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# Investigating How Technical Acumen and Student Grit Affect the Performance of Students in Online Learning Environments

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## Abstract

For educators to be effective, they must understand what pre-requisite knowledge students truly have when they enter the classroom rather than only presuming that knowledge exists. Thus, it is important for technology educators to identify assumptions about what students' educational experiences with technology have been prior to college (e.g., saving files, sending emails). The purpose of this study is to assess student experience with technology vs. what instructors assume they have experienced before entering the classroom. The findings show that many technology skills assumed to be prior knowledge, may no longer be part of students' educational experience prior to college. The study also investigates the relationships between student grit and their experiences with these technologies.

**Keywords:** technology, learning, pedagogy, grit

### 1. INTRODUCTION

Colleges and universities are steadily increasing the required technical skills needed for student success and ensure career readiness (Brown et al., 2020). However, there are many students entering their college classrooms without the basic technical skills needed to be successful in their courses (Bowman et al., 2023; Wallace & Clariana, 2005). There are different factors causing this reality such as a student's pre-college academic experience, family practices, and technology access (Goode, 2010). As a result, the level of technology exposure a student

has received prior to college could have a significant impact on the digital divide that is being felt across college campuses today (Goode, 2010). This reality was magnified with the onset of the COVID-19 pandemic (Kelly, 2023). Students had to quickly adapt to an online learning environment, and for many this was the first time being exposed to this course delivery format. Students were not only expected to possess the technical skills required to master course content, but the computer skills necessary to successfully matriculate through the course as well. This reality could prove to be detrimental to the performance of students who already experience a certain level of anxiety when taking technical/quantitative oriented classes (Núñez-Peñaab, Suárez-Pellicioni, & Bono, 2013). Yet, despite the challenges a student may be faced while participating in an online learning environment, there is a certain perseverance that presents itself known as student grit. Studies have shown that student grit, an internal drive despite all perceived challenges, plays a significant role in educational outcomes (Christopoulou et al., 2018). While some students may not possess the technical skills required initially, the resilience and drive they do possess is believed to be what produces their successful outcomes in academic environments.While there have been studies that focus on student grit and the technical skills needed in academic environments (e.g., Bliss & Jacobson, 2020; Calo et al., 2022; Stoffel & Cain, 2018), there has been little research that looks at both attributes together to determine if a correlation is present amongst them. Additionally, while this research study focuses only on undergraduate students, there are varying ages of students included in this study, which represent both nontraditional (students who are outside the 18-22 age range) and traditional (students entering college directly from high school) categories. Technical skill levels and student grit could differ between nontraditional students and traditional students, which as a result could affect course performance. This study also examines which technical skills students lack when entering college that their professors expect them to possess. Once this is identified, professors will be better able to identify the training students need to be successful in their courses. The contribution of this research is to assist business school instructors and professors overall in developing implementable strategies to maximize student performance in online learning environments.

## 2. TECHNICAL SKILLS

Students do not come into college guaranteed to have technical skills. Research has shown that incoming business school students lack the required computer skills, knowledge, and abilities to pursue their degree programs (Brown et al., 2020; Wallace & Clariana, 2005). As a result, some higher education institutions offer freshman courses, which introduce students to computer applications and information technology. Since these courses are not required general education at all universities, some students possessed more technical skills when the pandemic occurred. COVID-19 resulted in many colleges and universities transitioning to online learning, which required the immediate need for students to utilize the technical skillset they have accumulated over time. Yet, the technical toolbox was not consistent for all students, as some enter courses with different experiences and self-efficacy with technology (Claus et al., 2021; Kelly, 2023).

Students have had different levels of exposure to varied technologies from previous courses and previous work experience opportunities (Brown, 2021). Furthermore, there is a learning curve when students are introduced to new technologies. Students can be overwhelmed by the technology expectations of courses, especially if they lack sufficient technical knowledge (Zhang & Perris, 2004; Holley & Oliver, 2010). In supply chain related courses for example, much of the material being presented is quantitative and technical in nature and requires students to be exposed to a variety of technology and software tools, which can be intimidating for many students (Johnson & Kelly, 2020).

It is important for professors to train students on new technologies prior to requiring that students use these technologies for course deliverables (Aguilera-Hermida, 2020). However, the pandemic forced many students to learn these different technologies in an online learning mode, when they traditionally been accustomed to learning in face-to-face environments (Kelly, 2023). Therefore, instructors must consistently develop innovative practices to sharpen technical skills in college students to increase learning outcomes in online learning settings. The baseline of better training is identifying the technological training students need. Therefore, the following research question is proposed:

**RQ1:** What technology skills do students lack entering college that their professors expect them to possess?

## 3. STUDENT GRIT

A variable that is a strong predictor of the amount of assistance students will need in learning new material is grit (Nussbaum et al., 2021). Grit is defined as a combination of internal motivation and belief that one's work with be worthwhile; it is an imperative skill for students to possess and there is a correlation between student grit and performance outcomes (Duckworth et al., 2011; Eskreis-Winkler et al., 2014). Student grit has a lot to do with whether students feel expected to know more than they currently do regardless of the context. Grit is a pre-requisite for having the instinct to look up how to do a task one is unfamiliar with rather than freezing or feeling helpless (c.f., Loftus et al., 2020). Therefore, students with grit are going to be more likely to have that instinct to learn what to do when asked to do a technical task that they have not been formally taught. Grit increases monotonically across lifespans, and as such, older students are likely to possess more grit than younger students (Duckworth & Eskreis-Winkler, 2013). The National Center for Educational Statistics (n.d.) identifies older, non-traditional college students who are likely to have had non-educational life experiences between reaching adulthood and beginning their university studies as those 24 and older while traditional college students are 18-23 years old. As such, the following hypothesis is proposed:

**H1:** Non-traditionally aged college students will have higher than traditionally aged college students.

It is apparent that student grit, during the pandemic, has become one of the deciding factors regarding student success in a course (Chen et al., 2022). The pandemic contributed significantly to the stress many students faced in the academic environment, however students with a certain level of grit are dedicated to their long term goals and will therefore adjust accordingly to achieve the desired outcome (Mosanya, 2021). Because students with high grit normalize the challenge of learning something new, being challenged with the task of learning something new is less likely to surprise them than students with low grit. Surprises are the events most likely to form clear memories (Frank et al., 2022). Thus, it is possible that students with high levels of grit face encountering a new technology as one more inevitable step that must be navigated to reach that long term goal, while students who lack grit do not feel that navigating the new technology is part of their duty, but rather something that should be taught to them. Therefore, the following research question is proposed:

**RQ2:** Will there be a difference in grit between students who recall instances in which their professors have expected them to have technology skills that they did not possess and those that do not recall such an occasion?

This phenomenon of grit positively relating to students' self-initiative to learn and problem solving has been identified in disciplines such as nursing (Munn et al., 2022), social work (Chonody, 2022), humanities, social sciences (Salud, 2022), and medicine (Miller-Matero et al., 2018). However, research has not been conducted to study how student grit affects the experience and student performance for those in business schools. This study intends to help close this research gap with respect to how student grit was prevalent during the COVID-19 pandemic for business school students. In addition, the study will show how grit often develops across one's lifetime, which means that faculty should be especially cognizant that their younger students may not have the instinct to help themselves and may require more attention while enrolled in the course.

## 4. METHOD

### Participants

In total, 254 students participated in this study. Although all students surveyed were undergraduates, both online and face-to-face courses were surveyed, which included a population of non-traditional students. Therefore, the average age of participants was 26.0 (*SD* = 12.42) years old. In total, 165 students were traditionally aged and 83 were non-traditionally aged. Course rank broke down as follows: 38 first-year, 42 sophomores, 63 juniors, 106 seniors, and 5 students who chose not to identify their class rank. In terms of gender, 141 participants identified as female, 107 students identified as male, one student identified as non-binary/third gender, and five chose not to identify their gender. Student majors broke down as follows: 167 business, 37 technology, 12 engineering, 6 math, 6 natural science, 4 arts/humanities, 4 social sciences, 2 law, 1 agriculture, 1 health, 9 "other," and five students chose not to identify their major.

### Procedure

Researchers sent a link to students enrolled in their courses during the spring and summer 2022 semesters. For courses that had a research component built into the class, this research opportunity served as one of many assignment

options for students. For courses that did not have a built-in research component, no incentive was offered. The link was provided with a simple ask that students complete the questionnaire if they have time. In total, students needed less than 5 minutes to complete the questionnaire.

**Instrumentation**

The questionnaire began with several closed ended questions about students' technology skills. An open-ended question was also included asking students to share any technologies they recall being expected to know by a professor that they had no prior knowledge of. The questionnaire also included a measure of grit and demographic items.

Duckworth and Quinn's (2009) assessment of grit was used. This measure was composed of 8 Likert-type items with a 7-point response scale ranging from *Disagree Strongly* to *Agree Strongly*. Before using the measure for hypothesis or research question testing, it was subjected to confirmatory factor analysis to ensure that the hypothesized factor structure was observed in the current dataset. The following fit statistics were observed for the measure: goodness of fit (GFI) = .83, comparative fit index (CFI) = .76, root mean square error approximation (RMSEA) = .18, and standard root mean residual (SRMR) = .10. Recommended fit is GFI ≥ .90, CFI ≥ .90, RMSEA ≤ .10, and SRMR ≤ .08 (Byrne, 2016). If RMSEA alone is elevated, it is safe to use a measure for hypothesis testing given that fit statistic's sensitivity to even the most minor misfit, but all three other fit statistics should be acceptable before proceeding to hypothesis testing (Chen et al., 2008). Therefore, the standard residual covariance matrix was examined for misfit. One item, "I am diligent," was causing a statistically significant amount of residual error upon multiple items in the measure. Once that item was removed, the fit statistics were acceptable: GFI = .93, CFI = .91, RMSEA = .11, and SRMR = .07. As such, the measure was used for hypothesis and research question testing without the problematic item. The reliability score for the finalized measure was α = 0.80. The measure had a mean of 4.74 (*SD* = 1.10).

## 5. RESULTS

The first research question asked which technology skills professors expected students to know, but that they did not actually know. This question was examined by looking at three closed ended questions. The first question asked students if they had an email account before coming to college. Ten students indicated that they never had an email account before starting college. The second question asked whether students knew how to attach a file to an email. Two students indicated that they did not know how to attach a file to an email, both of whom were Juniors. The third question asked if students knew how to take a screenshot so that they could email a photo of their technology issue to professors. Twenty-two students indicated that they did not know how to take a screenshot, including 6 first years, 4 sophomores, 5 juniors, and 7 seniors.

Next, the data was analyzed in through a filtering closed-ended question and an open-ended question. Students were first asked if they could recall a time in which a professor expected them to have tech skills entering their class that they did not actually have. In total, 135 students indicated that *yes* there had been times in which they had been expected to have more technology skills by their professors than they currently possessed. This question was followed by an open-ended question, asking students to list the technologies they remember their professors expecting them to know. Recurring themes from those responses included:

How to

- Perform basic functions in MS Word, Access, or Excel such as build graphs and use Excel formulas
- Use programming knowledge
- Convert a file into a different file type
- Zip or unzip a file
- Take a screenshot
- Troubleshoot their own technical problems
- Use Google suite programs
- Install programs
- Use Tableau
- Build a PowerPoint deck that has more than a transcription
- Navigate the new websites
- Share their screen within video conferencing platforms
- Edit media files

As such, the responses varied from basic computer skills to knowledge of specific programs. The hypothesis proposed that there would be a statistically significant positive relationship between age and grit. An independent t-test supported this hypothesis [$t(24) = -5.27$, $p < .001$, traditional $M = 4.50$, non-traditional $M = 5.24$]. Figure 1 visually summarizes the finding.

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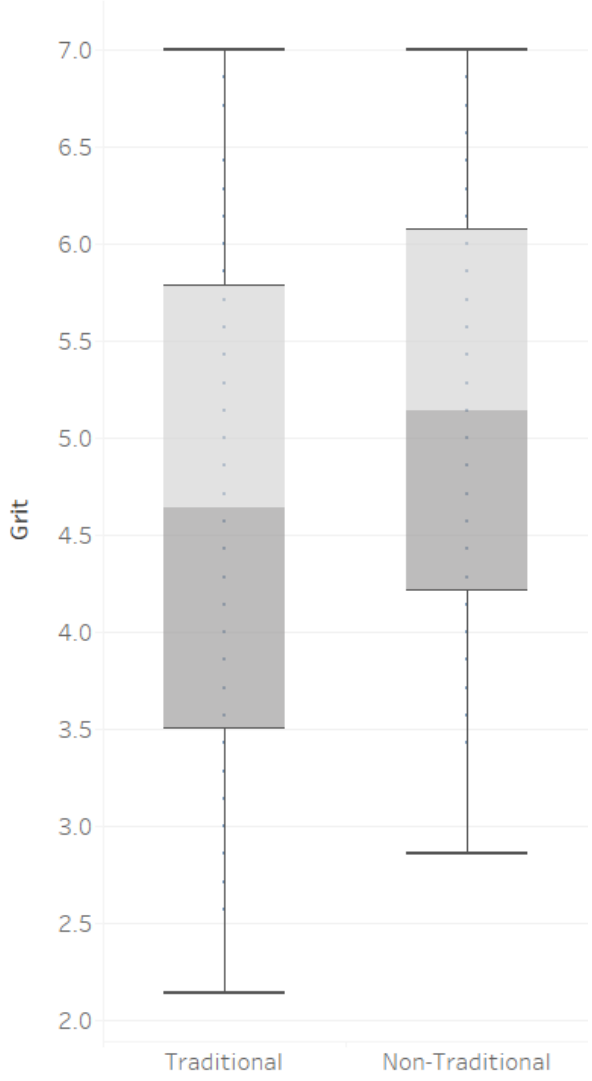
Figure 1: H1

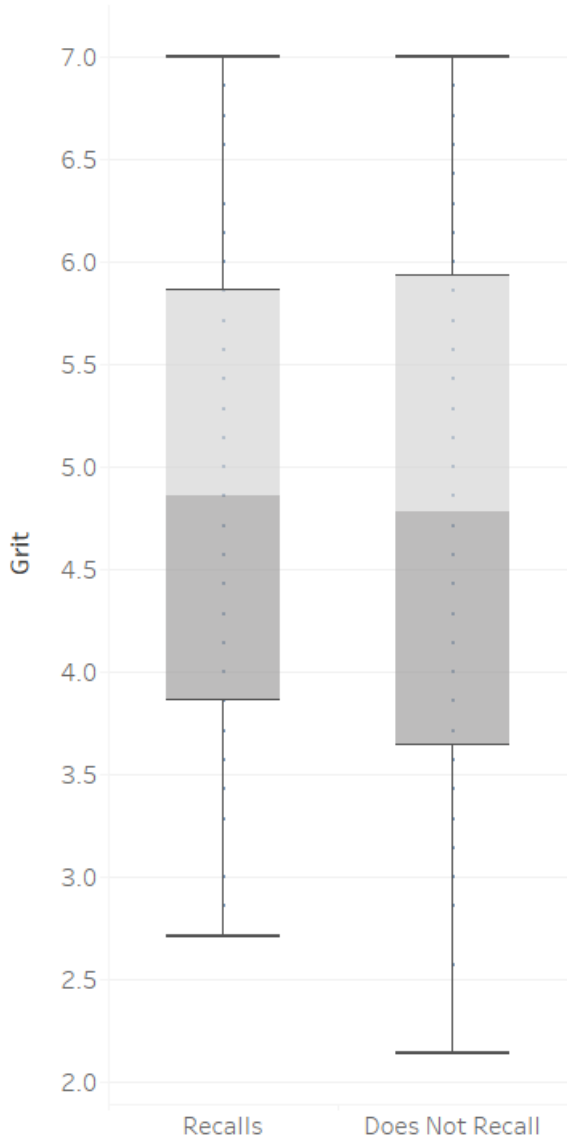



The second research question asked whether students who could recall a time in which they were expected to know technology they did not had lower grit than those who did not recall such an occasion. An independent t-test found no statistically significant difference between these groups $t(251) = -1.49$, $p = .14$. Figure 2 visually summarizes this finding.

## 6. DISCUSSION

Taken together, the data from this study tells a story about students' relationship with technology. Once upon a time, in the not-too-distant past, instructors could rely upon college students to be the technology experts in the room (Westerman et al., In Press). Early Millennials, who had to learn basic programming skills to entertain themselves with Dino Math and Oregon

Figure 2: RQ2




Trail, and then regularly maintenance their machines to cope with connection to dial-up internet, needed advanced computer literacy simply to entertain themselves with technology. Students who have grown up in the era of graphic user interfaces and automatic disc defragmentation cycles need not know anything more advanced than how to point and click to entertain themselves. As such, the need to know how to discover and upscale computer skills is not present in Generation Z students as it was their predecessors, and instructors cannot assume technology literacy for future learners as they did students 10-20 years ago (Garland & Violanti, 2021).

Students from this study indicated a wide variety of technological skills that professors assumed they knew before entering the classroom that students in fact did not know. Some of these skills were basic computer literacy skills such as installing a program or converting a file type. A possible explanation for this finding may be the impact Covid-19 had on educational environments. In the wake of Covid-19, more schools than ever turned to cloud-based classroom systems such as Google Classroom where students completed all assignments from writing essays to solving equations in a cloud-based system without ever using desktop applications or installing software (Ansong-Gyimah, 2020; Okmawati, 2020). Given that these cloud-based services save time for instructors with their auto-grader features and reduce carbon footprints by removing the need for paper assignments, it is unlikely that K-12 education will return to the old norm of teaching in post-pandemic education. As such, post-pandemic students are more likely than ever to lack these basic computer literacy skills that participants in this study cited were expected of them as pre-requisite knowledge. Furthermore, students are unlikely to have experience using desktop applications, such as basic MS Office skills, which participants in this study mentioned was presumed knowledge by their professors. The new normal of post-pandemic education means students are coming out of K-12 education experiencing a narrower variety of technological tools prior to entering college.

This begs to question how educators should address this deficit in student technology skills given the need for educators to cover the content of their own class, without losing teaching time to catch students up with basic technology skills. One possible intervention that could be taken from the literature is to focus on increasing student grit, as research explains that grit is learned over time, and the higher students' grit, the more likely they are to look these skills up for themselves (Duckworth & Eskreis-Winkler, 2013). Yet, data from this study suggests that the historically reliable suggestion of grit interventions may not be the answer to this technology deficit. Indeed, while the expected trend of non-traditionally aged students having more grit than traditionally aged college students appeared in this data, students with higher grit were not more likely to recall being expected to know technology that they did not in class. As such, even students with high grit, who are unsurprised or daunted by the task of learning a new skill, were no less likely to recall being surprised with new technology expectations than students with low grit. This indicates that the issue is not likely to be lack of grit, else these memories would have been less prevalent in high grit students (c.f., Duckworth et al., 2011; Frank et al, 2022). Instead, this is an issue that lies outside of students' motivation to better themselves and their belief that they can learn new things. Likely, this finding is an artifact of the "new normal."

As instructors embrace the "new normal" that is education in the post-pandemic landscape, it is critical to remember that:

1. Basic computer skills that were "normal" for all students to have 10+ years ago, are no longer normal.
2. The shift from old normal to "new normal" in education is almost always met with resistance, but educational change provides opportunities to better serve students (Claus et al., 2021).

Answering the question of how to upscale students' technology acumen to catch up with the technology skills they need to be successful in the college classroom requires an answer far beyond the scope of this paper. However, the authors propose avenues for future research to explore how to close the technology gap: Perhaps…

1. it is time for basic introduction to technology general education courses to span beyond MS Office and focus on basic computer literacy, covering even some of the most basic skills which students indicated were beyond them in this study such as attaching files to emails and taking screenshots.
2. basic technology skills should be added to modules in first-year orientation courses.
3. instructors should have video tutorials in their learning management system walking students through the basic technology skills expected in the class so that they are available to students as needed, but do not retract time from their curriculum.
4. early assignments in courses should require using all technical skills needed for the class so that students gain this knowledge before more heavily weighted assignments are due that might cause more stress and anxiety to both students with high and low grit.
5. a simple online survey could be presented at the beginning of class that assesses students' technology gaps so that the professor knows which areas might need

more attention than just relying on video tutorials to gain knowledge of the needed skill.

There are a variety of options for closing the gap between the skills professors expect students to know and the skills they do know coming out of post-COVID K-12 learning. Future research is needed to explore which interventions will be most effective.

## 7. LIMITATIONS

This study is not without its limitations. There was minor measurement noise in the grit measure. The utility of items in latent variable measures changes over time as new generations of participants place different meanings on words (Croucher & Kelly, 2019). As such, it is unclear whether the failure of this item is an artifact of this sample's composition or if the item is aging out of utility. Future research is needed to explore this measure.

This paper was also limited in our sample age diversity. The sample was weighted more heavily towards traditionally aged college students. Also, the implication of older undergraduates having more grit than younger undergraduates should not be generalized outside of the university setting as these non-traditional students are already a self-selected population who have the grit to return to college despite the demands of their adult life.

## 8. CONCLUSION

As education emerges into a new era of normal, it is important to discard our assumptions about what is normal regarding students' technology experiences and likewise, develop a new understanding of what normal technology skills are for this generation of college students. Universities and researchers must explore avenues to bridge the gap between what students know and what they need to know to be successful. Professors must begin questioning their assumptions about the technological skills students have and think creatively about how they can support students who need additional training.

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