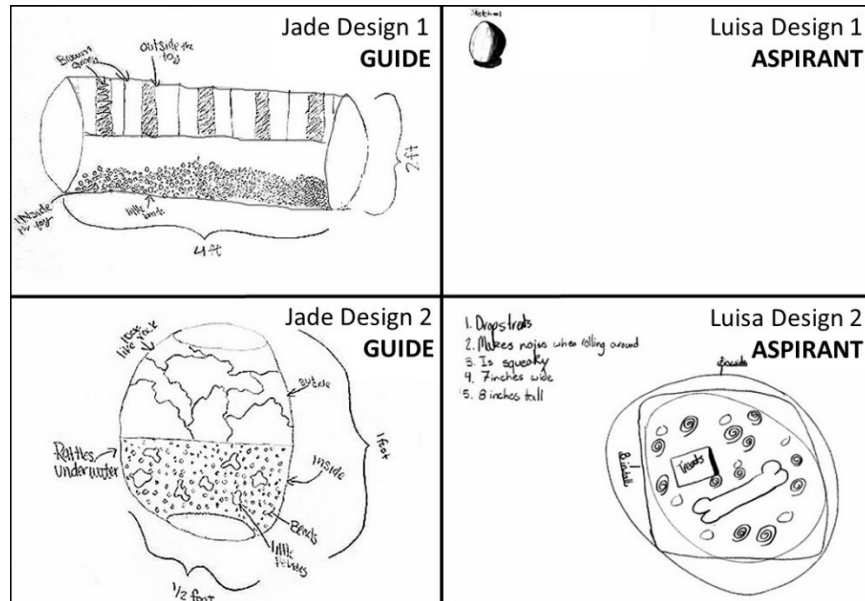
Figure 4. Initial (top row) and revised (bottom row) sketches from the Guide and Aspirant girls.

The Supporters

Three of the student pairs (two female pairs and one male pair) shared many characteristics that are illustrated by the linked climbers in Figure 2b. First, the participants in each supporter pair seemed to be at a similar level in their abilities, as depicted by the climbers being at similar heights on the mountain. Neither participant in a pair was overly dominant or appeared to have significantly greater technical or metacognitive knowledge than his or her partner.

Second, the participants were supportive. Although the participants tended to follow their own path up the mountain (their own climb up the design challenge with independent features), they did so with the support of their partner. The female pairs especially showed a great deal of mirroring of one another's comments and behavior. They were positive, encouraging, and complimentary about their partner's design. The boys were more competitive but in a teasing way. They were well matched and showed camaraderie.

Finally, for participants in these three pairs, the design changes came about through a combination of explanations about their own design and feedback from their partner. Although the number of the design changes were not as numerous as those of the Guide and Aspirant pairs, each participant made solid redesigns. There was no design fixation.

The Soloists

Two student pairs (one male pair and one female pair) shared some characteristics with the Supporters but differed in others. Just like the Supporter pairs, the Soloist participants in each pair seemed to be well matched. No one participant was dominant. No one participant appeared to have significantly greater metacognitive or technical knowledge.

However, the Soloist pairs differed from the Supporter pairs in that they offered little or no feedback to their partner. Even when prompted by a script, or asked a spontaneous question by a partner, little or no feedback was forthcoming. In addition, they offered no complimentary (emotional) support to their partner. Therefore, design changes for each of the participants in the soloist pairs came about only (or primarily) through explanations about their own designs. This dynamic is illustrated in Figure 2c in which the climbers ascend the mountain up their own paths with no support rope connecting them.

The Olympian and the Coach

One male student pair had a unique dynamic. They were close friends and had worked together previously. Each was highly verbal and had an excellent ability to simulate how the user would interact with the design. One of the students, however, had significantly more technical knowledge than the other. Their unevenness led to a dynamic in which the less knowledgeable student was in awe of his partner's knowledge and design. Consequently, nearly all of the boys' redesign energy was focused on the more knowledgeable student's design. The less knowledgeable student became like a Coach to an Olympian, cheering him on and offering lots of feedback for improvements—both solicited and unsolicited. The Olympian's resulting redesign was more technical and complicated than any of the other student participants; however, the Coach never explicitly implemented his own redesign ideas. So, the redesign outcomes were uneven. The Olympian made a challenging climb to the top of a steep mountain with the support of the Coach, but the Coach remained halfway down the mountainside, never making it to the top (see Figure 2d).

Findings for Prompts

There were two sets of scripts that the paired peers read aloud to each other and responded to: One set was intended to provoke explanations to a partner, and the other set was intended to provoke feedback from a partner. For both sets of scripts, the metacognitive prompts that were most effective at inciting the students to reflect upon their designs were the "negative" prompts (which asked about design weaknesses; see Figures 5 and 6). However, "neutral" prompts (which asked about how the design worked or how the user would interact with the design without any value-laden words like *weakness*, *improve*, or *best*) were only slightly less effective than the negative prompts, as shown in Figure 5. "Positive" prompts (which asked about best parts of the design) were less

effective than negative or some neutral prompts but enhanced student rapport by generating praise in most cases.
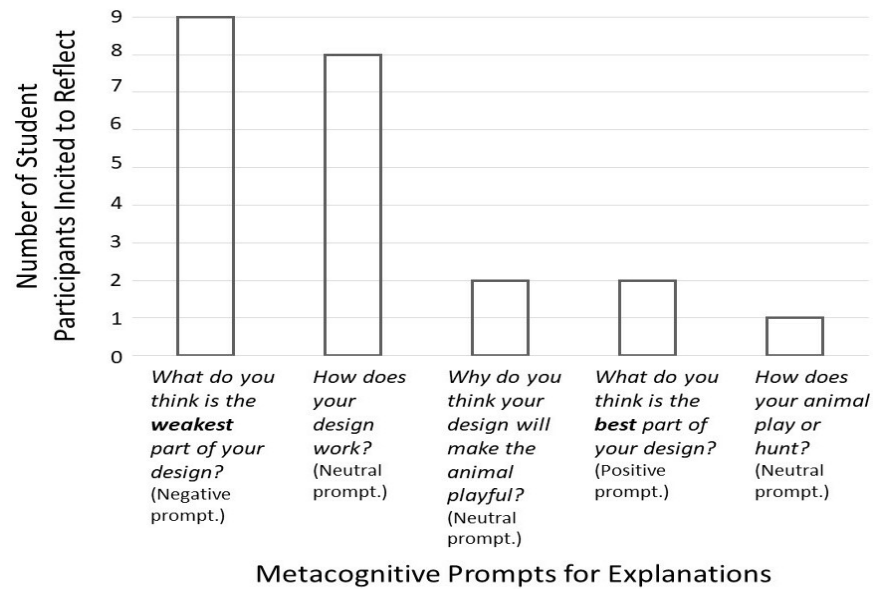

Figure 5. Number of participants who reflected on their own designs when prompted for explanations.
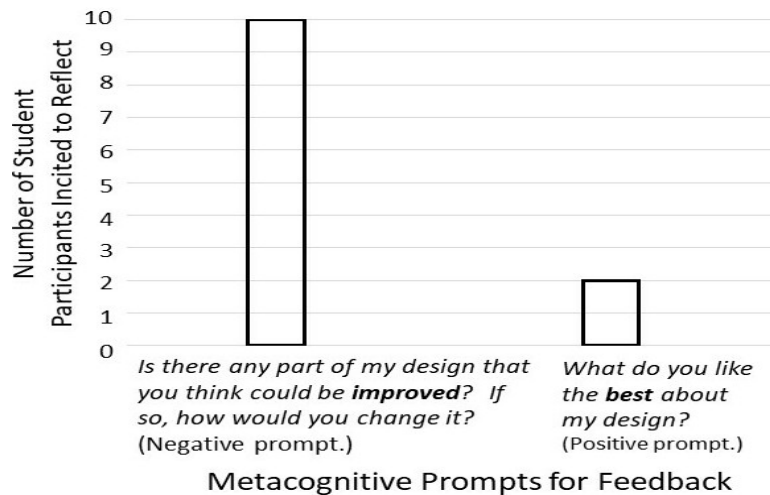
Figure 6. Number of participants who reflected on their partners' designs when prompted for feedback.

The prompts generated peer-to-peer verbal phenomena (e.g., explanations, questions, and feedback). We counted the frequencies of the verbal phenomena and analyzed the counts across all the cases to see if there were any relationships with the numbers of design changes made.

In addition, we examined combinations of verbal phenomena. An "Expressiveness Index" was defined as the sum of all verbal utterances from a participant (excluding the reading of the prompts). Therefore, a participant's Expressiveness Index was the sum of his or her total explanations, feedback given, affirmations given, and questions asked.

Likewise, a "Stimulus Index" was defined as the sum of all the self or partner stimuli given to a participant about his or her design. Thus, a participant's Stimulus Index was the sum of his or her total explanations, feedback received, affirmations received, and questions asked about his or her own design. Plots of the indices versus the number of design changes made are shown in Figures 7. (With the exception of the Olympian and Coach case, the participants in each pair are grouped. Note that participants in a pair are near to each other.)
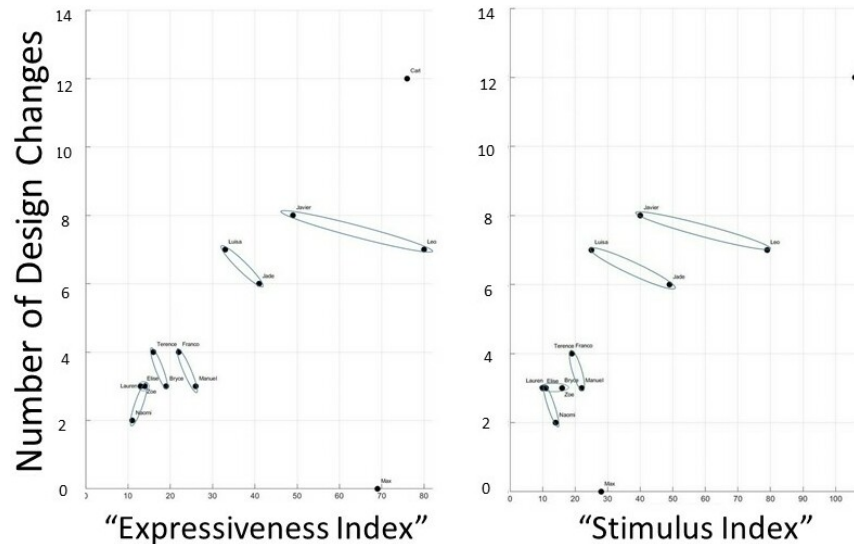
Figure 7. Frequency counts of participants' indices versus design changes.

Excluding the Coach (on the *x*-axis), there was a positive relationship between the Expressiveness and Stimulus Indices and the number of design changes made by participants. Those who were highly verbal and those who received the most stimulus made the most changes.

Conclusions

Peer Interactions

Four interaction patterns emerged from the analysis of the case pairs. The metacognitive strategies used by each pair to make design changes depended upon their interaction pattern.

- *Guide and Aspirant Interaction Pattern*: Design alterations were numerous for both students and came about through a combination of simple explanations, user-centered explanations, feedback, and Guide-generated questions.
- *Supporters Interaction Pattern*: Design alterations occurred mostly through a combination of simple and user-centered explanations and feedback.
- *Soloists Interaction Pattern*: Alterations occurred mostly through simple explanations, a few user-center explanations, and internal (unexpressed) reflection.
- *Olympian and Coach Interaction Pattern*: Alterations occurred for the Olympian through a combination of simple and user-centered explanations, extensive feedback from the Coach, and Olympian- and

Coach-generated questions. Alterations were limited to discussions for the Coach and were not explicitly expressed in a sketch.

In addition, for all interaction patterns except the Soloists, there was a socioemotional component to the alterations (Strong, 2018).

Prompts

The metacognitive prompts that were most effective at inciting the students to reflect upon their designs were the negative ones, which asked about design weaknesses. However, neutral prompts, which asked about how the design worked or how the user would interact with the design, were only slightly less effective than the negative prompts.

Design Changes and Verbal Phenomena

With the Coach participant excluded, we observed relationships between peer-to-peer verbal phenomena and the number of design changes. There was a strong positive relationship between the amount of feedback that participants received and the number of design changes that they made. There was a weak positive relationship between the number of explanations that participants made and the number of design changes that they made. There was no relationship observed between the number of questions asked and the number of design changes that they made (Strong, 2018).

When combinations of verbal phenomena were analyzed through the Expressiveness and Stimulus Indices, there were positive relationships with the number of design changes. In summary, the students who made the most design changes were the ones who (a) were highly verbal, (b) received the most stimulus about their designs from themselves or from a partner, and (c) were in a Guide and Aspirant pair. This pairing of unsure but motivated students with self-regulated learners had the greatest number of design changes per pair.

Significance for Middle School Educators

Design is a challenging, creative endeavor. It is a difficult subject to teach because there are no simple algorithms that can manage ill-defined and complex design problems. Nor can simple algorithms handle the nonlinear processes that arise during design, requiring iteration back to earlier stages. Designing requires considerable metacognitive skills to manipulate knowledge—skills that are still under development in adolescence.

This comparative case study demonstrated a pragmatic learning activity for enhancing adolescent designs during their earliest phases through guided peer interactions with metacognitive prompts. Design revision is stimulated through peer-to-peer verbal phenomena and through socioemotional means. Which verbal phenomena contribute to revisions and the degree to which the socioemotional component plays a role depends upon the interaction pattern of

the paired peers. Educators may choose to let students pair themselves or pair self-regulated learners with more unsure students to create dynamic Guide and Aspirant partnerships. Regardless of how students are paired or their interaction patterns, the learning activity helps adolescents avoid design fixation. Students are stimulated and motivated to alter their designs primarily by creating new criteria or refining or eliminating existing criteria.

The metacognitive prompts used in this comparative case study can be adapted to fit any design challenge. Teachers or instructional designers need only to develop prompts that ask about the user (the one who will be using the design) and what the user's characteristics and needs are. Prompts can then be developed that ask about how the user will interact with the design and why students think their designs will meet the user's needs. Finally, students can be prompted to evaluate a design's strengths and weaknesses—their own and their partner's.

The learning activity used in this study meets the *Next Generation Science Standards* (NGSS Lead States, 2013) for middle school students which requires sixth through eighth graders to be able to define a problem by specifying criteria and constraints (as was done in the design briefs), develop solutions (as was done in the sketches), and revise. The metacognitive prompts delivered by each student to a peer partner during the learning activity create an environment in which revision is supported both metacognitively and socially. Revision is necessary to emphasize the benefit of peer-prompted engineering design.

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Endorsement of Career and Technical Education: Phenomena Influencing Core-Subject Teacher Perceptions

Sheri Lynn Tucker & Andrew John Hughes

Abstract

The article provides an analytical overview of core-subject teachers' endorsement of career and technical education (CTE). The article discusses phenomena that have likely influenced core-subject teachers' perceptions of CTE and, in turn, their endorsement of CTE to students. California is taking steps towards successfully preparing students for college and career readiness, but more needs to be done (Bae & Darling-Hammond, 2014). Additionally, some educators still believe that "CTE programs maintain diminished value in helping to raise school achievement scores or encourage student success" (Shanklin, 2014, p. 3). Since the 20th century, CTE educators have been fighting negative perceptions of CTE, particularly that the only students who enroll in CTE are disengaged or underperforming. The study had a sample size of 16 participants ($N = 16$), and data were collected using focus groups, one-on-one interviews, and surveys. Findings show that participants were generally unaware of but were still biased against CTE. Participants' biases were influenced by multiple phenomena, including perfectionism, educational reforms, and societal expectations.

Keywords: teacher perceptions, career and technical education (CTE), college and career readiness, teacher support, administrative support

Career and technical education (CTE) continues to be perceived by core-subject teachers as well as the general public as a lesser-than, non-college-bound option; an option that is only fit for unmotivated or disinterested students. According to Bartholomew (2014), Gray (2004), Wonacott (2003), and others, the current debate regarding the value of CTE as an integral part of the standard academic curriculum has been ongoing since at least the early 1900s. The general public has a negative perspective of CTE that might be partially based on the blue-collar and white-collar separation seen in early descriptions of vocational and liberal education (Wonacott, 2003). Vocational education is for those wanting to earn a living or be productive in the workplace, whereas liberal education is for those wanting to fit in among others by developing intellectual capacities (Wonacott, 2003). Although these descriptions may have fit at one

This study described in this article is based on the first author's dissertation study (Tucker, 2019).

time, they are no longer viable. However, these perceptions persist based on numerous phenomena that have promoted the idea that CTE is only for non-college-bound students. For example, there are those who push for a 4-year liberal arts degree as a guarantee of white-collar employment that outweighs the trade-off of student-loan debt. In fall 2018, the graduation rate at California State University, San Bernardino (CSUSB), our local university, was 19% in 4 years and 57% in 6 years; therefore, pushing students to attend a 4-year liberal arts university is not working for the majority of students.

Perceptions of CTE are a common theme in the literature; thus, one might think that phenomena related to negative perceptions of CTE were being adequately addressed throughout the educational system. CTE literature continually presents rationales for including CTE as a part of the academic curriculum, frequently applying the idea that students will see the relevance to academic knowledge when this knowledge is applied in a CTE setting. It is impossible to argue with that rationale because CTE classrooms do provide students with the much-needed opportunity to apply knowledge during practical hands-on learning (Brand, Valent, & Browning, 2013). Despite CTE's rigorous focus on both academic and industry standards, technological literacy, and the development of 21st-century skills as well as the growing body of evidence suggesting a variety of benefits, CTE still has critics (Plank, DeLuca, & Estacion, 2008).

CTE is different today from even what it was just 8 years ago. Yet, critics of CTE continue to uphold long-standing stereotypes: "it prepares students only for work after high school, and its students are mostly male, too often minorities, academically backward, and destined for dead-end jobs" (Gray, 2004, p. 129). These same critics seem to endorse student choices related to differentiated learning, including Advanced Placement and honors programs (Gray, 2004). Despite supporting these choices of differentiation for academically blessed students, critics reject CTE as an important part of the developmental process for all students (Gray, 2004). The negative perceptions held by some in large part may be "because CTE has been chronically neglected by American education leaders and policymakers" (Dougherty, 2016, p. 1). "There was a time when 'vo-tech' was a pathway to nowhere. 'Tracking,' as practiced in the twentieth century, was pernicious. It sent a lot of kids—especially low-income and minority students—into low-paying, menial jobs, or worse" (p. 1). Negative perceptions of CTE remain, even with changes in CTE that promote students learning more than just career skills (Gordon, 2014). If the goal really is to improve student readiness for both college and careers, "then CTE is an important complement to the standard academic curriculum for more than half of all high school students" (Gray, 2004, p. 129). The integration of quality CTE with academic curriculum helps more students persist in and complete high school (Plank, 2001).

Findings from a study conducted by Kelly and Price (2009) revealed that students who participate in CTE come into the programs with lower grade-point averages, lower self-esteem, and, for many, a fatalistic perspective on math. Kelly and Price (2009) recommend offering at-risk students an opportunity to start over with reorientation in CTE. CTE programs can result in the betterment and academic re-engagement of students who will likely either fail or drop out without CTE experiences (Kelly & Price, 2009). Theoretically, both CTE and core-subject teachers recognize that CTE is important for increasing high school students' academic engagement and preparation for postsecondary success. For instance, Shanklin (2014) indicated similarities between perceptions of CTE and core-subject teachers regarding the importance of 21st-century skill development. Additionally, core-subject teachers recognized the benefit of CTE for students' success in postsecondary employment and education (Shanklin, 2014). However, when core-subject teachers were given the opportunity and assistance to integrate CTE with their subjects, they reverted to the stigmatized position that CTE courses do not prepare students for anything more than low-level positions in the workplace and that it is best to keep the two types of curriculum separate from each other (Shanklin, 2014).

Gordon (2014) discussed the elevated perceived value of CTE stemming from educational reform in the late 1980s, which aimed to integrate CTE and standard academic curriculum. Even with brief periods of support for CTE corresponding with educational reform throughout history, core-subject teachers seemingly remain less than enthusiastic about CTE being integrated with standard academic curriculum. California and other states are working to bridge the gap between CTE and core-subject teachers (Turnipseed, 2008). California has been increasing professional development aimed at helping CTE and core-subject teachers work together on integrating CTE and standard academic curriculum. These efforts to integrate CTE and standard academic curriculum show promise; however, without understanding core-subject teachers' perceptions of CTE and the phenomena influencing their perceptions, these efforts are likely in vain.

Background

This study was purposefully conducted to align with current educational trends in California and ongoing trends seen in the CTE literature. There are three guiding questions for this phenomenological study.

1. What ways do core-subject teachers endorse choices related to career and technical education for all students?
2. Do core-subject teachers encourage students by implementing the idea of career exploration or 4-year university attendance?
3. What are the lived experiences of the participants, and how might these impact their endorsement of CTE?

The assumption that identifying the lived experiences of core-subject

teachers will help explain their perceptions and endorsement of CTE was supported by the CTE literature. The fact that educators have looked at CTE courses as an option fit only for unmotivated, disinterested students since the beginning of the 20th century has been well documented with a few minor, short-term exceptions. American policymakers continue to find reasons to avoid designing vocational systems that can help students make the transition from secondary school to work (Dougherty, 2016; Schwartz, 2014). According to Stone (2014),

> Despite evidence to the contrary, global competitiveness arguments continue to be used as a means of promoting a strictly academic curriculum in high school—one designed solely to prepare students to pursue a four-year college degree—as the best and only education option. This college-for-all mentality has had the pernicious effect of diminishing the presence of high school CTE. (p. 4)

The California CTE Pathways Initiative prepares students to succeed in the workforce through partnerships between California Community Colleges and the California Department of Education. These partnerships provide students with seamless CTE from the middle grades through community college (California Community Colleges Chancellor's Office, 2013). In *For Each and Every Child: A Strategy for Education Equity and Excellence*, the U.S. Department of Education (2013) states:

> To achieve the excellence and equity in education on which our future depends, we need a system of American public education that ensures all students have a real and meaningful opportunity to achieve rigorous college- and career-ready standards. A world-class education consists not solely of mastery of core subjects, but also of training in critical thinking and problem-solving, as well as in 21st-century concerns like global awareness and financial literacy. (p. 12)

Rationale

The purpose of this research was to understand core-subject teachers' perceptions of CTE and whether they endorsed CTE to students. The study was designed to gather data related to core-subject teachers' perceptions of CTE programs and the level to which teachers actively encourage students to pursue CTE. The secondary purpose was to indicate the phenomena that have influenced core-subject teacher perceptions of CTE. This study was informed by research design literature as well as literature regarding perceptions of CTE, manual arts, industrial arts, and technology education. In the literature, a dichotomy exists between CTE being recognized as valuable and being endorsed by core-subject teachers. Perceptions regarding the value of CTE from the

literature could best be described as heterogeneous. This seems to indicate that CTE is still struggling to be perceived as a viable option for students.

However, Stone (2014) and others have reported that "after years of languishing as the program for someone else's child, career and technical education (CTE) has been rediscovered by federal, state, and local policymakers" (p. 4).

> Over the last two decades, mostly in response to the reform agenda set forth in *A Nation at Risk* (National Commission on Excellence in Education 1983), high school vocational education in the United States has undergone reconceptualization, the primary change being to make it more compatible with the academic curriculum. (Lewis & Cheng, 2006, p. 67)

Lynch (2000) indicates that there is not a single statistic, survey, or anecdote that effectively framed the negative public sentiment toward the poor results from American high schools. Lynch (2000) identified *A Nation at Risk* as having the greatest probability as the seminal event that framed the call for educational reform. When the Carl D. Perkins Vocational and Applied Technology Education Act of 1990 passed, the possibility of change "became an official mandate and challenge for change . . . in which the integration of academic and vocational education was set forth as a federal funding guideline" (Lewis & Cheng, 2006, p. 68).

With the reconceptualization of high school vocational education and its integration with academic education came the "opportunity for the subject to emerge from social isolation in the high school (see especially Gray, 1991; Rosenstock, 1991)" (Lewis & Cheng, 2006, p. 68). But this was all nearly 30 years ago. Three decades later, CTE is still not perceived positively by teachers, administrators, or the general public. The phenomena that influence teacher perceptions come from long-standing beliefs and actions reinforcing the idea that CTE is a threat to education. More than a century ago, "technical education was called a 'deceptive farce' by zealous guardians of liberal education who considered it as a threat to the intellect and as unacceptable in the public schools" (Gordon, 2014, p. 24). To be clear, the authors value and recognize the benefit of high-quality CTE and have witnessed students become more engaged in their learning as a result of CTE, helping them persist in and complete high school as well as being a catalyst in their success in postsecondary education and careers. This made us wonder why core-subject teachers seem to hold a different perception of CTE.

Creswell and Creswell (2018) explained that exploration is an important reason for conducting qualitative research. They go on to say that "In *qualitative* research, inquirers use the literature in a manner consistent with the assumptions of learning from the participant" (p. 27). "The researcher seeks to listen to participants and build an understanding based on what is heard" (p. 27). The

phenomenological design of this study captures the stories of the participants, and the analysis identifies the lived experiences in common that contribute to similar perceptions. The researchers were able to identify themes from transcribed recordings associated with participants' stories. The themes identified were related to participants' perceptions and endorsement of CTE. The study also explores what contributing phenomena have influenced these participants' perceptions of CTE. Exploring individuals' lived experiences collectively can provide a deeper understanding of complex issues like core-subject teachers' perceptions of CTE.

Method

Instrumentation and Data Analysis

This phenomenological research investigation of core-subject teacher perceptions was conducted using a survey as well as semistructured, open-ended focus groups and one-on-one interviews. There were two instruments used: the survey and the interview protocol used during the interviews and focus groups. The survey included the following items: (a) the number of years in education, (b) the levels and grades taught and how many years at each level, (c) degree attainment, (d) credentials held, (e) subjects taught, and (f) characteristics used to describe the participants personal connection with CTE, including non-education-related work experience, parent work experience, partner work experience, or child (or children) work experience in a CTE industry sector and educational attainment for parent, partner, and child (or children) in that sector. The focus groups happened prior to the interviews, which helped further develop the protocol (see Table 1). The protocol developed throughout each focus group and was then used to guide the interviews. However, the interaction during the focus groups and interviews should be considered conversational. The interviewer used verbal and nonverbal feedback to guide and promote the interviewees' storytelling.

Table 1
Interview Protocol

Question number	Interview question
1.1	Have you discussed options/choices regarding a postsecondary path with your students?
1.2	If yes, what options/choices have you discussed with your students?
1.3	Why did you discuss these options/choices?
1.4	Since you have been reading research that indicates CTE courses in your school meet the levels of rigor and relevance necessary to qualify as to what Bill Daggett, EdD., International Center for Leadership in Education, would you categorize your class as a Quadrant "D" class?
2.1	What is your perception of this information?
2.2	What are your experiences in your life that would cause you to hold that perception?
3.1	You have been asked to collaborate in writing curriculum for your core-subject class, how are you planning to proceed with integrating CTE content standards in the curriculum for your core subject?
3.2	Have you done any work similar to this collaboration?
3.3	If yes, what were the results?
4.1	At your school, from your perspective, based on your experience, what is the postsecondary expectation for students taking your courses?
4.2	At your school, from your perspective, based on your experience, what is the postsecondary expectation for students taking CTE courses?
5.1	How do you feel when one of your students decides to take a CTE course instead of a core-subject course?
5.2	What do you believe are the best choices for students' postsecondary success?
5.3	How do you promote making this choice to your students?

Procedure

The study was conducted over a 28-week period during the 2018–2019 academic year. The interview protocol was used to gather each participant's perception of CTE. The recorded interviews were transcribed and later coded by a trained coder using perspective themes. The coder was selected based on their 18 years of teaching experience, 5 years of industry experience, and overall

understanding of CTE. The coder taught middle school language arts, social studies, high school CTE, and had industry-related work experience. All interviews were read multiple times by the coder and researchers, transcribed, coded, and identified themes. All of the focus groups and one-on-one interviews yielded open-ended responses. Initial themes in the coded transcripts were compared to one another to refine themes. While refining the themes, it became evident that participants' responses more accurately belonged in two primary themes: (a) the level of teacher involvement and (b) the perceived level of administrative support.

Participants and Demographics

Core-subject teachers from a Southern California school district were contacted through their school email addresses and were invited to participate in the study. All participants were high school teachers who held a valid, state-issued, single- or multiple-subject teaching credential. Participation included completion of a survey instrument and either taking part in one of two earlier focus groups or one of nine later one-on-one interviews. There were a total of 16 participants, 11 of whom completed the demographic survey. One focus group had three participants, the other focus group had four participants, and one-on-one interviews were conducted with nine participants.

Participants had a total of 258 years of teaching experience ($M = 23.45$, $SD = 5.96$), with most of this experience at the high school level (Table 2). The majority of the participants held a bachelor's degree in a non-teaching-related CTE industry sector (72.7%), have before or were still working in a non-teaching-related CTE industry sector (81.8%), and had at least one parent who spent the majority of their career in a non-teaching-related CTE industry sector (72.7%; see Table 3). Five of the participants had partners, two of whom were teachers and three of whom worked in another CTE industry sector. Ten of the participants had children, one participant's children were below the age of 9, two participants children were teachers, and seven of the participants had children working in a non-teaching-related CTE industry sector.

Table 2
Demographics

| Gen. | Teaching experience (years) | Levels (years) | | | | Credential | | Subject |
		Ele.	Mid.	Hi.	Coll.	Sing. sub.	Multi. sub.	
F	21	10		11	5	✓	✓	Art
F	25		1	24		✓		Math
M	20		2	18	7	✓		English & ELD
M	28		4	24		✓		Soc. Science
F	30			30			✓	English & Music
F	25			25		✓		Soc. Science
M	25		1	24			✓	Math & Business
F	16			16		✓	✓	Soc. Science
F	30		3	27		✓		Math
M	11		2	9		✓		Science & Soc. Science
M	27			27		✓		English

Table 3
Participant Connection with Career and Technical Education

n	Bachelor's degree in CTE Industry Sector	Work Experience in a CTE Industry Sector	Partner Works in CTE Industry Sector	Parent Worked in CTE Industry Sector	Children Work in CTE Industry Sector
11	8 (72.7%)	9 (81.8%)	3 (27.3%)	8 (72.7%)	7 (63.6%)

Note. CTE industry sectors not including education or teaching.

Results

Phenomena and Themes

The presence of phenomena influencing participants' perceptions of CTE became evident during the analysis. There are numerous phenomena that have influenced these participants' perceptions of CTE. Phenomena influencing teacher perception of CTE come from long-standing systematic structures that

reinforce the idea that CTE only benefits the academically disadvantaged. Perfectionism and the push for external motivators are the two primary phenomena influencing the participants' perceptions. For these participants, numerous lived experiences have abetted their perceptions of CTE. Relating to the white-collar and blue-collar separation is the participants' push for perfectionism. Participants hold a common assumption that student failure (lack of skill and motivation) is a result of parents not pushing their children hard enough. This assumption relinquishes the participants' ability to control what motivates and develops students' abilities. The participants were seemingly uninterested in the potential of their students when the potential is counter to the white-collar societal image. Participants viewed students not attending a 4-year college as a failure, related to their own failures or to their students being incapable. Expressing that anything less than 4-year college enrollment was indicative of failure, participants seemed fixed on the separation of CTE and college. Participants did not express understanding that students could work, earn an associate's degree, and later earn a bachelor's degree. Despite this being more of the norm in Southern California, participants focused on external motivators, such as degrees. The push to put every student in a 4-year college was the focus, more than the student's well-being or ability development. From the analysis, two separate themes emerged: (a) perceived level of administrative support and (b) level of teacher involvement. Several subthemes were identified within the two primary themes. These themes are discussed in the following sections.

Perceived Level of Administrative Support

This first primary theme connects the perceived actions of school administrators and instances in which they do or do not support CTE programs. Little direct evidence was identified to indicate administrative support for CTE. A participant stated, "I don't think this administration" is trying. "I think [they] tried [minimally] last year" to develop scheduling that allows students to be successful academically and in CTE. There is a level of misunderstanding that participants have surrounding CTE. Most participants believed that taking CTE classes precludes students from attending college. Participants believed that administrators actively encourage students to pursue one or the other, CTE or a 4-year university. One participant stated that "all the way, federal, state, all the way down to our administration, all the way down to our faculty meetings that everything is college-prep, college-ready, A through G" (A–G is in reference to the University of California's entrance requirements). The participants expressed experiencing pressure to increase college entrance and inflate grades from the administration. Another participant was concerned that "IB (International Baccalaureate), AP (Advanced Placement), and CTE can't be simultaneously supported." They stated, "We offer a variety of programs," and "while I am a proponent of IB and AP," we can't "support [too much variety]."

Related to simultaneously supporting programs, participants discussed unequal programmatic funding.

The participants discussed the seemingly larger amounts of funding for CTE programs and inadequate funding for academic programs. Apparently, the administration had not been transparent about the funding or funding structures at the school, district, county, or state levels. The participants did not have a way to compare CTE and academic classroom operating costs. Participants expressed feeling threatened or undervalued by the higher amounts of money allocated to CTE. Participants expressed frustration with the lack of explanation for CTE funding compared to funding and support associated with opportunities for professional growth and collaboration with other educators. The participants seemingly had a negative perception of CTE due to the perceived additional support, especially related to funding, that the administration gave CTE.

Participants reported the interest that administrators have in how teachers are performing and related that to adequate program funding and interdepartmental training for the teachers. Participants recognized the existence of a dichotomy between what the administrators say they support and what their actions indicate. Policies that prevent CTE programs from continuing to be the place to put "unplaceable" students are often ignored in the name of just getting students in a class. A participant refers to the importance of ignoring these policies when stating, "CTE helps students figure out what they want to do as a career, [CTE programs] give [students] guidance. I think those programs give meaning and purpose to students; they give them a place of belonging and excitement." The participant added, "I think overall, I would completely support CTE, or I do support CTE, but conversely, I fully support going to a 4-year university." Another participant reflected on the issue of rigor, stating that "the students are not willing to adjust" to meet teacher expectations. "Now, if you get a higher academic student in the CTE classes, they know how to meet a teacher's expectations, but again CTE is not being funneled those students, so you just have to keep dumbing it down. CTE classes [can't be] rigorous because students are not high achievers."

Level of Teacher Involvement

The second primary theme presents examples of the teachers' desire to guide and direct their students' postsecondary choices but not endorse CTE. Participants stated that they support CTE; however, their stated actions do not show support for CTE. Participants are passionate about the academic advantages that AVID and IB programs provide. Participants seemed to lack an understanding of and enthusiasm for CTE. Participants downplayed discussions related to pursuing employment, certificate programs, trade schools, and other experiences commonly associated with CTE while at the same time emphasizing the importance of attending a 4-year university and earning a bachelor's degree. The data analysis revealed that the participants disapproved of students enrolled

in a CTE program, likely resulting in these students receiving less career and academic guidance when compared with students pursuing a purely academic schedule.

Participants discussed factors that would positively influence their perception of CTE. A participant stated, "I'm a huge proponent of CTE when it is done right." When asked how they would define "done right," the participant stated, "I would say being done right is that there's not a stigma attached to it." Following the discussion regarding stigma, the participant presents a stigmatized perception of CTE, saying, "the level of quality of education for all students whether it's CP (college prep), AP, or IB is important." Only low achieving "students [are] buoyed up by CTE and are then more successful." Another participant stated, "I do believe that CTE is viable, and it should be a choice"; "not everyone is going to college." Another participant reported, "I'm proud to be a part of this school that has these programs; I know Culinary exists, I know that people have benefitted from it; I know that people do learn a lot and go out and use these skills; when I hear about that someone's in them, I say, good for you, the more, the better." Later this participant stated that "all of my students will attend college." Similarly, all participants verbalized their support for CTE in general while almost simultaneously countering that support by presenting a dichotomy in which CTE is lesser-than, only for low achieving students, and that all their students were attending a 4-year university. The researchers expected the participants to have a negative perception of CTE; however, they were surprised when reviewing the transcripts to see that participants knew little about CTE and held beliefs about CTE based on limited anecdotal evidence.

Implications

The data collected related to the guiding questions indicated that participants were positively disposed to the idea of CTE; however, they primarily focused on encouraging their students to attend a 4-year college, as if that is the only option. This is despite their own personal connections to CTE. The participants did not enthusiastically endorse the decision to pursue a career through CTE programs. Participants presented the idea of career planning as less important and separate from obtaining a 4-year college degree. The participants were sincere, student-centered educators who not only spend their contract hours but their own personal time investigating instructional strategies and getting to know the thoughts, dreams, and turmoil within their students' lives; however, these apparent facts make the participants' resistance to unequivocally recommend CTE as an option much more difficult for the researchers to reconcile. If teachers, like the participants, are willing to learn about CTE options at their school but are not willing to endorse them, it seems even less likely that individuals not willing to learn about CTE options will support CTE.

For more than 30 years, it has been said that individuals who were less likely to choose postsecondary education as their first choice after high school

were underachievers and not competent enough to successfully attend postsecondary institutions. However, Berliner and Biddle (1996) argue that "the negative effects of vocational education may be likely because of not enough time in the schedule" to balance CTE and academic courses (p. 2). The limited ability for CTE students to take "academic courses can be the explanation for an achievement gap; not the fact that students took vocational education classes" (p. 2). This issue was addressed by a participant, "I think administration probably figures CTE is not for academic kids." The participants' school site course schedule limited students' ability to take both academic and CTE course offerings. At the beginning of the 20th century, CTE was founded on the idea of integrating apprenticeships with classroom instruction as part of the public schools' curriculum. Despite the well-intentioned plans to increase student enrollment in CTE and place students in a position to develop both academic and industry skills, technological literacy, and 21st-century skills before entering postsecondary schooling or career, CTE became the easiest place to put underachievers. The educational system in the United States decided to separate work-based learning from academics, which engendered the belief that CTE was only valuable for those students who placed little value on learning. By continuing to ignore the value inherent in CTE, educators in the United States are withholding the key to best practices for many students, especially with respect to postsecondary success.

Recommendations for Educational Leaders Including Teachers

Four-year college attendance should not be the only goal. The phenomenon of only promoting 4-year college discounts the value of learning a skilled trade. Comparing the graduation rate at CSUSB for first-time students at 57% after 6 years and community college transfer students at 72% after 6 years, the data supports the notion that students should attend a community college and learn a skilled trade prior to attending the University (California State University, San Bernardino, 2018). One recommendation to educational leaders is to recognize the intrinsic value of CTE, to acknowledge that, for many, it represents equivalent training that can reengage students and promote postsecondary success. Another recommendation for educational leaders is to provide enough time in the school year for students to try different CTE programs without missing important academic courses. Students should have options and not be forced to decide between academics and CTE. Students should not be deciding at 15 years old about pursuing either postsecondary schooling or work.

Teachers often work in semi-isolated environments. Being separated from other faculty does not encourage a strong sense of community among the faculty members. This individualistic nature of the teaching profession limits the time that could be used to develop integrated curriculum. A third recommendation for educational leaders is to provide time that can be used for communication and collaboration to design integrated academic and CTE curriculum.

Administrators should be also more transparent about scheduling and funding. California is already pushing for college and career readiness through efforts like Linked Learning, but more time for integration efforts is needed.

Conclusions

Pushing attendance to a 4-year college is not working for many people, and college attendance should not be presented as the only option. Balancing academic and CTE course offerings will provide the next generation of students with the technological literacy and 21st-century skills that they are going to need. Instead of directing our graduates to college before they have a goal or direction in mind, we should be encouraging more career planning and exploration. Students can receive work experience and on the job training as well as further develop career skills while they explore career and school options. Students might find a career that suits them, or at least, they will learn more about themselves and their interests before committing to expensive postsecondary schooling. This sort of discussion always reminds us of a story our late friend John Marcus would tell. John had just finished an undergraduate degree in zoology and premed. John would remind us that at this point, he had spent 17 of his 21 years of life in school. At his first interview for a summer job, the interviewer asked him, "What is it that you can do?" John responded, "Nothing, I've been in school all of my life." John later went on to become a successful attorney and loved every day of work. The somewhat sad reality of the story is that without CTE experiences, students graduate every year with little to no practical skills, resulting in little postsecondary direction and no way to support themselves while exploring their options.

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Professionalism in Engineering Technology: A Study of Final Course Grades, Student Professionalism, Attendance, and Punctuality

Jeffrey M. Ulmer

Abstract

Final course grades and professionalism grades were compared to determine statistically significant differences for (1) students with 90% or higher final course grades, (2) students with 80–90% final course grades, (3) students with 70–80% final course grades, (4) students with 0–70% final course grades, and (5) all students with a final course grade. Forty-one engineering technology courses were offered over 16 semesters (fall 2013 through fall 2018) in 100% online, face-to-face, and hybrid formats. Student populations were both undergraduate and graduate (master's) students in engineering technology courses at one Midwestern university. A total of 729 students were involved in the study. Study results indicate that professionalism grades, in terms of attendance and punctuality, were high (median of 93.33–100%) for students earning 80–100% median final course grades. Students earning 70–80% mean final course grades were less motivated to earn high professionalism grades— earning a 75.20% mean. There was little difference between final course grades and professionalism grades for students earning less than a 70% median for a final course grade. The aggregate of all student final course grades (median of 91.35%) in comparison to professionalism grades (median of 98.28%) yielded a significant difference.

Keywords: Attendance, Education, Professionalism, Student Grades

In Merriam-Webster, *professionalism* is defined as "the conduct, aims, or qualities that characterize or mark a profession or a professional person" ("Professionalism," 2019). At one Midwestern university, professionalism is demonstrated through attendance, punctuality, and assignment deadline behavior. Students are offered the choice of participating in one course section via a face-to-face classroom format or a 100% online format. Classroom students earn attendance points by attending scheduled classroom sessions, and online students earn attendance points through the submission of online discussion board session screen-capture videos (asynchronous delivery) according to scheduled dates and times. Punctuality for classroom students is merely arriving to class on time; however, for online students, punctuality is turning in the online discussion board session screen-capture videos on or before the scheduled date and time. Assignment deadline behavior is demonstrated by turning in assignments and other class activities on or before the scheduled date

and time. Students are provided with the opportunity to earn 25% of their total potential course points through the attendance and punctuality portion of professionalism. The remaining assignment deadline behavior points are accounted for through student performance on assignments and other activities.

National data for the 2015–2016 school year showed that approximately eight million students, one out of seven students, were chronically absent, meaning that they missed 15 or more days of school (Blad, 2018). This is an academic problem that is not easily solved. Many of these absent students fail to realize that, as Woody Allen has said, "'80% of success is showing up'" (Moore, 2006, p. 26). To make matters worse, class attendance decreases as an academic semester progresses (Marburger, 2001; Rodgers, 2001; Stripling, Roberts, & Israel, 2013; Van Blerkom, 1992; Zhao & Stinson, 2006). Professionalism, with absenteeism as one of the critical elements, is an individual activity (Klay, Brower, & Williams, 2001). As the science fiction movie "The Fifth Element" had a critical element to spare the universe from destruction, "class attendance is a critical ingredient [or element] for developmental education students' academic success" (Moore, 2004, p. 35). Although the literature review did not yield data or commentary on student punctuality and turning in assignments and activities on time, student attendance was well researched in academic journals. Therefore, this study is primarily a replication of a student attendance study ($n = 698$) conducted by Moore (2005).

Significance and Purpose of the Study

This study is significant in drawing attention to the term *professionalism* as supported in the academic classroom and 100% online through the elements of attendance, punctuality, and assignment deadline behavior. Classroom- and online-demonstrated professionalism is a learned behavior that prepares students to be successful in their future careers. However, the importance of professionalism has been underestimated in the face of reports that student absenteeism can be as high as 25% (Friedman, Rodriguez, & McComb, 2001) or even higher (Romer, 1993) in some universities. "In college classrooms throughout the country, seats are empty" (Moore, 2005, p. 26).

The purpose of this study was to learn if students earn higher final course grades when professionalism is demonstrated through attendance and punctuality? Punctuality was included in the study because 25% of a student's total potential course points were earned through the attendance and punctuality portion of professionalism. Thomas and Higbee (2000) stated it best: "Nothing replaces being present in class" (p. 229)."

Research Question and Hypothesis Statements

The research question is: Do students earn higher final course grades when student professionalism is demonstrated through attendance and punctuality? From this question, the following null and alternative hypotheses were developed.

- H_{01}: $\mu1 = \mu2$. There is no statistically significant difference between students with 90% or higher final course grades in comparison to professionalism grades in terms of attendance and punctuality.
- H_{A1}: $\mu1 \neq \mu2$. There is a statistically significant difference between students with 90% or higher final course grades in comparison to professionalism grades in terms of attendance and punctuality.
- H_{02}: $\mu1 = \mu2$. There is no statistically significant difference between students with 80–90% final course grades in comparison to professionalism grades in terms of attendance and punctuality.
- H_{A2}: $\mu1 \neq \mu2$. There is a statistically significant difference between students with 80–90% final course grades in comparison to professionalism grades in terms of attendance and punctuality.
- H_{03}: $\mu1 = \mu2$. There is no statistically significant difference between students with 70–80% final course grades in comparison to professionalism grades in terms of attendance and punctuality.
- H_{A3}: $\mu1 \neq \mu2$. There is a statistically significant difference between students with 70–80% final course grades in comparison to professionalism grades in terms of attendance and punctuality.
- H_{04}: $\mu1 = \mu2$. There is no statistically significant difference between students with 0–70% final course grades in comparison to professionalism grades in terms of attendance and punctuality.
- H_{A4}: $\mu1 \neq \mu2$. There is a statistically significant difference between students with 0–70% final course grades in comparison to professionalism grades in terms of attendance and punctuality.
- H_{05}: $\mu1 = \mu2$. There is no statistically significant difference between all student final course grades in comparison to professionalism grades in terms of attendance and punctuality.
- H_{A5}: $\mu1 \neq \mu2$. There is a statistically significant difference between all student final course grades in comparison to professionalism grades in terms of attendance and punctuality.

Assumptions of the Study

The following assumptions were made for this study.
1. Student–instructor interaction and teaching styles did not affect the study.
2. Student motivation and performance were not affected by course delivery type (100% online, face-to-face, or hybrid) or topic matter.
3. Students participated to the best of their ability in all courses.
4. The study is not biased toward or against any student type (undergraduate or graduate), gender (female or male), age, or cultural background.

5. Grades earned by students are generalizable to any student.
6. Paired-samples *t*-test grade differences are parametric (normally distributed), continuous, and were randomly and independently acquired.
7. Wilcoxon signed-rank test grade differences are nonparametric (not normally distributed), continuous, and were randomly and independently acquired.

Limitations of the Study

The following are limitations for this study.

1. Participants were both domestic and international students at one Midwestern university.
2. Some students may have lacked the motivation to study a topic (or topics).
3. Students may not have been academically prepared to take any class.
4. The results of this study may not be repeatable at another educational institution.
5. Violation of any of the paired-samples *t*-test assumptions would have created a limitation.
6. Violation of any of the Wilcoxon signed-rank test assumptions would have created a limitation.

Literature Review

Traits of Professionalism

Ritz and Bevins (2012) state that "citizens need basics for daily livelihoods, and less developed economies still rely on manual labor for their economies and survival of their people" (p. 101). Professionalism is one of those basics, and a high level of professionalism in attendance, punctuality, and meeting assignment (or project) deadlines is a core fundamental required for any company's success, regardless of the country in which they are located. A broad scope of professionalism is summed up in the 13 principles described by Ratanawongsa et al. (2006): "altruism, respect, sensitivity, accountability, confidentiality, communication and shared decision making, integrity, compassion and empathy, duty, competence, managing conflicts of interest, self-awareness, and commitment to excellence and ongoing professional development" (pp. 759–760). In their study, participants identified three main barriers to professionalism: time constraints, workload, and the institution's culture. As a side note, Hollenbeck (2009) shared that professionalism is manifested by mentoring others and upholding personal dignity and the dignity of fellow associates.

Career readiness "can be simply described as the level of achievement a student needs to be ready to join and succeed in the marketplace" (Deif, Stark,

Butler, & Olsen, 2017, p. 3). As future employees, students exhibit elements of professionalism through their education, training, and value-added skills in their interactions with others (Ritz & Bevins, 2012). Other elements for successful careers rely upon communication, problem-solving, and applied work (Davis & McDonald, 2016; National Academy of Engineering, Committee on Standards for K–12 Engineering Education, 2010). Applied-work professionalism requires physical presence for colleague collaboration (Korhonen, 2003; Ritz & Bevins, 2012).

Customer Satisfaction

Customer satisfaction is directly tied to the quality of products and customer service, including levels of under or over fulfillment. Like the business world, student performance in terms of low attendance, late class arrival, and late work may be a students' response due to a low satisfaction level (Flanigan, Benson, & Porter, 2017; Oliver, 2010; Schunk, 2000). Low levels of student satisfaction may manifest itself in skipping class and affect other students as well (Stripling et al., 2013; Wyatt, 1992). The net effect results in decreased morale and lower academic success for a given course, which affects the entire class (Brauer, 1994; Moore, 2004, 2005). This is exacerbated when considering that a higher percentage of students are more likely to skip class on a Friday than on other days (Marburger, 2001). Student satisfaction is obtained through a sense of class community (Klay et al., 2001), although no amount of class attendance can overcome a student's lack of motivation to learn (Kahveci, 2010; Yau & Cheng, 2012).

Reasons to Skip Class

Friedman, Rodriguez, and McComb (2001) state that class attendance is a puzzle. The reasons for class attendance are diverse and are different for each student not attending class. In a study by Gump (2004), students reported missing class for the following reasons: health, preoccupation, weather, personal choice, inconvenience, and preparedness (p. 52). Stripling, Roberts, and Israel (2013) found that students in their study chose to miss class for these top seven reasons: (1) "I have deadlines for other academic work," (2) "I am studying for a test in another course," (3) "I have already earned enough points for the grade I want," (4) "Class is before or after a test," (5) "I do not find the class challenging," (6) "I know the grade that I will receive," and (7) "I have not completed an assignment that is due" (p. 54). One element missing from this list is the student's need for financial support through college loans or part/full-time jobs while attending class (Sullivan, 2018).

Although some universities and community colleges mandate classroom attendance in their policies (Moore, 2005), many institutions view student attendance as optional (Moore, 2006; Romer, 1993). In a study by Friedman et

al. (2001), students reported that earned grades or penalties for attendance did not promote student participation or affect their final course grades significantly.

Last but not least, one must also consider the effect that course instructors can have on student attendance. Does the instructor's demeanor promote a desire for students to attend class or skip it? Instructors also heavily affect a student's motivation to attend a class by their course policies. One element, according to Light (1990), is the essential ingredient of rapid student feedback on course work. According to Thomas and Higbee (2000),

> The best . . . teacher, no matter how intellectually stimulating, no matter how clear in providing explanations and examples, may not be able to reach the high-risk freshman who has no real interest in learning . . . and will certainly not be successful with the student who fails to show up for class. (p. 231)

Student Success

According to Moore (2006), attendance is "an explicit expression of students' motivation for academic success" (p. 19). These students succeed when interpersonal and diverse student-learning methods are accounted for (Keith, Stastny, & Brunt, 2016). Successful students are supported by well-designed, properly placed, and utilized academic resources (Sullivan, 2018). Learning does not occur just because a student attended class; however, "students who make higher grades enjoy attending class, are more grade-conscious, or are more intrinsically committed to being engaged in their education" (Moore, 2005, p. 32).

Students understand that they will earn higher class grades through classroom attendance (Moore, 2006). In fact, students often start a new course with the intent of coming to all class sessions and earning a high overall class grade (Moore, 2005). Poor student academic success is often linked with a student's thought of making up for missed class periods. Rodgers (2001) found that attendance affected performance; for example, "a student with average attendance of 74 percent of classes would score between 1.3 and 3.4 percentage points lower than an otherwise identical student with perfect attendance" (p. 293).

Methodology

Study Population and Time Frame

Forty-one engineering technology courses were offered over 16 semesters (fall 2013 through fall 2018) in 100% online, face-to-face, and hybrid formats. Student populations were both undergraduate and graduate (master's) students in engineering technology courses at one Midwestern university. A total of 729 participants were involved in the study, including students from the United States and various countries around the world.

Variables

The continuous variables present were professionalism grade and final course grade—both variables were converted to percentages. Variables such as class status (undergraduate or graduate), gender, age, course type (100% online, face-to-face, or hybrid), statistics anxiety level, academic background, and cultural differences were not considered.

Statistical Analysis

Final course grades and professionalism grades were compared to determine statistically significant differences for (1) students with 90% or higher final course grades, (2) students with 80–90% final course grades, (3) students with 70–80% final course grades, (4) students with 0–70% final course grades, and (5) all students with a final course grade.

Once the preliminary statistics were run using IBM SPSS Version 24.0, at a significance level of 0.05, it was determined that both the paired-samples *t*-test and the Wilcoxon signed-rank test were needed. Paired-samples *t*-tests were used for grade difference average data results that were parametric (normally distributed). Wilcoxon signed-rank tests were used for grade difference median data results that were nonparametric (not normally distributed).

According to Field (2013, p. 371), a paired-samples *t*-test is a parametric test used to measure the average difference between one assessment to the next, for one data measurement on one individual, and then tallies the averaging information of all data sets, for all individuals, to determine if a mean statistical difference exists between graded results. The assumptions for a paired-samples *t*-test state that grade differences are parametric (normally distributed), continuous, and are randomly and independently acquired. Note that only the grade differences must be parametric not the actual data distributions themselves (Field, 2013, p. 378).

Also, according to Field (2009, p. 552), a Wilcoxon signed-rank test compares grade differences to determine the sign of the differences (positive or negative) toward the calculation of statistical significance. This statistical test is equivalent to the dependent (paired-samples) *t*-test for parametric (normally distributed) data (see Field, 2009, p. 329), which measures the average difference between one assessment to the next, for one data measurement on one individual, and then tallies the averaging information of all data sets, for all individuals, to determine if a statistical difference exists between pretest and posttest median results.

Statistical Study Results and Assumption Testing
Hypothesis 1 Results

There was a statistically significant difference between students with 90% or higher final course grades ($n = 413$) in comparison to professionalism grades

in terms of attendance and punctuality. Consequently, the null hypothesis was rejected, and the alternative hypothesis was retained with final course grades (*Mdn* = 95.05%) in comparison to professionalism grades (*Mdn* = 100.00%, *z* = -9.280, *p* = 0.000, *r* = -0.456). Using Cohen's criteria for *r*, this was a moderate effect size (Minium, Clarke, & Coladarci, 1999, p. 73). This level of effect size means that although statistically significant, the difference in medians is moderate. Regarding meeting assumptions for the Wilcoxon signed-rank test, per the Kolmogorov-Smirnov test, nonnormality was confirmed at *p* = 0.000. As for the other two assumptions, both met requirements, were continuous, and were randomly and independently acquired.

Hypothesis 2 Results

There was a statistically significant difference between students with 80 to 90% final course grades (*n* = 202) in comparison to professionalism grades in terms of attendance and punctuality. Consequently, the null hypothesis was rejected, and the alternative hypothesis was retained with final course grades (*Mdn* = 86.25%) in comparison to professionalism grades (*Mdn* = 93.33%, *z* = -7.516, *p* = 0.000, *r* = -0.528). Using Cohen's criteria for *r*, this was a moderate effect size (Minium et al., 1999, p. 73). This level of effect size means that although statistically significant, the difference in medians is moderate. Regarding meeting assumptions for the Wilcoxon signed-rank test, per the Kolmogorov-Smirnov test, nonnormality was confirmed at *p* = 0.000. As to the other two assumptions, both met requirements, were continuous, and were randomly and independently acquired.

Hypothesis 3 Results

There was a statistically significant difference between students with 70 to 80% final course grades (*n* = 73) in comparison to professionalism grades in terms of attendance and punctuality. Consequently, the null hypothesis was rejected, and the alternative hypothesis was retained with final course grades (M = 81.65%) in comparison to professionalism grades, *Mdn*= 75.20%, *t* (72) = 4.258, *p* = 0.000, *r* = 0.194. Using Cohen's criteria for *r*, this was a low effect size (Minium et al., 1999, p. 73). This level of effect size means that although statistically significant, the difference in means is low. Regarding meeting assumptions for the paired-samples t-test, normality was confirmed with at *p* = 0.074. As to the other two assumptions, both met requirements, were continuous, and were randomly and independently acquired.

Hypothesis 4 Results

There was no statistically significant difference between students with 0 to 70% final course grades (*n* = 41) in comparison to professionalism grades in terms of attendance and punctuality. Consequently, the null hypothesis was retained, and the alternative hypothesis was rejected with final course grades

(*Mdn* = 63.43%) in comparison to professionalism grades (*Mdn* = 65.52%, z = -1.808, p = 0.071, r = -0.282). Using Cohen's criteria for r, this was a low effect size (Minium et al., 1999, p. 73). This level of effect size means that although it was not statistically significant, the difference in medians is low. Regarding meeting assumptions for the Wilcoxon signed-rank test, per the Kolmogorov-Smirnov test, nonnormality was confirmed with at p = 0.008. As to the other two assumptions, both met requirements, were continuous, and were randomly and independently acquired.

Hypothesis 5 Results

There was a statistically significant difference between all student final course grades (*n* = 729) in comparison to professionalism grades in terms of attendance and punctuality. Consequently, the null hypothesis was rejected, and the alternative hypothesis was retained with final course grades (*Mdn* = 91.35%) in comparison to professionalism grades (*Mdn* = 98.28%, z = -12.263, p = 0.000, r = -0.454). Using Cohen's criteria for r, this was a moderate effect size (Minium et al., 1999, p. 73). This level of effect size means that although statistically significant, the difference in medians is moderate. Regarding meeting assumptions for the Wilcoxon signed-rank test, per the Kolmogorov-Smirnov test, nonnormality was confirmed with at p = 0.000. As to the other two assumptions, both met requirements, were continuous, and were randomly and independently acquired.

Conclusions and Future Research

Table 1
Null Hypotheses 1–5 Results

Null hypothesis	Result	Final course grade[a]	Professionalism grade[a]	p-value
Null Hypothesis 1: ≥ 90% final grades	Rejected	95.05%	100.00%	0.000
Null Hypothesis 2: 80–90% final grades	Rejected	86.25%	93.33%	0.000
Null Hypothesis 3: 70–80% final grades	Rejected	81.65%	75.20%	0.000
Null Hypothesis 4: 0–70% final grades	Retained	63.43%	65.52%	0.071
Null Hypothesis 5: All final grades	Rejected	91.35%	98.28%	0.000

Note. For each null hypothesis, final course grades are compared to professionalism grades for that group of students.

[a] Medians were used for Null Hypotheses 1, 2, 4, and 5, and means were used for Null Hypothesis 3.

Table 1 summarizes the study results. Study results indicate that professionalism grades, in terms of attendance and punctuality, were high (median of 93.33–100%) for students earning 80 to 100% median final course grades. Students earning 70–80% mean final course grades were less motivated to earn high professionalism grades—earning a 75.20% mean. There was little difference between final course grades and professionalism grades for students earning less than 70% (median) for a final course grade. The aggregate of all student final course grades (median of 91.35%) in comparison to professionalism grades (median of 98.28%) yielded a significant difference.

Based on the study results, classroom and 100% online students who earned a final course grade of 80% or higher were more concerned about class activities and therefore participated at a higher level than other students at less than 80%. Because professionalism, in terms of attendance and punctuality, was a part of each course, students earning 80–100% final course grades treated professionalism as any other course objective—as tasks to be completed.

The part of the results that can't be quantified is if the professionalism tracking and grading efforts in each course, in terms of attendance and punctuality, will help these 729 students to be more responsible future workers in industry. Will they be more inclined to go to work and show up on time? Will they demonstrate an example of solid stewardship of their time and efforts for fellow workers to emulate? It is the hopes of this researcher, former industrial manager, and academic that students are now more aware of the need to be professional in their careers.

Recommended future research includes a study on tracking punctuality alone, aside from attendance. Researching missed and late assignments and projects may also be of benefit. Deif, Stark, Butler, and Olsen (2017) call for more research on the link between student success and first-day attendance. Flanigan, Benson, and Porter (2017) recommend future research on customer satisfaction models for millennials; however, the same type of research is needed for student satisfaction with the academic experience. The current study should also be repeated in order to replicate or refute its findings.

Stripling et al. (2013, p. 57) call for further research on why undergraduate students choose to skip class. The recommended focus would be on class size, class scheduling, class structure, class classification, instructor behavior and issues, student performance, personal issues, and learning activities.

For academics seeking to generate greater levels of student participation in their courses, Stripling et al. (2013, p. 57) also recommends the following to boost attendance and student satisfaction in their courses: take attendance, know the course content, develop quality lectures and class sessions, relate in-class work to assignments and assessments, plan rigorous courses, present course

information in an interesting way, allow students to enter late, and develop teacher–student rapport.

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