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INCORPORATING KINESTHETIC LEARNING INTO UNIVERSITY CLASSROOMS: AN EXAMPLE FROM MANAGEMENT INFORMATION SYSTEMS

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ABSTRACT

Aim/Purpose	Students tend to learn best when an array of learning styles is used by instructors. The purpose of this paper is to add, to introduce, and to apply the concepts of kinesthetic learning and learning structures to university and STEM education.
Background	The study applies the concept of kinesthetic learning and a learning structure called Think-Pair-Share to an experiential exercise about Moore's Law in an introductory MIS classroom. The paper details the exercise and each of its components.
Methodology	Students in two classes were asked to complete a short survey about their conceptual understanding of the course material before and after the experiential exercise.
Contribution	The paper details the benefits of kinesthetic learning and learning structures and discusses how to apply these concepts through an experiential exercise used in an introductory MIS course.
Findings	Results indicate that the kinesthetic learning activity had a positive impact on student learning outcomes.
Recommendations for Practitioners	University educators can use this example to structure several other learning activities that apply kinesthetic learning principles.
Recommendations for Researchers	Researchers can use this paper to study more about how to incorporate kinesthetic learning into education, and about teaching technology concepts to undergraduate students through kinesthetic learning.
Impact on Society	The results of this study may be extremely beneficial for the university and STEM community and overall academic business community.

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Future Research	Researchers should consider longitudinal studies and other ways to incorporate kinesthetic learning activities into education.
Keywords	kinesthetic learning, learning structure, drawing, Moore's Law, STEM

INTRODUCTION

Students prefer when instructors incorporate a variety of learning styles and instructional methods into their lessons (Chisholm & Spencer, 2017; Dowling, 2012; Wagner & Drago, 2004). At the college level, however, lecture remains the primary way students learn (Eom, Wen, Ashill, 2006; Mobley & Fisher, 2014). This is especially true in the science, technology, engineering, and mathematics (STEM) fields, where students often benefit from hands-on instruction and active learning. For example, a recent study in the context of STEM courses found that only 18 percent of instructors utilize a variety of learning styles during class time, and that approximately 55 percent of instructors spend about 80 percent of class time lecturing with little student involvement (Stains et al., 2018). In this sense, there remains an opportunity to inform college instructors, and specifically those who work in the STEM fields, about how to utilize and incorporate learning styles and methods that differ from lecture and that promote active learning, student participation, and engagement.

One learning style that shows a great deal of promise, but remains less understood, understudied, and underutilized at the college level is *kinesthetic learning* (Chisholm & Spencer, 2017). As a subset of active learning, kinesthetic learning emphasizes the physiological element of learning and has been linked to "strengthening concepts as well as connecting ideas together" (Tranquillo, 2008, p. 1). Kinesthetic learning differs from auditory and visual learning, which have received the most attention in a university setting (R. Dunn, Beaudry, & Klavas, 2002; Mobley & Fisher, 2014). Rather than lecturing or showing videos, instructors use kinesthetic learning activities (KLAs) to engender student involvement by "touching, moving, and interacting with their environment" (Wagner & Drago, 2004, p. 3). Students, in turn, become highly involved and engaged with the course material, and often see improved performance (Bryan & Karshmer, 2013). Kinesthetic learning can involve a variety of activities such as field trips, manipulating objects, lab experiments, and drawing pictures (Chisholm & Spencer, 2017). There is little guidance however about how college instructors can adopt and implement kinesthetic learning and KLAs into the classroom.

The purpose of the paper is to address this gap by reviewing and highlighting the benefits of kinesthetic learning for college instructors. Specifically, the paper details how concepts embedded in kinesthetic learning were applied to a KLA that was used for a class lesson in an introductory management information systems (MIS) course, which serves as the context for the study. To complete the KLA, students were tasked with drawing pictures about concepts related to Moore's Law and the advancement of technology over the last several decades. The paper details the KLA and reports on the results of a survey which inquired about students' perception about their confidence in course material as a result of the KLA, and about their overall satisfaction with the learning activity. Overall, this study is meant to offer college-level instructors a deeper understanding of kinesthetic learning through drawing, as well as a concrete example of how to administer a KLA in an introductory classroom.

The rest of the paper is organized as follows. First, the paper offers information about the value of incorporating several learning styles into the classroom, with a focus on kinesthetic learning. Moreover, it offers guidance about how to ground a KLA into an overarching learning structure. A concrete example of how to incorporate a KLA into an MIS classroom is then detailed. Next, the results of a survey about students' perceptions of the KLA are summarized. Lastly, concluding remarks are presented.

LITERATURE REVIEW

LEARNING STYLES

Students enter the classroom with a diversity of learning styles (C. Dunn & Brown, 2014). Learning styles are defined as "the differences that exist between individuals in how they best learn" (Wagner & Drago, 2004, p. 1). In this sense, the instructor should adjust his or her teaching methods to address the differences in students' learning styles (Griggs et al., 2009). Research suggests that students benefit when instructors vary their teaching styles (Mobley & Fisher, 2014). If an instructor adheres to a single learning style throughout a course, there may be a mismatch that occurs between the learning styles offered by the instructor and the preferences of the learners, and therefore, low levels of student achievement may occur (Mobley & Fisher, 2014).

Research on learning styles dates back several decades (e.g., R. Dunn et al., 2002). Traditionally, learning styles have been discussed in terms of four dimensions: cognitive, affective, physiological, and psychological (R. Dunn et al., 2002). More current research typifies learning styles into four learning modes that encompass the senses used in the process of learning (Prithishkumar & Michael, 2014). These modes are embedded in the VARK learning style model, which classifies students in terms of how they learn best (Fleming, 2001).

VARK stands for visual (V), aural (A), read/write (R), and kinesthetic (K) (Fleming, 2001). The following list summarizes the VARK learning style model related to each letter.

- **V**isual learners prefer demonstrations in terms of pictures or videos (Wagner & Drago, 2004). They have a preference to use lists to stay organized (Prithishkumar & Michael, 2014).
- **A**ural learners prefer to listen to lectures. Aural learners enjoy discussions and seminars.
- **R**ead/write learners prefer lecture notes and handouts and prefer to take notes during lectures and while studying.
- **K**inesthetic learners learn by doing (Wagner & Drago, 2004). Kinesthetic learners "prefer to apply touch, movement and interaction to their learning environment" (Prithishkumar & Michael, 2014).

Though little attention has been paid to the kinesthetic component of the VARK model and its application to college-level courses, some research does exist. For example, in the context of technology, Iqbal, Mangina, and Campbell (2019) designed an augmented reality software grounded in kinesthetic learning. Similarly, Shamir, Kocherovsky, and Chung (2019), at the K-12 education level, adopt kinesthetic learning to introduce a paradigm to teach children how to code and learn mathematics concepts through music and dance. Likewise, Ayala, Mendívil, Salinas, and Rios (2013) incorporated kinesthetic learning concepts and a KLA by designing a classroom activity that uses Microsoft Kinect to introduce mathematical concepts to students. Microsoft Kinect enables students to interact with the mathematical concepts by drawing graphs and moving around, rather than sitting at a desk and watching or listening to a lecture or a video. Ayala et al. (2013) found that students were able to use Microsoft Kinect to replicate the drawings of several graphs by using technology and that students overall enjoyed the learning activity.

The drawing component of kinesthetic learning is of interest in the current study. As discussed above, at the college level, students can benefit when instructors incorporate drawing into curricula. For example, Riordan (2006) applied kinesthetic learning through drawing in an international accounting course. The authors specifically describe the drawing activity in terms of "drawing a process flowchart for translating financial statements" (Riordan, 2006, p. 53). The authors argue that drawing the process flowchart enables students to spend more time thinking about the logic behind the process (Riordan, 2006).

Apart from the aforementioned research, drawing as a kinesthetic learning activity has not been studied much at the college level, or in STEM education, but is advocated as a means to keep students engaged and think creatively (Chisholm & Spencer, 2017). Drawing has, however, been studied a great deal in primary and secondary education. In elementary education, for example, drawing has been argued as a valuable way to introduce or reinforce "modes of representation" so that students can "learn to repeat patterns and shapes intentionally" (Anning, 1999, p. 163). Drawing as also been argued as a means to go beyond using language to interpret course material, since language can bias one's understanding of course material (Brier & Lebbin, 2014). That is, according to Kantrowitz (2012), drawing "enables the drawer to see and comprehend that which is beyond words" (p. 10). Therefore, drawing represents a valuable means by which students can think logically and become engaged with course material beyond language and invites students to think creatively and critically about course concepts.

Based on previous research on drawing at the college level (e.g., Ayala et al. 2013; Riordan, 2006), as well as the promise drawing holds at the primary and secondary education levels, this study investigates kinesthetic learning through a KLA that involves drawing. Before the KLA is detailed, the concept of learning structures should be introduced. This is because it is vital for instructors to craft their learning activities in an overarching framework (Kagan, 2001).

LEARNING STRUCTURES

Learning structures are overarching frameworks that are a means to assist the instructor with shaping, or providing a structure for, course content. Learning structures are not classroom activities and do not contain any content themselves. To elaborate, Kagan (2001) provides an explanation of the difference between learning structures and learning activities:

> "Activities almost always have a specific content-bound objective and, thus, cannot be used to deliver a range of academic content. In contrast, structures may be used repeatedly with almost any subject matter, at a wide range of grade levels, and at various points in a lesson plan." (Kagan, 2001, p. 12)

Learning structures can be categorized into two types: competitive and cooperative (Kagan, 2001). *Competitive structures* emphasize competition among students. When an instructor lectures and asks the entire class to answer a question, a strategy based on a structure called "Whole-Class Question-Answer," students tend to compete with one another to answer questions. When an individual student then answers the question, other students fail to answer the question. In this sense, the "Whole-Class Question-Answer" structured learning framework rewards individual students and has been argued to create a learning environment not conducive to social interaction or discussion (Kagan, 2001). *Cooperative structures* deemphasize competition and emphasize collaboration (Banks, 2003). Kagan (2001) illustrates an example that compares the competitive structure called "Whole-Class Question-Answer" with the cooperative structure called "Numbered Heads Together." Using the latter structure, the teacher assigns numbers to small groups of students (i.e., each group of students is given a number). Then, during the lecture, when the teacher asks a question, he or she invites the students to discuss their thoughts briefly with their small group (Kagan, 2001). After a moment, the teacher announces one of the assigned numbers. The students assigned that number then provide their answers. In this sense, the Numbered Heads Together structure promotes collaboration and discussion among all students, not just one.

Using this guidance, and coupled with the literature on kinesthetic learning, this paper provides an example of a KLA grounded in a cooperative learning structure called Think-Pair-Share (Kagan, 1989; Kaddoura, 2013). The KLA and learning structure are elaborated on below.

THE LEARNING ACTIVITY

OVERVIEW OF THE LEARNING ACTIVITY

The KLA was administered in an introduction to MIS course, which is a required business administration course that enrolls approximately 90 students per quarter. The KLA was administered to students enrolled in the MIS course over two academic quarters. The KLA was introduced to students during week 5 of the 11-week course, which is on a quarter system. The topic for the week was "Understanding Moore's Law and its Implications in Business." This content is based on Chapter Five of the textbook *Information Systems: A Manager's Guide to Harnessing Technology* (Gallaugher, 2017).

The purpose of the KLA is for students to better understand the role of Moore's Law in the past few decades of computing, as well as think about the future of technological advancement. The drawing component is meant for students to critically think about the advancement of technology though visual representation. Students can "go beyond words" to visually depict Moore's Law and summarize the course content.

The KLA is divided into two parts. Part one is an overview of the topic of Moore's Law that involves class discussion and writing. Part two is a graded assignment that involves hand-drawing and the discussion of those drawings. The KLA occurred over two class sessions (one Monday session and one Wednesday session). One class session lasts approximately one hour and twenty minutes. The specific wording of the KLA can be found in the Appendix. I describe the KLA in more detail below.

STRUCTURE OF THE LEARNING ACTIVITY: THINK-PAIR-SHARE

The KLA is guided by a cooperative structure called Think-Pair-Share (Kagan, 1989, 2001). Think-Pair-Share is a structured learning framework that emphasizes "inductive reasoning, deductive reasoning, application, participation, and involvement," (Kagan, 1989, p. 14) and fits well with the goals of kinesthetic learning. The steps of think Think-Pair-Share are as follows:

- *Think:* the instructor requires that the students *think* to themselves about a topic. This typically involves providing a few general questions and having students think about them individually and/or reading a chapter by themselves and taking notes.
- *Pair:* students *pair* up with another student and discuss the topic and/or the answers to the questions.
- *Share:* students *share* their groups' discussion with the entire class.

PART 1 OF THE KLA: INTRODUCING THE TOPIC

Prior to the KLA, students are encouraged to read Chapter Five of the textbook (the chapter on Moore's Law). This gives students prior knowledge about the topic and its implications. On the first day of the week, students are given the following prompt, which the instructor explains:

> Take a moment to think individually and write about what you already know related to Moore's Law. For example, you could answer questions such as, "What is Moore's law?" or "What are some implications of Moore's Law?" You are more than welcome to use your textbook or the Internet as you write.

After students write their notes, the instructor gives a short lecture and plays several short videos related to Moore's Law. For example, one of the videos is a collaboration between the television show *Myth Busters* and Intel Corporation which explains the core concepts of Moore's Law (Intel, 2015). Once the videos conclude, students are then asked to revisit what they wrote about Moore's Law, to think of a few keywords or phrases related to Moore's Law, and discuss the keywords and phrases with a fellow student. Once the discussion has concluded, students are encouraged to leave their desks and write these keywords on the whiteboard at the front of the classroom. Examples of keywords written by students include "faster," "exponential," "electronic waste," "processing," and "doubling," among others. Figure 1 shows an example of the keywords written by the students.

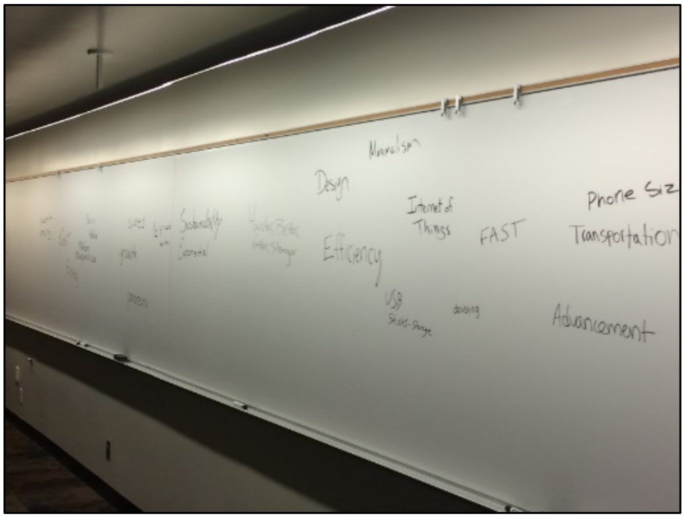

Figure 1. Keywords Related to Moore's Law

Once the keywords are written on the board, the instructor chooses several of the keywords and requires that the students who wrote those specific keywords to explain what they mean. Students then share their thoughts with the class and the instructor provides feedback.

PART 2 OF THE KLA: THE ASSIGNMENT

Once part one is completed, the instructor provides information about the assignment for the week. The instructor clarifies that the assignment comprises the following components. The components are discussed below under the headings of Think, Pair, and Share. Two examples of the product of the KLA are provided in Figure 2.

Think

Before Part 2 begins, students are told that they must *hand-draw* two separate drawings that illustrate the concept of Moore's Law, and that these drawings will be presented to groups and the entire class during the next class period. Drawing One should represent the main idea of Moore's Law. Drawing Two should summarize another section in Chapter 5. Students are then given a few minutes to select their group members. The groups are typically comprised of three to five people. The instructor then assigns each group a number based on the five sections in the chapter. Students are assigned a number from one to five. The numbers represent the specific section of the chapter they need to summarize. For example, if a student in a group with the number five is given the number three, he or she needs to hand-draw a summary related to the material presented in section 5.3 of Chapter 5 for Drawing Two. Students are also encouraged to be creative and told that these drawings will be presented during the next class period.

Pair

Students come to the next class session with their two drawings. They are given approximately 15 minutes to *pair* up with their group members and discuss their drawings. After the discussion, each group elects one or two group members to share their drawings with the entire class. In other words, each group nominates one or two students to present his or her drawings to the class. The sharing with the entire class occurs in the next step.

Share

The instructor begins by inviting the one or two group representatives from each group to share Drawing One (i.e., the overall main idea of Moore's Law). This typically yields about 20 to 30 students who line up at the front of the classroom and describe their drawing. To share, students place their drawings on the classroom document camera and explain the drawing. Each student's discussion of Drawing One typically takes approximately 30 seconds.

Once each group representative has shared Drawing One, the instructor asks the representatives from each group to share Drawing Two (i.e., the drawing that summarizes the assigned section of Chapter 5). To facilitate the sharing of Drawing Two, the instructor first invites the group representatives who were assigned section 5.1. This yields about four to eight students who present their drawings. Once the students from section 5.1 share their drawings, the instructor then thanks those students and directs them to retake their seats. The instructor then invites the group representatives from section 5.2 to share their drawings. Again, this yields approximately four to eight students. This process repeats until the group representatives from section 5.5 have concluded. It should be noted that the instructor provides feedback and commentary during each section as well. Figure 2 showcases two examples of drawings about the main idea of Moore's Law.

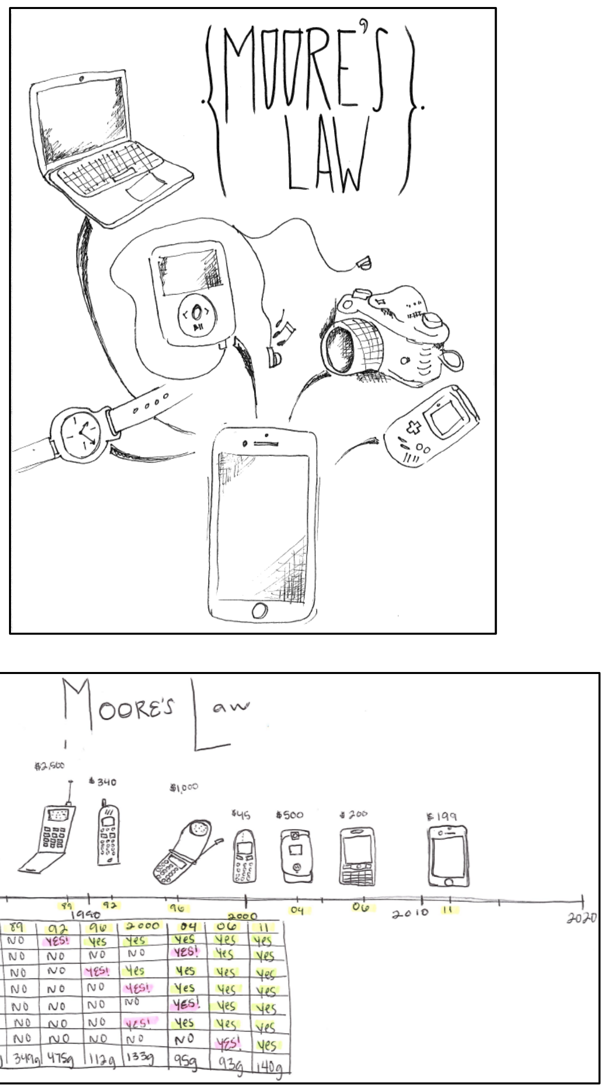

Figure 2. Two Examples of Students' Drawings about Moore's Law

The Assignment Recap

Once each student has shared and discussed his or her drawings, the instructor then provides an overall summary of the concepts of Moore's Law and underscores the important components of each section of the specific chapter. The instructor also answers any questions that students may have about the chapter and concepts discussed during the KLA. For example, students would present drawings such as the two shown in Figure 2, and the instructor would ask the student to explain how the drawing is related to Moore's Law and/or the specific section he or she had to summarize.

Results

The author has facilitated this activity several times over the past four years. Over that time period, students have expressed approval with the assignment, though no evidence was collected. Moreover, students seemed to have instilled several important concepts related to Moore's Law. For example, students seemed to have an understanding that computer processing power has increased substantially over the last several decades, and that transistors are getting smaller, both of which have led to advancements in data processing and the integration of computing to business functions. To supplement these observations, the author felt that it was necessary to have a formal assessment related to the perceptions of student outcomes. Therefore, a survey questionnaire was distributed to the students in order to obtain more objective feedback about the KLA.

The survey questions were inspired by Tyran (2006), who surveyed students in a Systems Analysis and Design classroom to provide feedback about a course exercise. The survey questions were written in a before and after format (see Table 1 for detailed questions). In other words, students were asked to rate their confidence in the understanding of the material based on several specific learning outcomes *before and after* the KLA. The survey questions ask about the kinesthetic component of the KLA (e.g., the hand-drawing of the material) as well as the Think-Pair-Share structure (e.g., the group discussion and sharing the drawings with the class). The survey was offered for extra credit. A total of 109 students in both MIS courses completed the survey. The students were an average age of approximately 22 years old. Table 1 displays the questions and the results of the survey.

Table 1. Student Perceptions of the KLA

QUESTIONAIRE ITEM	MEAN	STD. DEV.	
Kinesthetic Learning Activity (Hand-drawing)			
Pre vs. Post Drawing: Change in Confidence and Understanding of the Main Idea of Moore's Law.			T-Test
Before I completed the *hand-drawn visual* of the main idea of Moore's Law, I was confident that I understood Moore's Law.	5.38	1.41	$p<.000$ ($t=7.38$)
After completing the *hand-drawn visual* of the main idea of Moore's Law, I am confident that I understand Moore's Law.	6.43	0.71	
Pre vs. Post Drawing: Change in Confidence and Understanding of the Specific Book Section of Moore's Law.			T-Test
Before I completed the *hand-drawn visual* of my specific section about Moore's Law, I was confident that understood Moore's Law at a deeper level.	5.07	1.34	$p<.000$ ($t=7.27$)
After completing the *hand-drawn visual* of my specific section about Moore's Law, I am confident that I understand Moore's Law at a deeper level.	6.11	0.88	

QUESTIONAIRE ITEM	MEAN	STD. DEV.	
Questions about the Think-Pair-Share Structure of the KLA			
Pre vs. Post Drawing and Group Discussion: Change in Confidence and Understanding of the Main Idea of Moore's Law			T-Test
Before discussing my hands-on visual of the main idea of Moore's Law with my group, I was confident that I understood Moore's Law.	5.59	1.14	p<.000 (t=5.42)
After discussing my hands-on visual of the main idea of Moore's Law with my group, I was confident that I understood Moore's Law.	6.27	0.81	
Pre vs. Post Drawing and Group Discussion: Change in Confidence and Understanding of the Specific Book Section of Moore's Law			T-Test
Before discussing my hands-on visual of my specific section about Moore's Law with my group, I was confident that I understood Moore's Law.	5.52	1.16	p<.000 (t=5.20)
After discussing my hands-on visual of my specific section about Moore's Law with my group, I was confident that I understood Moore's Law.	6.21	0.91	
Pre vs. Post Drawing, Group Discussion, & Class Discussion: Change in Confidence and Understanding of Moore's Law			T-Test
Before the class discussion of Moore's Law, I was confident that I understood Moore's Law.	5.08	1.52	p<.000 (t=9.72)
After the class discussion of Moore's Law, I was confident that I understood Moore's Law.	6.42	0.73	
Questions about the Overall Satisfaction with the KLA			
Overall, I was satisfied with creating a hand-drawn visual of Moore's Law.	5.52	1.48	
Overall, I feel creating the hand-drawn visual of Moore's Law helped me understand Moore's Law.	5.47	1.60	
Overall, I feel discussing my hand-drawn visual of Moore's Law helped me understand Moore's Law.	5.63	1.35	
Overall, I feel having students share their drawings of Moore's Law with the entire class helped me understand Moore's Law.	5.61	1.54	
Overall, I was satisfied with the assignment as a whole.	5.79	1.26	
Note: Scores are based on a 7-point Likert Scale, where 1 = Strongly Disagree and 7 = Strongly Agree.			

To provide more context to the survey data, the author also collected qualitative data about the KLA. The qualitative data (see Table 2) are comments from students about the assignment based on the question prompt: "Could you please provide comments about the Moore's Law activity, including comments about hand-drawing Moore's Law on your own, discussing your drawing with your fellow students, and having a select number of students present his or her drawing to the entire class?" Table 2 provides a summary of selected quotes related to the KLA. The quotes highlight how students felt about the KLA.

Table 2. Student Perceptions of the KLA

QUOTES FROM STUDENTS ABOUT THE KLA
"Honestly, I felt a little weird doing hand drawings because (1) I'm a terrible artist and (2) I've never been asked to do something like that in a university setting. However, it was extremely helpful for me to assess my own learning while thinking of what to draw, as well as to see the key concepts that other students were able to connect with for their drawings." – Student 1
"I think physically drawing something out as a visual helps to implement an idea more firmly." – Student 2
"I believe that the hand-drawing was an unorthodox and interesting way to deepen our understanding of Moore's law. The goal could have been achieved using the "standard" approach of having students prepare a PowerPoint or Word doc, but this technique may have encouraged more participation and engagement. In all, I think the lesson served its purpose. I feel the class discussions are always advantageous, at least for those who are engaged. They almost always lead to thinking about things in a different way." – Student 3
"It was hard for me to come up with something to draw at first, but once I began, it was very useful for my knowledge. Having other students present their drawing was great because then I was able to learn past my own thoughts, it forces me to be open-minded and learn past my own thoughts and opinions." – Student 4
"I enjoyed seeing everyone's individual and different ideas while presented with the same project, and how it could be interpreted in a variety of ways. I felt that explaining my own drawing helped me understand it more, as well as hearing others helped with the understanding of theirs as well." – Student 5
Note: The data for this table is based on the following prompt: "Could you please provide comments about the Moore's Law activity, including comments about hand-drawing Moore's Law on your own, discussing your drawing with your fellow students, and having a select number of students present his or her drawing to the entire class?"

Overall, the quantitative results (Table 1) indicate that in each of the question sets there was a significantly higher rating after each of the components of the KLA than before. For example, students indicated that, after completing the drawing, they were significantly more confident that they understood Moore's Law and their specific section related to Moore's Law. Moreover, students seemed to gain confidence in their understanding of Moore's Law after discussing their drawing. While this is not evidence that the drawing itself advanced their knowledge and contributed to their confidence, the results of the survey suggest that students perceived themselves as more confident in their understanding of Moore's Law after completing and discussing their drawings than before. More research should inquire into the effect of the drawing itself, perhaps by using experimental and control groups.

Students also seemed satisfied with the KLA. For example, the quantitative results show that students were satisfied with creating the drawing (mean = 5.52 out of 7) and felt that creating the hand-drawn visual of Moore's Law helped them understand Moore's Law (mean = 5.47 out of 7). Additionally, students indicated that they were, overall, satisfied with the assignment as a whole (mean = 5.79 out of 7). It can therefore be concluded that in general students perceived the KLA as a satisfying experience that helped them develop confidence in the course concept.

The qualitative results (Table 2) also depict a general satisfaction with the KLA. Interestingly, several students had comments that echoed those by Student 1, for example, who said that s/he is not the best artist and that s/he has "never been asked to do something like that in a university setting." This relates to the author's first-hand experiences with student feedback. For example, students regularly approach the KLA, and the drawing component specifically, with some hesitation. However, the author has found from first-hand experience, that the drawing component of the KLA typically helps students think critically about the course material. This reaffirms Student 1's comment that the drawing component of the KLA prompted him/her to "assess my own learning while thinking of what to draw." In this sense, based on the qualitative data, and the experience of the author, the KLA was considered by the author as a success.

The results of the study are generalizable. To elaborate, when incorporating drawing into different topics, students will likely express overall satisfaction. For example, as discussed previously, Riordan (2006) incorporated drawing into a lesson on process modeling in international accounting, while Ayala et al. (2013) had students recreate graphs using Microsoft Kinect. In these examples, students are often highly engaged and report satisfaction with the activity. Drawing, rather than reading a text or watching a movie, which could (and likely should) be incorporated into a KLA to promote an array of learning styles, deviates from a more traditional university lecture or hands-on assignment by challenging students to think beyond the language used in their textbooks and beyond their own vocabulary in order to describe and summarize a phenomenon. In this sense, though there may be some initial reluctance, students will likely come away from the KLA satisfied.

CONCLUSION

While kinesthetic learning offers tremendous promise to strengthen learning outcomes, it has not been well researched at the college level. The paper describes the benefits of kinesthetic learning and details how to implement a kinesthetic learning activity that involves drawing in an introductory MIS classroom. The learning activity is embedded in an overarching learning structure called Think-Pair-Share, which provides a framework for the execution of the kinesthetic learning activity. The paper details the specifics of the learning activity through a lesson on Moore's Law and the advancement of computing over the last several decades. Specifically, in the kinesthetic learning activity, students are given the task to hand-draw two visuals related to Moore's Law. One drawing is the overall main idea of Moore's Law; the other drawing is a summary of a section of the textbook to which they are assigned. Students complete the drawings individually and then discuss their drawings with classmates. After that, students are invited to share their drawings with the entire class.

To understand if the kinesthetic learning activity was of value, the author had students complete a survey that asked them questions related to their overall confidence before and after the learning activity. Students were also asked to comment about the activity. The quantitative results suggest that overall students were satisfied with the kinesthetic learning activity and that students perceived themselves as more confident after completing the activity than before. The qualitative results also indicate that students enjoyed the activity and that the activity was worthwhile. These results extend research that suggests drawing is a meaningful way to engage students with course material (Anning, 2006; Riordan, 2006).

Overall, the study can provide university instructors with a novel means to design course content to incorporate kinesthetic learning and learning structures into courses going forward. While the current example was in the context of an introductory course, the concepts can be applied to multiple levels of education and in multiple disciplines at the undergraduate and graduate levels.

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APPENDIX: OVERVIEW OF THE COURSE EXERCISE

BEFORE CLASS:

Please read Chapter 5 titled "Moore's Law and More: Fast, Cheap Computing, and What This Means for the Manager."

WHAT TO DO FOR THE WEEK:

We will start the lesson by watching a few of the following videos related to Moore's law:

- *Instant Egghead* explains Moore's Law -
  - https://www.youtube.com/watch?v=bLSMn0cNWAw
- Myth Busters Explains Moore's Law -- https://www.youtube.com/watch?v=Hoqa-fBsQfs
- Myth Busters on Transistors -- https://www.youtube.com/watch?v=EtcpueRBMA4
- Browse the following link: any comments? 10 Images that convey Moore's Law -- https://www.washingtonpost.com/news/innovations/wp/2015/04/14/10-images-that-explain-the-incredible-power-of-moores-law/

As you watch, please do the following:

Take a moment to think individually and write about what you already know related to Moore's Law. For example, you could answer questions such as, "What is Moore's law?" or "What are some implications of Moore's Law?" You are more than welcome to use your textbook or the Internet as you write.

Once the videos are over:

Think of two or three keywords related to Moore's Law. Please write these keywords on the whiteboard.

We will then start on the class assignment for the week. The assignment will center on a discussion of Moore's Law. This assignment will comprise both classes this week.

FIRST CLASS (AND FOR HOMEWORK):

During class and for homework you are responsible for two hand-drawings:

- A hand-drawn visual of the main idea of Moore's Law;
- The overall main idea of your section. Sections will be assigned to you during class.

Get creative! These drawings will be presented and discussed during the next class period.

SECOND CLASS:

You all will have about 15 minutes to regroup and finish your assignment and hand-drawings. You will then nominate a group member or two to come to the front and lead a discussion of Moore's Law. We will use most of the class time on Wednesday to present and discuss Moore's Law.

BIOGRAPHY

Christopher B. Califf is an Assistant Professor of Management Information Systems in the Department of Decision Sciences in the College of Business and Economics at Western Washington University. His research interests include technostress, healthcare IT, qualitative research, cloud computing, and IT in emerging economies. His research has been published in outlets including MIS Quarterly (forthcoming), MIS Quarterly Executive, Journal of Information Technology, AIS Transactions on Human-Computer Interaction, Computer Networks, and Information Technology & Tourism, as well as in several conference proceedings such as the International Conference on Information Systems, Hawaii International Conference on System Sciences, and the Americas Conference on Information Systems. Chris has also served as a Guest Editor for a special issue of the Journal of the Association of Information Systems, and regularly reviews for several high-quality journals.