SoTL Best Practices: 21st-Century College Students' Perceptions of Learning Styles and Instructional Design Materials' Influence on the Successful Completion of Assignments

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There is a long history of interest in individual differences in learning styles. Beginning in the 1960s, academic research endeavors began examining the concept of personalizing teaching as the best scholarship of teaching and learning best practice (SoTL). This current series of interconnected empirical studies take a fresh look at SoTL by examining students' self-perception of their learning styles and whether their perceptions relate to how they learn. Today's college students are growing up in the information age of the 21st Century. Many educators believe that a best practice is to focus on delivering personalized instructional material through technology. Thus, the current mixed methods study adds value to SoTL research by examining these concepts through a representative sample of the subject university in the United States. To assure the reliability and validity of the complex series of three integrated studies, research assistants were trained by a researcher experienced in experimental and survey designs. Data were analyzed using SPSS27®. The study's findings indicated that focusing instructional materials on individual learning styles does not equate to learning success; in fact, the data showed no relationship. The data showed that a combined instructional delivery methodology (kinetic and audio) had a positive influence on learning success. The findings revealed that explicit instructions with or without audio were the most effective in leading to students' ability to follow instructions successfully. Managing students' self-perceptions of learning styles is important to assure successful learning experiences. Findings, conclusions, implications, recommendations, and limitations are presented herein.

INTRODUCTION

Across multiple years of teaching, the authors recognized a change in students' abilities to successfully follow instructions. Therefore, to identify best practices for learning to occur, this study scientifically approached SoTL at the intersect of teaching and learning by examining approaches to instructional material design and students' self-perception of learning methods (Trigwell, 2013).

The authors have adopted Trigwell (2021) definition of scholarship of teaching and learning (SOTL) as "a professional way of thinking and practicing that seeks to improve student learning through a process of inquiry and peer review" (p. 286). The current study focuses on a key element of SoTL for which research has been relatively silent which is the effectiveness of instructional material design and its influence on the successful completion of an assignment.

This study consists of a series of three interconnected studies focused on the role of instructional material design and self-perception of learning style as to students' successful completion of assignments. The findings of the current study provide insights into the design of instructional materials, discovered through scholarly inquiry, for the purpose of enhancing teaching and learning. The purpose of the design of instructional materials is to improve students' ability to understand and successfully follow instructions. Thus, this study examined whether educators should focus on instructional material design creation through the lens of learning style to determine whether individualized instructional materials are warranted (Allcock & Hulme, 2010; Hattie, 2009; Scott, 2010), determine if technology (e.g., YouTube video) should be used as a key element in designing instructional materials (Moussa, 2018), and determine whether students of the information age's

perceptions of their own learning style are correct or misguided (Cox, 2008).

The findings of the current series of studies are expected to add value to the SoTL literature and serve as a guide when designing instructional materials. In this study's literature review section research on learning theory/styles, assessment of learning styles, instructional materials design methodology, self-perceptions of learning style, and corresponding hypothesized relationships are presented. Within the methodology section, hypotheses were tested. Further, this section provides details of the studies' sample characteristics, research design, measurements, studies' processes, and findings from each of the three study methodologies. The final section of the paper presents conclusions, implications, recommendations for academicians and practitioners, and limitations of the research.

LITERATURE REVIEW AND CONCEPTUALIZATION
Learning Theory/Styles

Learning theory is defined as how students receive, process information, and retain knowledge (Gross, 2012). Whereas, learning style focuses on what type of instruction is most effective for an individual (Pashler et al., 2009). The supporters of the concept of leaning styles argue that instructions should be tailored to a student's learning style. These personalized and unique lessons and outlets for students, of all academic levels and ages, to learn through may provide students with a new outlook on daily schoolwork, tasks, and overall learning. The idea is knowing what type of information presentation (e.g., instructional materials and instruc-

tional delivery method) a student needs to provide the most effective way for them to learn (Pashler et al., 2009).

The information age (i.e., a period characterized by a shift to an economy based on information computerization and away from traditional industrialization) has resulted in significant technological strides in all aspects of life, including the educational system in the United States (US). Millennials and Gen Z college students were born into and grew up in the information age (IA). In the US, "today's education systems are expected to bring up individuals who know how to learn in the information age" (Durukan et al., 2021, p. 2).

The Cox (2008) study demonstrated that students' perceptions of technology tools and preferred learning styles are not correlated. Other studies have shown that focusing solely on learning styles distract from proven teaching practices by encouraging a tendency to look for explanations of behavior in the wrong places (i.e., learning style tests) (e.g., Allcock & Hulme, 2010; Hattie, 2009; Scott, 2010). Growing up in the IA is believed to influence college students' self-perceptions of their learning style. It has been theorized that technology has played a significant role in how today's students learn (Moussa, 2018).

Although learning style assessments have been around for some time, there is little to no scientific evidence that supports a link between learning style and student success (Pashler et al., 2009). It is believed that people think and learn differently and the best way to optimize their experience is by tailoring the instructional material delivery to them (Chew, 2016). According to Revelle (2019), instructors should constantly assess the learning methodologies and stay flexible in adapting to encourage, enlighten, and coach learners to make successful connections with their instructional learning materials. Yet, a student's learning style does not explain whether a student can successfully complete an assignment.

Assessment of Learning Styles

Assessment has a background not only in education, but also in commercialization around the selling of measurement devices (Pashler et al., 2009). Coffield et al. (2004), reported finding 71 different types of learning style assessments. Not all learning style assessments are created equal. Unfortunately, several measures used to determine learning styles have not demonstrated respectable psychometric properties and may not reflect the influence of technology on learning styles. One type of learning style assessment developed by Neil D. Fleming in 1987 is called VARK. The VARK (i.e., visual, aural, reading, kinetic) has been shown to have discernable concrete dimensions (Bernardes & Hanna, 2009; Scott, 2010). VARK is an individualized and standardized pedagogical model that can be adapted into surveys allows users of any age, sex, and education, to find their specific learning style, such as being visual, audio, reading, or kinetic based learners. Additionally, the major focus of the VARK system is on input and output during learning (Lehman, 2019). In fact, VARK has evolved into VAK with less emphasis on reading which may be timely due to the exponential growth of technology in higher education. Ever since the VARK model's creation in the late 1980's, many educators and students alike have used and have implemented the VARK model to help benefit instruction and learning inside and outside of the classroom; being able to develop lesson plans and strategies that best fit each student and their learning personalities.

The VARK test is an easily adaptable design created to accurately measure student preferences for learning methods (Bernardes & Hanna, 2009). However, it is not a complete learning style inventory. The VARK model offers four preferences. These preferences vary in strength and usage, yet they are not discrete in nature. Therefore, the learning style survey is not statistical in nature and can only suggest the learning style preference (Fleming, 2001). People tend to adopt differing learning styles depending upon the content of the course and instructors teaching strategy. Yet, it provides a quick means of identifying student learning styles that reliably correspond to stated educational preferences. The dominant unimodal categories and VARK numerical scores showed high correspondence between what the developers of VARK indicated as expected educational preferences and the self-reported educational preferences (Fleming, 1995; Fleming & Mills, 1992).

Instructional Materials Design Methodology: Implicit vs Explicit

Scott (2010) questioned whether identifying a student's learning style would be harmful labeling and ignoring evidenced-based teaching practices would ultimately interfere with student learning. Furthermore, Scott argues that *learning styles* have little to offer as to delivery of a quality learning experience. Additionally, there is little evidence that indicates a student's learning style and the professor's preferred instructional materials (e.g., implicit/explicit instructions) are one in the same (Lehman, 2019).

Implicit instructional materials are reflective requiring one to think about what is being asked and think deeply about methodically processing the instructions. Implicit instructional materials are covert (i.e., hidden details), lacks some of the structure in providing guidance, and is abstract (i.e., presented in skeletal form) requiring an individual to draw on previous knowledge as to what is expected (Jensen, n.d.; Snow, 1977).

Explicit learning is overt and concrete (Lazonder & Egberink, 2014). Explicit learning is semantic (i.e., clarity of meaning) and often intermittent. Like explicit learning, explicit instructional materials are also overt (i.e., no hidden details) and concrete in that needed details are obvious and not abstract. Thus, explicit instructions are highly structured and contain extensive well-ordered relevant information.

From the Farahani et al. (2019) quasi-experiment in which the authors examined implicit/explicit teaching of Persian language structures found that explicit teaching revealed more positive results than implicit teaching. To add new SoTL knowledge for the teaching community, the current study examines the following hypotheses extending Farahanie et al. (2019) across disciplines by examining the role of implicit/explicit instructional materials from an interdisciplinary area of academic work (Simmons et al., 2013).

Self-Perception of Learning Style

Students' perceptions of how they learn may not be aligned with their actual learning styles. The meshing hypothesis is a model concept which indicates the best instructional learning method is one that matches the learners perceived style preference. The assumption is that the student will know which way they learn best (Chew, 2016). Therefore, the instructional method that works for one student may not work for another student if they have different learning styles (Pashler et al., 2009). A meta-analysis on 39 studies indicated by matching students with their learning

style had little effect on their achievement (Chew, 2016; Kavale & Forness, 1987).

Massa and Mayer (2006) found that when a learning style is self-reported, there was a very weak relationship with the learner's objectively measured actual learning outcomes. Clark (1982) found that a student's preferred leaning style was negatively correlated to their achievements. In other words, what students prefer is not always the best way for them to learn. Chew (2016) provides an analogy of children preferring candy and soft drinks over milk and fruit, but *would a parent just give them what they want because they want it?* Does matching students to their preferred leaning styles improve learning outcomes? A recent study by Nancekivell, et al. (2019) stated teaching to a student's *learning style* is a psychological neuroeducational myth posit that people learn better if the mode of learning matches their style of learning (i.e., visual, auditory, or kinesthetic).

PROJECT METHODOLOGY
Based on the research presented in the literature review and conceptualization section above, the following hypotheses were tested.

> H_1: **There is no statistically significant relationship between learning styles and success in following instructions.**

> H_2: **There is a statistically significant relationship between the instructional materials design methodology used and success in following instructions.**

> H_3: **There is no statistically significant relationship between learning style (measured using VARK methodology) and instructional materials designs (implicit/explicit instructions).**

> H_4: **There is no statistically significant relationship between college students' self-perceptions of learning style and their actual learning style.**

To test the hypotheses and draw conclusions, the researchers depended on a systematic three-step process by 1) examining respondents' learning styles, 2) conducting an instructional methodology experiment, and 3) conducting a follow-up survey. Data from the three studies were analyzed using SPSS27®.

Study participants were solicited among college juniors and seniors (N, 2586) (Georgia College & State University [GCSU], 2021). To provide validity of the study findings, an announcement was sent out to the campus community through the university's website asking for participants. Further faculty across campus were asked to encourage their students to participate. The researchers also reached out to their students directly asking for participants. Students were not given any incentive to participate. In fact, they were told if they did not choose to take the study seriously, then not to participate since this is such an important topic for future students' college success.

The targeted sample for the study was 148 participants from a small liberal arts university located in the Southeastern United States. The targeted sample size was determined based on statistical power of greater than 25 respondents per treatment group in the experimental portion of the study. Responses were anonymous as no part of the study collected any identifying information. Respondents for all three steps in the study were identified only by the last three digits of their nine-digit student identification number making it impossible to identify any one respondent. The three-digit identification numbers were used throughout the entire study.

Research Design
Prior to the study, several research assistants were recruited and trained prior to the experiment to serve as monitors for the experiment. Potential student participants were informed that the study was an ongoing study across a full semester and were required to consent to not discussing the study until they were debriefed by the researchers. Participants in the study signed a consent form the week prior to the study that disclosed their rights as a participant and informed them about anonymity. The signed consent forms did not include the students' identification number and were stored in a separate location from the study materials. The participants were informed about the study's online processes when participating using Zoom across three separate dates. Students were aware that other students in the same Zoom breakout room would be able to see them but there would be no audio and no visual of their actual participation.

Students often proclaim their preference for learning or instructional material types, but currently there is no known empirical research that supports what students prefer is what they need to complete an assignment successfully. Many studies have examined learning styles, but none have compared the type of instructions (implicit/explicit) to learning style, preference for instruction type, and successful completion of an assignment.

This exploratory study consists of three studies (i.e., pre-experiment survey, a 2x2 quasi experiment, and a post experiment survey. This series of studies primarily focuses on the "what" question as to what "treatment" (i.e., instructional materials style) influences individual performance in successfully completing assignment. This study seeks to determine if there is a relationship between learning style, instructional material design style, preference of learning style, and successful completion of an assignment.

Study Part #1 - Pre-Quasi Experiment Test
Study Materials
A *VARK (i.e., Visual, Aural, Read, and Kinesthetic sensory modalities)* test was administered online prior to the quasi experiment. The VARK test was composed of 16 standardized situations for which each participant had an equal opportunity to respond however they saw as the most personally applicable and reasonable. The sources of the questions found on the pre-quasi experiment test came from a collection of VARK surveys found on the official VARK organization's website (VARK, 2021). The VARK test identifies participants' learning style.

Processes
During week one of the study, all respondents took the adapted VARK to assess whether they are a visual, aural, read, and kinesthetic learner or a combination of any of these. At the end of the VARK and again prior to the quasi-experiment (Part #2), the participants were informed to 1) arrive at the designated time on Tuesday of the following week in the same Zoom room, 2) bring a

#2 pencil, 3) a blank piece of paper, and 4) bring a cellphone with a camera to take a picture of their final project for the quasi-experiment. They were also instructed to be prepared to keep their sound off during the quasi experiment.

Study Part #2 – Quasi-Experiment
The success of the participants' outcome in the quasi-experiment was based on the participants' abilities to follow one of two types of instructions (implicit or explicit) under one of two types of conditions (video instructions or no video instructions). Participants' artistic, aesthetic, and technical capabilities were not considered to have an impact on the overall success score for the quasi-experiment. See Figure 1 for details.

Administrative Processes
Randomization of subjects involved connecting the participants in the order they registered to participate in the experiment to an experimental group online in Zoom with breakout rooms designated: A, B, C, or D. The process was repeated until all participants were put into an experimental group Zoom breakout room. Breakout room assignments were preset before the experiment began so that participants were automatically sent to the designated breakout room. Each breakout room was monitored. Participants were informed through a consent form that the study was an ongoing study and were required to sign the form in an agreement (as part of the consent form) not to discuss in any way anything about the experiment with anyone until they were
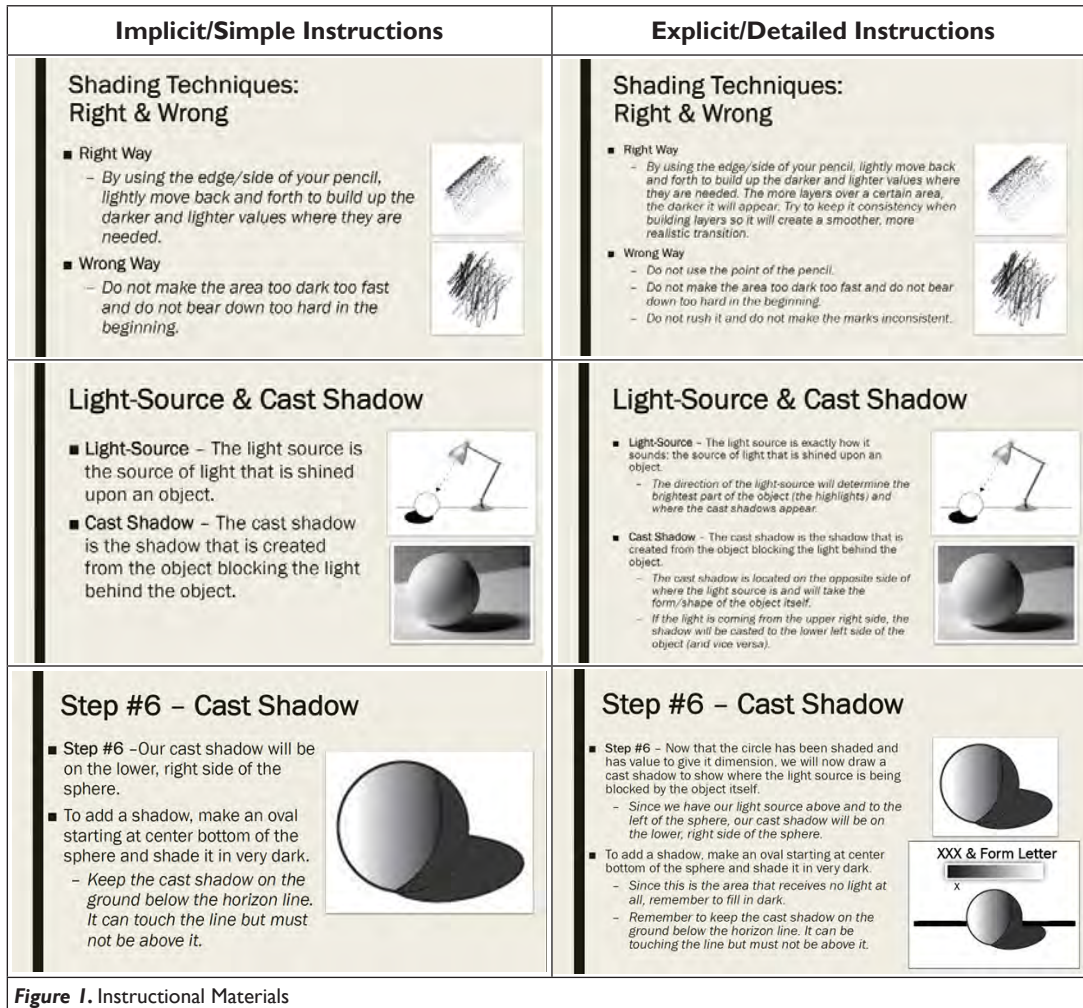

Figure 1. Instructional Materials

The study was a 2x2 between-subject quasi-experimental design in which every participant experiences only one condition in a laboratory (i.e., online in Zoom). The quasi-experiment tests the influence of treatment (i.e., type of instructional material) as to respondents' ability to successfully complete an assignment (Figure 2). It was proposed that instructional methods (i.e., implicit or explicit) and the presence of type of instructional material (i.e., visual, aural, kinetic, and/or written YouTube video presence included visual, aural, and written content) (independent variable) predicts learning success (dependent variable). See Figure 2 for details.

	Least Favorable to Success	Most Favorable to Success
Type of Instructions	Implicit	Explicit
Presence of YouTube Video Instructions	No	Yes

Figure 2. 2x2 Quasi Experimental Design

debriefed by the researchers. Prior to the experiment, participants were sent via email instructions on how to log into Zoom, they were instructed to turn off all devices except the computer they were using for the experiment, to have their camera phone ready to take a picture, and informed that the chat for Zoom would only connect with the fully trained research assistant monitoring their Zoom breakout room.

Study Material

The lesson instructions for this study were developed and edited, and previously taught by one of the coauthors, an educator. Modifications used in this study involved creating the explicit and implicit drawing instructions, adding images, and removing unnecessary and nonapplicable materials. The source material for drawing used in this experiment was acquired from Slideshare.net (2021). An example of what the final drawing should look like regardless of the instructions (simple = implicit or detailed = explicit) is provided in Figure 1. All participants were required to draw as part of the assignment, thus, visual, aural, read, and kinesthetic was a natural part of the overall experiment for all participants.

For treatment condition #1, this group of participants was provided with written implicit step-by-step instructions (i.e., simplistic minimal but adequate instructions) to read along with limited visual instruction of how to draw a sphere and participants were asked to replicate it. Treatment condition #2, this group of participants was provided with implicit step-by-step instructions (i.e., simplistic minimal but adequate instructions) within a YouTube video of how to draw a sphere and participants were asked to replicate it. Treatment condition #3, this group of participants was given written explicit instructions (i.e., detailed) to read and detailed visual instructions of the process of drawing a sphere and were asked to replicate it. Treatment condition #4 group of participants was given explicit step-by-step instructions (i.e., detailed) in a YouTube Video of how to draw a sphere and asked to replicate it.

Processes

During the experiment, once in the breakout room, participants' faces were visible to the research assistant, monitoring their breakout room, but the research assistant's face was not visible to participants. The respondents were instructed to turn off their audio output. They were informed that the research assistant for their breakout room was unable to see the actual drawing completed by the respondents while they were participating on Zoom. They also were instructed that the research assistant would not answer any questions about the experiment but would answer technical internet related questions. All participants were provided treatment materials that instructed them to draw and shade a sphere based on the conditions for their treatment group. They had 20 minutes to complete the drawing. The length of time was tested by a sample before the event to assure enough time to complete the task without too much time to over think the task. Upon completion of the drawing, participants were required to raise their Zoom hand and wait for the research assistant to give them permission to take a photo of the drawing, name it by the last three digits of their student number (a nine-digit number) and submit the anonymous survey through an online link provided for them by the research assistant in a private chat within Zoom. Next, they were instructed to turn off their cellphone, and wad up their drawing in front of the researcher. Then, a

Qualtric post-experiment survey link was given to the participant through a private Zoom chat and participants were instructed to take the survey.

Study Part #3 – Post Experiment Survey and Manipulation Check

Administrative Processes

Participants were not informed that this survey included a manipulation check question They were instructed to identify their survey using only the last three digits of their student number. Once they completed the survey, they were instructed to raise their Zoom hand. They were thanked for their participation and were removed from the breakout room by the research assistant.

Study Materials

A 22-question follow-up Qualtrics survey was completed. The participants' multidimensional perception of learning techniques was measured with a five-item (5) semantic differential scale with scale points 1-6 and a two-item (2) Likert scale with scale points of 1-6 measuring perception of single method learner or multi-method learner. A one (1) item Likert type perception of likelihood for success if using method in experiment was measured on scale points of 1-6. The survey also contained one (1) manipulation check question that asked participants to identify the correct letter connected to their quasi-experiment and 13 key demographic and psychographic questions. These questions included gender, year in college, whether they were international students, number of art classes taken, college major, years of playing video games, hours a week playing video games, time watching online videos, time watching YouTube videos, why they watch videos, their screen time during a typical week, whether they had been previously tested for learning styles, and age. Data were collected to identify if they have taken art classes, and if so, how many art classes were taken in high school or college. For this study, the quality of the drawing was not what was being gauged but instead which steps were completed properly was measured. There was a manipulation check asking them the letter (A, B, C, D) assigned to their experimental manipulation. To avoid cheating on the manipulation check, they wadded up their drawing once they had uploaded the photo, instructed to keep their eyes on the screen while filling out this survey, and informed they were being watched by the research assistant.

ANALYSES
Sample

Of the 124 respondents, 51 identified as male (40%) and 73 were female (60%). This closely represents the population of the sample university as to gender. Out of 6,989 students, 36% report as male; whereas the sample report 39% as male. The sample consisted of juniors (n, 43) and seniors (n, 80) as they have a higher level of learning at the college level and would have experienced multiple teaching methods. However, one first year student did participate. Those responding consisted of art, marketing, English, management, management information systems, mass communications, and psychology majors. Of the total number of respondents nine were double majors or were minoring in a second discipline.

Study Completion Rate

Randomization of the sample resulted in the following usable submission per treatment group: Form A = 29; Form B = 33;

Form C = 30; Form D = 30; Total = 122. A total of 158 began the three-step study, however, 36 were removed for not completing one or more of two surveys and/or failing the manipulation check.

Measures

Study #1 – VARK
The four different responses (i.e., *Visual, Aural, Read, and Kinesthetic sensory modalities*) were tallied and summed for each student with the most repeated/consistent response being chosen to be divided by the number 16; to find a percentage value of how much the participant favored towards the majority/a particular learning preference/style. A larger value percentage would result in a stronger connection/correlation to a specific learning type whereas a smaller percentage would show a lack of definitiveness, weaker connection towards their majority learning type. If there were two majority consistent learner responses, (either due to being of equal value or varying by 6.25% or one response difference), the participant was classified as both learner types: with the first listed as the majority in cases of different values.

Study #2 Quasi-Experiment
All criteria for the text chosen are universal to learning styles and universal to the formats of the instructions given. The seven criteria are as follows: 1) last three digits of student identification number and a treatment letter, 2) practice value scale, 3) circle and horizonal line, 4) "X" in upper left side for light source, 5) shading in circle, 6) highlight left alone, and 7) cast shadow on lower right side [failure to include or complete listed criteria(s) as well as incorrectly including or incorrectly completing criteria(s) was grounds for the deduction of point(s)]. The total amount of points gained through each criterion was then divided by the value of seven to determine their percentage for overall success in completing the instructions provided. The range/limits/ threshold to determine success is over 80%; anything lower is determined as a failure to complete the instructions. Each of the six (6) steps in drawing of a shaded sphere were examined by the research team to determine if they were completed properly. This step did not take into consideration the quality of the drawing, only if all six steps were completed properly within the 20-minute timeframe allocated.

Study #3 Follow-Up Survey with Manipulation Check
A five-item 7-point semantic differential Perception of Learning Technique scale was subjected to an exploratory factor analysis (EFA). The EFA revealed that the scale was unidimensional with all five scale items loading on one factor at $\geq$.80 (i.e., Perception of Pedagogical Methodology).

The perceptions of pedagogical methodology are highly reliable with a Cronbach's alpha of .903. Attitude toward learning was measured with a two-item Likert scale with endpoints of 1=strongly disagree and 6=strongly agree. Likelihood to do well using the instructional methodology used in the experiment was measured with a one item likelihood scale with endpoints of 1=not at all likely and 7=very likely. Manipulation check was a one item scale in which respondents report the form letter from the treatment randomly assigned in the experiment.

FINDINGS
Hypotheses Testing

H_1: There is no statistically significant relationship between learning style and success in following instructions.

From the cross tabulation between VARK and success in following instructions, the cross tabulation was not significant (Fisher-Freeman-Halton Exact Test of >.05). Thus, the cross tabulation could not be interpreted using the Fisher-Freeman-Halton Exact Test. A directional measures test revealed an Eta of .0882 (.007) demonstrating no statistically significant effect size. Thus, H_1 was supported. See Table 1 for details.

Because learning style is important to this study, a frequency analysis was conducted. The largest percent of learning style was found to be kinetic (55.4%). It is important to note that no respondents were identified in the single categories of either reading or visual learners. The second largest group was found to be multimethod learners. See Table 2 below for details.

H_2: There is a statistically significant relationship between the instructional materials design methodology used and success in following instructions.

Table 1. Crosstabulation Directional Measures of Hypotheses					
Hypothesis 1	Nominal by Interval	Eta	VARK Identification Dependent	.035	H_1 Supported
			Success Dependent	.0882	
			Success Dependent	.2352	
Hypothesis 3	Nominal by Interval	Eta	VARK Identification Dependent	.140	H_3 Supported
			Treatment Type Dependent	.0272	
Hypothesis 4	Nominal by Interval	Eta	Perception of Learning Dependent	.056	H_4 Supported
			Success Dependent	.3762	

Table 2. Hypothesis 1 - VARK Frequency Analysis				
	Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Audio	19	15.7	15.7	15.7
Kinetic	67	55.4	55.4	71.1
Multimethod	35	28.9	28.9	100.0
Total	121	100.0	100.0	

A comparison of the means provided interesting findings. It revealed that explicit instructions with or without audio had an influence on successful completion of the assignment. Audio was also important in successful completion of the assignment regardless of whether instructions were implicit or explicit. However, explicit instructions with or without audio contributed to the successful completion of the assignment. Implicit without audio failed to influence successful completion of the assignment. H_2 was supported. See Table 3 for details.

Table 3. Hypothesis 2 - Significant Relationships

Significant Simple (implicit) with Audio positive mean compared to simple no audio (+11.38455)	Audio makes a difference
Detailed (explicit) with Audio positive mean compared to simple no audio (+12.89391)	Detailed with Audio makes a difference
Detailed (explicit) no Audio positive mean compared to simple (explicit) no audio (+13.08523)	Detailed makes a difference

H_3: There is no statistically significant relationship between learning style (measured using VARK) and instructional materials designs (implicit/explicit instructions).

From the cross tabulation between VARK and instructional delivery method (i.e., explicit/implicit), the cross tabulation was not significant (Fisher-Freeman-Halton Exact Test of >.05). Thus, the cross tabulation could not be interpreted using the Fisher-Freeman-Halton Exact Test. A directional measures test revealed an Eta of $.027^2$ (.000) demonstrating no statistically significant effect size. H_3 was supported. See Table 1 for details.

H_4: There is no statistically significant relationship between college students' self-perceptions of learning style and their learning style.

From the cross tabulation between perceptions of learning style and their learning style, the cross tabulation was not significant (Fisher-Freeman-Halton Exact Test of >.05). Thus, the cross tabulation could not be interpreted using the Fisher-Freeman-Halton Exact Test. A directional measures test revealed an Eta of $.376^2$ (.141) demonstrating no statistically significant effect size. H_4 was supported. See Table 1 above for details.

Other Findings

It has been theorized that technology has played a significant role in how today's students learn (Durukan et al., 2021; Moussa, 2018). According to Kivunja (2014) Marck Prensky identified digital natives as those born beginning in 1980. He proposed that they "are all 'native speakers' of the digital language of computers, video games, and the Internet" (p. 95). Thus, he proposed that today's students are digital fluent. Camm, Russell, Xu, and Rajappan (2018) reported that over one billion individuals globally use YouTube instructional videos. Alkhudaydi (2018) proposed benefits of YouTube instructional videos such as focusing students' concentration, attracting their attention, etc. Studies by Buzzetto-More, 2012; Donkor, 2011; and Kelly, McGrath, & Cannon, 2009 report that instructional videos are a valid approach to tapping into student multiple intelligences and learning styles. Thus, the current study collected data on students' personal video usage (i.e., YouTube videos; video games). Ninety-two percent (92%) of the current study respondents reported watching YouTube videos

weekly of which 79.7% reported watching videos for the purpose of learning something. A regression analysis of weekly YouTube watching, and successful completion of instructions revealed that watching YouTube videos for any purpose did not lead to success in following instructions. Thus, the current study does not support using instructional videos as a SoTL best practice.

In the study by Smith, et al. (2020), the authors found that a person having previous online gaming experience does appear to affect their ability to learn "novel video games", but the learning does not spread to the "learning to learn model". The learning model postulates that cognitive ability from gaming bolsters attentional or memory capacity in learning new tasks beyond gaming to other novel tasks (p.1). Fifty-two percent (52%) of the current study respondents reported playing video games weekly. To measure a potential relationship, a regression analyses was performed to determine if any weekly video game playing had an influence on successful completion of instructions. Finds from a regression analysis (i.e., video game weekly watching and success in following instructions) revealed a statistically significant relationship (<.05). The model only explained 7.7% of success came from hours spent weekly playing video games. The betas showed that the more time on video games the greater negative but minimal influence on success (-.009) while playing video games demonstrated a minimal increase in success (.051). Although the findings of this study show minimal success in completing instructions based on gaming experience, they support the Smith et al. (2020) study that online gaming experience appears to have no effect on one's ability to succeed in new task outside of gaming as 93% of the change in the model comes from something other than online gaming experience. Thus, gaming is a weak if not unimportant factor in determining one's ability to successfully follow instructions.

Although artistic abilities were not considered as part of success in completing the assignment, the experiment required an artistic drawing. To determine if previous art experience influenced success in the current experiment, the researchers collected data on past art class experience to clarify whether artistic skills played any role in the successful completion of the assignment for students participating in the study. From the cross tabulation between Art classes taken and success in following instructions, the cross tabulation was not significant (Fisher-Freeman-Halton Exact Test of >.05). Thus, the cross tabulation could not be interpreted using the Fisher-Freeman-Halton Exact Test. A directional measures test revealed an Eta of $.144^2$ (.021) demonstrating no statistically significant effect size. Thus, there was no relationship between past art experience and success in completing the study. See Table 4 for details.

Table 4. Crosstabulation Directional Measures – Art Classes and Successful Completion of Assignment

Nominal by Interval	Eta	Success Dependent	.144
		Art Classes Taken in High School and/or College Dependent	.0252

Because the sample was predominantly female (60%), a cross tabulation between gender and successfully completing the assignment was conducted to eliminate any reference from bias in the sample. The cross tabulation was not significant (Fisher-Freeman-Halton Exact Test of >.05). Thus, the cross tabulation could not be interpreted using the Fisher-Freeman-Halton Exact Test. A directional measures test revealed an Eta of $.052^2$ (.003) which

demonstrates no statistically significant effect size. Thus, gender was ruled out as playing a significant role in the findings of the study. See Table 5 for details.

Table 5. Crosstabulation Directional Measures – Gender and Successful Completion of Assignment			
Nominal by Interval	Eta	Success Dependent	.052
		Gender Dependent	.0522

CONCLUSIONS AND IMPLICATIONS

The current study used multiple methods to take a fresh look at instructional material design and learning success. An in-depth study of secondary research resulted in the creation of testable hypotheses. To test the hypotheses, an assessment of learning styles was conducted to reveal students actual learning style(s) (Study #1), followed by a quasi-experiment to uncover participants' ability to successfully complete an assignment when given either explicit or implicit instructional materials (Study #2). Then, survey data were collected to determine preference of learning styles and compare it to their actual learning style. The survey also collected data for a manipulation check for the quasi-experiment (Study #3). These three studies provided the data necessary to test four hypothesized relationships. All hypotheses were supported.

The findings of the current study do not support the Relleve (2019) study that claimed an instructor should adapt learning materials to students' individual learning styles to ensure student success. The findings of the current study aligned Allcock & Hulme (2010), Hattie (2009), and Scott (2010) studies that claimed designing teaching materials to learning styles are a distraction from proven learning practices and should be avoided. The study found that a combined delivery methodology that includes kinetic and audio elements has positive influence on student success. The current study further demonstrated that detailed instruction (i.e., explicit) with or without audio instructions were the most effective in leading to student success in following instructions. This finding supports the Lazonder & Egberink (2014) study. The findings of the Lehman (2019) study were supported by the current study. The data analysis showed regardless of the students' learning style there is no relationship between instructional materials and learning styles. The findings of this study do not support Chew's (2016) premise that students know their own learning style and will do best if their learning style is present in teaching materials. Contrary to Chew (2016), the current study showed no relationship between a students perceived learning style and their actual learning style. This is a good indication that perceptions could be harmful if not mediated. Many of the students in the current study believed that YouTube videos (i.e., audio/video) were how they learned best. The students were surprised to see how few of them learned successfully from instructions found on YouTube videos and the like. Other participants in the study believed that their online gaming behavior positively influenced their ability to follow instructions regardless of whether the instructions were explicit or implicit. The findings clearly showed that those with many hours gaming were not guaranteed to successfully complete instructions.

As shown in this empirical study, there is no relationship between learning style and student success. It is important to mitigate the incorrect or misleading perception that a student who believes they know their own learning style will have a positive effect on their ability to successfully follow instructions. Findings also indicated that although students today are digital natives focusing instructional material on their individual learning styles, including technological learning material, does not indicate successful learning. Thus, a best practice for SoTL is to avoid designing instructional materials with individual learning styles in mind but instead to create explicit instructions available in written and audio format that provide opportunities for kinetic learning tasks. This study revealed another SoTL best practice when creating instructional material is to avoid the misleading assumptions that online gaming and watching instructional videos lead to 21st Century college students successfully following instructions.

RECOMMENDATIONS AND LIMITATIONS

The research team recommends that future research be conducted to determine the level of harm that a student's *perceived learning styles* has on a student's ability to successfully complete an assignment. Francis Bacon's Meditationes Sacrae (1597), stated that *knowledge is power* which remains true today. In 1817, Thomas Jefferson added *safety and happiness* to *knowledge is power* (Bartlett, 1919; Jefferson Quotes & Family Letters, 1817). Therefore, it is recommended that to reduce harm caused by faulty self-perceptions of a student's learning style, instructors test students to determine their perceptions compared to actual learning style using the revised VARK (i.e., VAK) and share those findings with the students.

This study is limited by a student sample. Future research should include students from the hard sciences. Another limitation is the sample is from a small USA public liberal arts institution. It is recommended that the study should be replicated at larger institutions both inside and outside of the USA to determine if the findings across diverse institutions and cultures.

It is further recommended that research into the cost/benefit of tailoring each assignment to unique learning styles as opposed to a university learning opportunity should be examined.

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REFERENCES

Alkhudaydi, M.D. (2018). Investigating factors that influence the use of YouTube in teaching biology in high schools in Saudi Arabia based on the technology acceptance model. *Electronic comprehensive Journal for Education and Science Publications*, 13, 1-10.

Allcock, S. J., & Hulme, J.A. (2010). Learning styles in the classroom: educational benefit or planning exercise. *Psychology Teaching Review*, 16(2), 67-77.

Bartlett, J. (1919) Familiar quotations. 10th ed. Little, Brown and Co., p. 168.

Bernardes, E. & Hanna, M. (2009). How do management students prefer to learn? Why should be care. *International Journal for the Scholarship of Teaching and Learning*, 3(1), 1-13, doi.org/10.204.29/ijstol.2009.030121

Buzzetto-More, N. (2012). Social networking in undergraduate education. *Interdisciplinary Journal of Information, Knowledge, and Management*, 7, 63-90.

Camm, C.F., Russell, E., Xu, A.J., & Rajappan, K. (2018). Does YouTube provide high-quality resources for patient education on atrial fibrillatiablation? *International Journal of Cardiology*, 272, 189-193.

Chew, K. S. (2016). Tailoring teaching instructions according to student's different learning styles: Are we hitting the right button. *Education in Medicine Journal*, 8(3), 103-107. http://dx.doi.org/10.5959/eimj.v8i3.455

Clark R.E. 1982. Antagonism between achievement and enjoyment in ATI studies. *Educational Psychologist*, 17(2), 92-101. doi: 10.1080/00461528209529247.

Coffield, F., Moseley, D., Hall, E., Ecclestone, K., Coffield, F., Moseley, D., & Ecclestone, K. (2004). Learning styles and pedagogy in post-16 learning: A systematic and critical review. Think! Evidence. Retrieved March 30, 2021, from http://evidence.thinkportal.org/handle/123456789/62

Cox, T.D. (2008). Learning Styles and students' attitudes toward the use of technology in higher and adult education classes. *Institute for Learning Styles Journal*, 1, 1-13.

Donkor, F. (2011). Assessment of learner acceptance and satisfaction with video-based instructional materials for teaching practical skills at a distance. *International Review of Research in Open and Distance Learning*, 12(5), 74-92.

Durukan, N., Oktay, K., & Oktay B. (2021). A Study of eight-grade students' science learning styles in terms of some variables. *Bartin University Journal of Faculty Education,* 10(1), 1-17, doi: 10.14686/buefad.754599

Farahani, M.V., Rezaei, O., & Masoomzadeh, M. (2019). Explicit and implicit teaching Persian language structures and editing methods and translation performance of Iranian undergraduate translation students. *Journal of Applied Research in higher Education*, 11(4), 926-940, https://doi.org/10.1108/JARHE-11-2018-0240

Fleming, N.D. (1987). *Teaching and learning styles: VARK strategies*. Neil Fleming.

Fleming, N. D. (1995). I'm different; not dumb. Modes of presentation (VARK) in the tertiary classroom. In *Research and development in higher education, Proceedings of the 1995 Annual Conference of the Higher Education and Research Development Society of Australasia (HERDSA), HERDSA* (Vol. 18, pp. 308-313).

Fleming, N. D. (2001). Teaching and learning styles: VARK strategies. ISBN: 978-0473079567

Fleming, N.D., & Mills, C. (1992). Not another inventory, rather a catalyst for reflection. *To Improve the Academy*, 11(1), 137-155. https://doi.org/10.1002/j.2334-4822.1992.tb00213.x

Gross, R. (2012). Psychology: The Science of Mind and Behaviour. Hodder Education. ISBN: 978-1-4441-6436-7

Georgia College & State University [GCSU] (2021). Institutional statistics. GCSU. Retrieved March 21, 2021, from https://irout.GCSU.edu/data20/enr-fall-char.html

Hattie, J. (2009). The black box of tertiary assessment: An Impending revolution. In L. H. Meyer, S. Davidson, H. Anderson, R. Fletcher, P.M. Johnston, & M. Rees (Eds.), T*ertiary Assessment & Higher Education Student Outcomes: Policy, Practice & Research*. (pp. 259-275). Ako Aotearoa.

Jefferson Quotes & Family Letters. (1817). Jefferson's letter to Ticknor, November 25, in PTJ:RS, 12:204.

Jensen, Eric (n.d.). Brain-Based Learning Secret: Implicit Learning. March 21, 2021, from https://www.brainbasedlearning.net/brain-based-learning-secret-implicit-learning/#:~:text=Many%20types%20of%20learning%20can,bike)%20and%20imitation%20learning%20(learning

Kavale, K.A., & Forness, S. R. (1987). Substance over style: Assessing the efficacy of modality testing and teaching. *Exceptional Children*, 54(3), 228-239. https://doi.org/10.1177/001440298705400305

Kelly, M., McGrath, M., & Cannon, G. (2009). A multi-method study to determine the effectiveness of, and student attitudes to, online instructional videos for teaching clinical nursing skills. *Nurse Education Today*, 29(3), 292-300.

Kivunja, C. (2014). Theoretical perspectives on how digital natives learn. *International Journal of Higher Education,* 3(1), 94-107.

Lazonder, A.W. & Egberink, A. (2014). Children's acquisition and use of the control-of-variables strategy: effects of explicit and implicit instructional guidance. I*nstructional Science*, 42(2), 291-304. doi: 10.1007/s11251-013-9284-3

Lehman, M.E. (2019). Using VARK learning styles to predict instructional preferences," *NACTA Journal*, 63(2), 109-114.

Massa, L. J., & Mayer, R. E. (2006). Testing the ATI hypothesis: Should multimedia instruction accommodate verbalizer-visualizer cognitive style. *Learning and Individual Differences*, 16(4), 321-335.

Moussa, N. (2018). Learning styles and the adoption of modern technology among adult learners. *Institute for Learning Styles Journal,* 1, 11-21.

Nancekivelle, S.E., Shah, P. & Gelman, S.A. (2019). Maybe they're born with it, or maybe it's experience: toward a deeper understanding of the learning style myth. *Journal of Educational Psychology,* 112(2)M 221-235 HTTP://dx.doi.org/10.1037/edu0000366

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2009). Learning styles: Concepts and evidence. *Psychological Science in the Public Interest*, 9(3), 105-119. https://doi.org/10.1111/j.1539-6053.2009.01038.x

Relleve, C.C.O. (2019). Values education pedagogy for Z learners," DasmaSIPAG Paglilingkod March 21, 2021, from https://www.dlsud.edu.ph/coed/ncvre/docs/2019/DrChesterRelleve-PEDAGOGYGENZ.pdf

Scott, C. (2010). The enduring appeal of 'learning styles. *Australian Journal of Education*, 54(1), 5-17, https://doi.org/10.1177/000494411005400102

Simmons, N., Abrahamson, E. Deshler, J.M., Kensington-Miller, B., Manarin, K., Moron-Garcia, S., Oliver, C. & Renc-Roe, J. (2013). Conflict and configuration in a liminal space: SoTL scholars' identity development. *Teaching & Learning Inquiry,* 1(2), 9-21, htttps://doi.org/10.20343/teachlearningu.1.2.9

Slideshare.net (2021). How to shade a sphere and floating spheres project step by step instructions. March 11, 2021, from https://pt.slideshare.net/becomstock/how-to-shade-a-sphere-and-floating-spheres-project-step-by-step-instructions/10

Smith, E.T., Bhaskar, B., Hinerman, A., & Basak, C. (2020). Past gaming experience and cognition as selective predictors of novel game learning across different gaming genres. *Frontiers in Psychology*, 11, 786.

Snow, R.E. (1977). Individual difference and instructional theory. *Educational Researcher*, 6, 11-18.

Trigwell, K. (2021). Scholarship of teaching and learning. 2nd Ed. Routledge. EBook ISBN: 9781003008330

Trigwell, K. (2013). Evidence of the impact of scholarship of teaching and learning purposes. *Teaching & Learning Inquiry,* 1(1), 95-105, https://doi.org/10.2979/teachlearninqu.1.1.95

VARK (2021). The VARK questionnaire, Version 8.0. March 11, 2021, from https://vark-learn.com/the-vark-questionnaire