Career and Technical Education Experiences Relationship to Technology Attitudes, Self-regulation and Grit

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Abstract

Career and Technical Education (CTE) secondary school experiences have a positive impact on career development and academic achievement. This study explores other positive impacts such as technology attitudes, persistence, and cognitive traits that are associated with career and academic success. This study investigated the relationships between high school CTE experiences of 103 pre-service education students and technology attitudes, grit, and self-regulated learning. The results demonstrate a statistically significant positive correlation between the number of CTE courses taken in high school and technology dependence. Similarly, there is a positive correlation between CTE courses and self-regulatory skills. Grit was positively correlated with internship experiences in high school.

Keywords: career and technical, self-regulation, grit, technology attitudes

1. Introduction

Career and Technical Education (CTE) experiences in high school are linked to positive academic outcomes (Castellano et al., 2017; Gottfried & Plasman, 2018). The mechanisms by which this occurs are unclear. One possible explanation for the increased success of students with CTE experience is the increased focus towards employability skills which overlap with academic skills. For example, notable career-ready skills include responsibility and professionalism (Association for Career and Technical Education, 2010). These constructs are consistent with important cognitive traits such as conscientiousness, self-determination, and self-regulation (Credé et al., 2017; Littlejohn et al., 2012; Richardson et al., 2012).

Prior work has identified positive relationships between personal technology usage (e.g., smartphones) and cognitive characteristics such as self-regulatory skills and conscientiousness (Hartley et al., 2020). CTE experiences may also lead to more positive attitudes towards technology. CTE participants' relationship to technology usage may differ from non-participants in that their experiences include contemporary workplace technologies. In other words, CTE participants are more likely to see the value of technology beyond entertainment, personal productivity, and academic uses. This is consistent with the career ready expectations that inform much of the CTE programming (Association for Career and Technical Education, 2010; Brand et al., 2013). Technology use in general is also of interest for pre-service teachers with the expanding emphasis on computational thinking at all levels of education (Sands et al., 2018).

The purpose of this research is to explore the relationships between CTE experiences, self-regulated learning (SRL), grit, and technology attitudes in pre-service education students. It is hypothesized that CTE experiences will correlate positively with technology attitudes and traits that support college success (e.g., self-regulation, grit).

1.1 Career and Technical Education Experiences

CTE programs of study engage students in curricula that emphasize workplace readiness, authentic skills, and critical thinking. Research has identified a positive relationship between CTE experiences and school engagement (Xing & Gordon, 2020). One study indicated that each CTE credit earned had a positive influence on graduation rate ($b = .12$) (Castellano et al., 2017). The positive impact of CTE experiences on graduation appears to be especially significant for students at heightened risk of dropping out (Gottfried & Plasman, 2018).

Important CTE experiences beyond coursework may also make a positive contribution. Career and technical student organizations (CTSOs) are an integral component of the CTE curriculum. These are student-run organizations such as

DECA and FBLA that are aligned with the field of learning. Participation offers students opportunities to practice leadership skills and cultivate teamwork (Alfeld et al., 2007).

Preparing students for a technologically advanced work environment is an important goal of CTE. This is especially true in today's workforce where technology changes the landscape of occupations and how people engage in work. Working with a variety of technologies as a workplace competency has received considerable attention since 1991 when it was highlighted in the Secretary's Commission on Achieving Necessary Skills (SCANS) report (Redmann & Kotrlik, 2004). To prepare for a technology literate workforce, technology needs to be an integral part of the teaching and learning process.

1.2 CTE and Grit

The relationship between CTE experiences and cognitive traits can also make an important contribution to our understanding of the influences on academic performance. Of particular interest is the influence that CTE experiences might have on student persistence. Research with primary and secondary age students has shown that students' persistence or grit in addressing problems or obstacles is malleable (Duckworth & Quinn, 2009). Attitudes such as conscientiousness and personal responsibility that appear to promote the development of persistence are consistent with the experiences one expects from authentic engagement in workplace related tasks (Credé et al., 2017).

Prior research also indicates a positive relationship between grit and student participation in career-related or leadership events. Meacham (2019) found that CTSO students who attended a state leadership conference displayed higher levels of grit than average adolescents. Nealy and Marti (2019) found that the level of grit of female students increased as a result of their participation in a career exploration and orientation program in STEM. In the healthcare education literature, persistence has been noted as a critical success factor that is positively related to engagement in real-world contexts during high school (Thessin et al., 2017). In an extensive review of the health professions education literature, positive but weak correlations with resiliency were noted (Stoffel & Cain, 2018).

1.3 CTE and SRL

SRL focuses on understanding how learning is influenced by various cognitive, metacognitive (control over one's cognitive process), motivational, and contextual factors. A social-cognitive view of SRL involves skills such as planning learning tasks, exercising self-motivation, self-control, and self-observation (Zimmerman, 2006).

CTE Internships and workplace simulation learning provide an authentic learning environment that supports occupational related knowledge, skill, and attitude acquisition (Jossberger et al., 2010). Students need to demonstrate self-directed learning and self-regulated learning (SRL) skills to actively engage in such a learning environment to cope with individual independence and task demands (Van Grinsven & Tillema, 2006). Compared to self-directed learning that focuses on planning the learning trajectory (macro), SRL is more foundational and focuses on executing tasks (micro) (Jossberger et al., 2010).

These skills are useful in all learning environments but especially important in vocational and work-based settings in which students acquire specific technical skills in real-life practical tasks (Jossberger et al., 2020). Self-regulated behaviors are not only observed, but also influenced by the emerging performance and work outcomes during hands-on activities, revealing a dynamic process of work-based learning. The design of these learning environments are guided by instructors with varying approaches to learner guidance (directed vs. independent) and dealing with student differences (Voskamp et al., 2020).

1.4 CTE and Technology Attitudes

Research into the direct connections between CTE experiences and technology attitudes is limited. While integrating technology into core subjects has become a priority, it has long been a necessary attribute of CTE programming. The role of technology has also been supported by federal legislation that seeks to promote skills and experiences that improve career opportunities (Plasman et al., 2020).

Consistent with the Technology Acceptance Model (Davis et al., 1989) and the Theory of Planned Behavior (Ajzen, 1985), attitudes are directly related to individuals' behavioral intentions. Positive attitudes toward technology, which are positive judgments constructed out of one's beliefs and experiences, are a primary indicator of successful adoption and integration (Lee et al., 2010; Sang et al., 2010; Teo, 2009). CTE experiences in high school may foreshadow subsequent positive attitudes in college. However, this relationship is not explored in the literature.

1.5 The Present Research and Hypotheses

The positive impact of SRL skills and grit on academic performance is well established (Pintrich & De Groot, 1990; Schunk & Greene, 2018; Yeager et al., 2019). There is also a strong recognition of the inter-related nature of SRL, persistence (i.e., grit) and the goals of CTE (Nealy & Marti, 2019; Shen et al., 2007). However, a direct relationship

between CTE experience, SRL and grit has not been established. The same is true for CTE experience and technology attitudes (English & Kitsantas, 2013; Rosen et al., 2018). This work seeks to identify the potential influence of CTE experiences on subsequent traits of import to student success. In particular, the purpose of this study was to examine the relationship between CTE experiences in high school and subsequent SRL skills, grit, and technology attitudes of college students.

Three research hypotheses were constructed based on the review of the literature.

H1: CTE Participation in high school is positively correlated with positive technology attitudes in college.

H1a: CTE in HS is positively correlated with a positive view of technology as measured by the media and technology usage and attitude scale (MTUAS) (Rosen et al., 2013)

H1b: CTE in HS is positively correlated with dependence on technology as measured by the MTUAS

H2: CTE Participation in high school is positively correlated with self-regulated learning skills in college.

H2a: CTE in HS is positively correlated with cognitive resource management as measured by the motivational strategies for learning questionnaire (MSLQ) (Pintrich et al., 1991)

H2b: CTE in HS is positively correlated with regulation of cognition as measured by the metacognitive awareness inventory (MAI) (Schraw & Dennison, 1994)

H3: CTE Participation in high school is positively correlated to grit in college.

H3a: CTE in HS is positively correlated with the perseverance factor of the short grit scale (Grit-S) (Duckworth & Quinn, 2009)

2. Method

2.1 Design and Participants

103 (84 Female, 19 Male) undergraduate education students completed an online survey to fulfill a research requirement in an educational technology course. The setting is a large research university located in the southwest United States. The mean age was 21.5 years (SD = 3.96). 58 participants were enrolled in the elementary sections of the course and 45 were enrolled in the secondary sections. The study was approved by the university Institutional Review Board.

2.2 Measures

2.2.1 Cognitive Traits

Three measures of cognitive traits were used. The three measures are inter-related yet capture unique factors of cognition that contribute to academic achievement. The factors of interest for this study are cognitive resource management (e.g., focus, time management, efficient learning environment), regulation of cognition (i.e., metacognition) and grit.

The first measure used the cognitive resource management factor of the Motivational Strategies for Learning Questionnaire (Pintrich et al., 1991). The six cognitive resource management items are related to focus (e.g., *I work hard to do well in class*) and time and study environment (e.g., *I make good use of my study time*).

The second measure used the 11 items from the regulation of cognition factor of the Metacognitive Awareness Inventory (Harrison & Vallin, 2018; Schraw & Dennison, 1994). Sample items for the regulation of cognition items include *I set specific goals before I begin a task* and *I summarize what I've learned after I finish.*

The third cognitive trait measure used the 6 items of the persistence factor on the Short Grit (Grit-S) Scale (Duckworth & Quinn, 2009). Sample items include *I am diligent* and *Setbacks don't discourage me.*

All of the cognitive trait items used a 5-point fully labeled Likert response scale (Not at all typical of me - Very typical of me).

2.2.2 Technology Attitudes

The participant attitudes towards technology were measured with four items from the Positive Technology and Anxiety / Dependence attitude factors in the Media Technology Usage and Attitude Scales (MTUAS) (Table 1). While the two attitude factors are related, prior work has demonstrated an acceptable level of independence (Rosen et al., 2013).

Table 1. Media Technology Usage and Attitude Scales (MTUAS) (Rosen et al., 2013)

Positive Attitude Towards Technology Items
1. I feel it is important to be able to access the Internet any time I want.
2. I think it is important to keep up with the latest trends in technology.
3. Technology will provide solutions to many of our problems.
4. I feel that I get more accomplished because of technology.

Anxiety / Dependence on Technology Items
1. I get anxious when I don't have my cell phone.
2. I get anxious when I don't have the Internet available to me.
3. I am dependent on my technology.

Table 2. Means, standard deviations, Cronbach's Alpha and intercorrelations for scales.

	Items	Mean	SD	Alpha	I	II	III	IV
I. Cognitive resource management	6	23.4	3.78	.76				
II. Regulation of cognition	11	38.3	7.58	.88	.547			
III. Grit perseverance	6	23.3	4.23	.80	.433	.617		
IV. Positive technology attitudes	4	16.3	2.65	.62	.127	.029	-.025	
V. Dependence on technology	3	10.4	2.77	.73	.063	.073	.001	.400

Composite scores were calculated for each of the cognitive and technology measures described in this section (see Table 2). Cronbach's alpha for each of the measures was strong with the exception of the positive technology attitudes scale from the MTUAS. With only four items and being the subject of substantial prior research, the alpha is not necessarily indicative of unreliability (Taber, 2018).

2.2.3 CTE Experiences

Four aspects of students' CTE experiences were measured: the total number of CTE credits taken in high school, whether the student was a CTE concentrator, engagement in internship, apprenticeship, and/or job shadowing, and engagement in CTSOs.

Participants were asked to respond to the prompt:

Did you enroll in any CTE courses in these areas in high school? Yes/No

Affirmative responses revealed a listing of the career clusters identified in the National Career Cluster Framework (Advance CTE, n.d.) with a corresponding Yes/No field (health sciences, business, communication, computer sciences, manufacturing, hospitality and tourism, architecture/construction, agriculture, food and natural resources, engineering/engineering tech, transportation, and human services courses).

If participants responded yes to any of the areas, they were asked:

What is the total number of career and technical courses you completed while in high school?

And:

Consider the area above where you completed the most coursework. How many courses did you take in that area?

Participants were asked if they participated in internships, apprenticeships, and/or job shadowing during each year in high school and if they participated in any of the eleven U.S. Department of Education recognized career and technical student organizations (ACTE, n.d.).

3. Results

Participants reported an average number of 2.17 total CTE credits (Range 0 to 16, SD 3.10). 20 (19.4%) participants reported taking more than 2 credits in any one area and were thus designated a CTE Concentrator (Advance CTE & ACTE, 2018). The same number of students reported participating in at least one CTSO during high school. 26 (25.2%) participants reported participating in at least one internship during high school. CTE Concentrator, Internship Engagement, and CTSO Engagement were each dummy coded with 1 = yes, and 0 = no. See Table 3 for the frequency of high schools attended by type.

Table 3. Type of high school

What type of high school did you graduate from?	N	Percent
Traditional comprehensive	72	69.9
Career academy	6	5.9
Magnet program	8	7.8
Other (*college prep, dual enrollment, private, GED, charter*)	16	15.5
No response	1	1
Total	103	100

3.1 Research Hypothesis 1: CTE and Technology Attitudes

Dependence on technology was positively and significantly correlated with the total number of CTE credits taken as well as with the CTE concentrator variable (Table 4). The correlations between technology attitude and CTE credits and CTE concentrator were positive but not statistically significant. The correlations between technology variables and engagement in CTSO and/or internship were mixed and not statistically significant.

Table 4. Zero-order correlations with technology attitudes (N=103)

Variable	Total CTE Credits	CTE Concentrator	Internship Engagement Any Year	CTSO Engagement Any Organization
Positive Technology Attitude	.150	.132	-.047	-.064
Dependence on Technology	.193*	.267**	.048	-.053

* < .05. ** <.01. One-tailed

3.2 Research Hypothesis 2: CTE and Self-regulated Learning

Statistically significant positive correlations were identified between the total number of CTE credits taken and cognitive resource management as well as between the CTE concentrator and regulation of cognition (Table 5). Engagement in internship, apprenticeship, and/or job shadowing was positively correlated with grit and regulation of cognition. The correlations between SRL variables and engagement in CTSO were positive but not statistically significant.

3.3 Research Hypothesis 3: CTE and Grit

Engagement in internship, apprenticeship, and/or job shadowing was positively correlated with grit. The correlations between grit and the other CTE variables were positive but not statistically significant.

Table 5. Zero-order correlations with cognitive resource management, regulation of cognition and grit (N=103)

Variable	Total CTE Credits	CTE Concentrator	Internship Engagement Any Year	CTSO Engagement Any Organization
Cognitive Resource Management	.175*	.109	.008	.076
Regulation of Cognition	.148	.180*	.197*	.148
Grit	.088	.076	.198*	.041

* < .05. One-tailed

4. Discussion

The purpose of this research was to explore the relationships between CTE experiences in high school and subsequent SRL skills, grit, and technology attitudes of college students. It was hypothesized that CTE experiences in high school will positively correlate with technology attitudes, self-regulation, and grit in college. The hypotheses were generally accepted although there was variation across the different measures for each of the constructs.

4.1 CTE and Technology Attitudes

Two technology attitude constructs were used to evaluate the first hypothesis of a positive relationship between CTE experiences and technology. The positive technology attitude construct is designed to reflect a hopeful view of the positive role that technology can play (e.g., *technology can solve many of our problems).* The related construct of technology dependence could be viewed as the result of the hopeful view combined with a recognition of the realities associated with it (e.g., *I am dependent).* The latter construct demonstrated a strong relationship with the coursework measures. This was especially evident in the responses from course concentrators. These participants are in a position to see how technology might become problematic when the exploration of a particular career field is more substantive. It is also worth noting the lack of any measurable relationship between these attitudes and the non-coursework CTE measures. Three of the four indicators reflected a comparably small non-significant, negative correlation.

Taken as a whole the results provide a starting point for subsequent investigations in an area that has garnered limited research interest. This is surprising given the broad interest in technology integration at all levels of education. This is particularly noteworthy with major CTE legislation in the United States specifically calling for increased attention to technology (Plasman et al., 2020).

4.2 CTE and SRL

SRL was measured from a cognitive resource management perspective and a metacognitive perspective. The two perspectives were consistent with respect to CTE coursework (total credits and concentrators) but only the regulation of cognition perspective demonstrated a substantive relationship to the non-coursework indicators (internships and CTSO). This is understandable given that students who participated in internships and CTSOs are in a learning environment that differs substantially from classrooms. Participants need to construct meanings and process information from tangible events and real-world situations (Jossberger et al., 2020), and thus exercise more metacognitive strategies and resources.

These results provide limited support for the supposition that CTE experiences may generate more highly self-regulated learners. More investigation is clearly warranted to better understand possible mechanisms. While CTE experiences might foster more independence and sense of control in the learner, this will vary widely based upon the arrangement of the coursework. For example, the degree to which CTE instructors scaffold learning experiences will have important implications for the developing self-regulated learner (Jossberger et al., 2010). Research into the necessary parameters indicates that teachers must accommodate individual learner interests and identify the appropriate level of guidance to foster the development of self-regulated learning (Voskamp et al., 2020).

4.3 CTE and Grit

Although all the correlations with CTE were in the hypothesized direction, the grit measure did not reveal a statistically significant relationship to the coursework and CTSO measures. This work was then unable to verify the positive

relationship between CTSOs and grit identified by others (Meacham, 2019; Nealy & Marti, 2019). This perhaps is due to the operationalization of the CTSO experience in those studies (e.g., conference experience or the career orientation intervention) that differed slightly from the current work. In our study, we did not look into the varied nature and the degree of engagement of students' CTSO experiences. For example, did the student engage as a participating member or lead the organization as an officer, what was the degree of training and preparation the student had for competitive events, and how active the CTSO chapter was in the student's school? Each student's CTSO experience is unique and the measure we used may not have sufficiently captured the experience. This study did provide support for a statistically significant positive relationship between internships and grit. Taken as a whole, this and earlier studies indicate that grit and related constructs may play a role in the subsequent academic success of CTE participants.

4.4 Limitations

Although the high school CTE experience is a chronological precursor of technology attitudes, self-regulation, and grit based on our measures, the relationship identified from the correlations does not imply causation. Also, the low number of participants reporting CTE related experiences resulted in a limited dataset. Also, the use of the bivariate analysis limits the generalizability of the findings. These results can be used to begin the development of multivariate models that incorporate additional consequences (and possible precursors).

4.5 Future Research

As technology plays an ever-increasing role in teaching and learning, future research could investigate the use of technology in CTE, which may help us understand students' attitudes toward technology. Investigations should also look into technology use and curricula in various occupational fields due to the heterogeneity of CTE programing. Addressing the limitations noted above can also be addressed by querying college students in other fields of study. In addition, as a better understanding of the relevant relationships develop, it will be possible to begin the investigation of causal models.

Moving beyond non-experimental research, interventions that support the positive influences from CTE are worthy of study. For example, while interventions to support the development of grit in the healthcare professions have produced mixed results (Stoffel & Cain, 2018) there is encouraging evidence. Although beyond the scope of this work, clarification of the characteristics and contexts of successful interventions can support more consistent positive results. Successful interventions in related research should be used as a guide (Yeager et al., 2019). This research points to the potential for brief, scalable, and strategic interventions to positively impact student behaviors. By incorporating these strategies into existing CTE (and other) curricula, it is possible to make a broad and lasting impact.

4.6 Recommendations

The benefits of CTE participation on high school graduation is well established (Castellano et al., 2017; Gottfried & Plasman, 2018). This work extends the study of the apparent benefits. In particular, this work points to promising implications for behaviors that are consistent with student success in high school and post-secondary education. As a collective, the literature supports a continued expansion of CTE opportunities. This is not limited to curricular offerings as the promise of participation in work-related field experiences and student organizations is also supported.

When considering the characteristics of CTE programming (authentic, technology utilization, problem centered), the implications for the core curriculum can be extrapolated. In particular, the engagement of the learner in authentic, technology supported, problem-based activities can positively contribute to the development of skills consistent with student career and education success (Sungur & Tekkaya, 2006). Connections beyond the classroom that include field experiences and student organizations can benefit all learners.

4.7 Conclusion

The mission of the 21st century CTE program of study is to prepare students for both academic and career success. In contrast to the focus on the cognitive knowledge and skills in academic education, CTE focuses on the acquisition of domain-specific workplace skills. While existing research demonstrating a positive impact of CTE on academic outcomes is encouraging, there is a need to better understand the mechanisms by which this occurs. This study explored the relationships between high school CTE experience, technology attitudes, and cognitive traits, which is a significant step towards understanding how CTE contributes to academic success. Overall, this study adds to the growing research in support of the benefits of developing integrated curricula that support both academic and workplace readiness.

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