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ORIGINAL ARTICLE

Using computer-assisted learning to engage diverse learning styles in understanding business management principles

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Objective: Changes in small business and insurance present challenges for newly graduated chiropractors. Technology that reaches identified, diverse learning styles may assist the chiropractic student in business classes to meet course outcomes better. Thus, the purpose of our study is to determine if the use of technology-based instructional aids enhance students' mastery of course learning outcomes.
Methods: Using convenience sampling, 86 students completed a survey assessing course learning outcomes, learning style, and the helpfulness of lecture and computer-assisted learning related to content mastery. Quantitative analyses occurred.
Results: Although respondents reported not finding the computer-assisted learning as helpful as the lecture, significant relationships were found between pre- and post-assisted learning measures of the learning outcomes 1 and 2 for the visual and kinesthetic groups. Surprisingly, however, all learning style groups exhibited significant pre- and post-assisted learning appraisal relationships with learning outcomes 3 and 4.
Conclusion: While evidence exists within the current study of a relationship between students' learning of the course content corollary to the use of technologic instructional aids, the exact nature of the relationship remains unclear.

Key Indexing Terms: Chiropractic; Learning; Practice Management

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INTRODUCTION

Most chiropractic students today have grown up using computers, laptops, and cell phones, and can easily navigate the internet, and any number of software applications and platforms. According to the *Pew Internet and American Life Projec*t report,[1] adults born between the mid 1960s and mid 1990s are the most technologically savvy. During the last 10 years, computer-assisted learning (CAL) has grown and is now a primary means of educational delivery for many colleges. Websites, like YouTube and the Khan Academy, offer on-demand learning opportunities, while traditional brick-and-mortar universities, such as Harvard and MIT, offer open access courseware to students, which have been received exceedingly well. The flexibility of open access technologies, such as pod- and web-casts (forms of CAL), for delivering lecture and other curricular materials has been acknowledged as a key benefit to business learners and their teachers.[2] Given the prevalent use of curriculum delivery technologies, government and accrediting bodies impose strict guidelines and requirements when a college offers online learning opportunities.[3] Chiropractic colleges also have begun to use CAL in clinical assessment of patients.[4] Despite the breadth of CAL within the chiropractic clinic setting, few tackle this issue within a chiropractic classroom setting.[3,5,6]

Students entering chiropractic programs today not only likely have used some form of CAL before, but expect that it will be integrated into their course offerings.[3] Extant literature tells a small, mixed, story of the effectiveness and significance of using technology-based instructional aids.[3] To date, little research exists to explore the impact of technology on self-perceived achievement as related to course learning outcomes.[3]

Because of the flexibility of delivery and access, the use of technology can enable instructors to tap into multiple learning styles and target the varied needs of students. Fleming and Baum make the case that there are modes of preferred communication (input and output) that should be considered when addressing student needs and educational delivery.[7] There are four basic learning styles: visual, aural, read-write, and kinesthetic.[7] Visual learners learn best by seeing, aural learners learn best by hearing, read-write learners prefer to take in information in text format, and kinesthetic learners prefer hands-on learning. Conse-

quently, in a diverse classroom setting, it is reasonable to expect that all learning style preferences could be represented. The challenge for faculty members is to discover methods of content delivery that could engage students of all styles to ensure that course learning outcomes are achieved. Although lecture is a primary mode of teaching within most classrooms (which primarily is effective for aural learners), the use of technology-based instructional aids can assist faculty members with reaching students of different learning styles.[8] Learning styles theory (LST) is not without controversy, however. Although acceptance of learning styles is commonplace within United States mainstream culture, LST opponents posit that learning styles are a fallacy.[9] Opponents maintain a disbelief that there is one all encompassing learning style that any one person would learn better with, but that learning encompasses a more complex emotional meaning–making process.[9]

The purpose of our study was to determine if the use of technology-based instructional aids enhance students' mastery of course learning outcomes. Changes to small business, insurance, and health policy present challenges to the newly graduated chiropractor. This is not a new problem, however. The inclusion of chiropractic services for insurance reimbursement in the 1970s identified a need for chiropractic colleges to teach standards for documentation and insurance billing.[10] In response to this need, most chiropractic colleges now offer some business classes.[11] More recently, the Patient Protection and Affordable Care Act requires updated standards in billing and documentation of patient care.[12] One example of these changes is understanding and implementation of technology to prove meaningful use of electronic health records.[13] The impact of these changes is reflected in the *National Board of Chiropractic Examiners Practice Analysis of Chiropractic*, which includes survey data that the business and documentation components of practice have increased from 26.4% to 42.6% from 1998 to 2009.[14] Such changes require that graduating chiropractors be prepared skillfully in insurance and business practices. One way chiropractic faculty can close the learning gaps within these areas may be the use of adjunctive, technology-based instructional aids.

METHODS

Our study was exempted by the Palmer College of Chiropractic institutional review board. During the final year of the chiropractic program, students are required to take 11 credit hours of business-related courses. These courses are designed to build upon the knowledge learned in previous courses and to expand the competency of the students related to their business acumen.

Students who had taken the 8th trimester financial management course were eligible to participate in this study. During the 8th trimester financial management course, business concepts relating to financial planning and insurance billing were delivered using a traditional, lecture style format. Students did not have adjunctive, web-based instructional materials available to them during this course.

Web-based video tutorials reviewing the business concepts originally presented in the 8th trimester course were made available at the conclusion of the course and before the beginning of the 9th trimester course. Using a paper-based survey instrument, students in the 9th trimester course were asked to rate their opinions, understandings, and experiences within the lecture-only course that they had taken during their 8th trimester. Later in the same survey, students were asked to rate their understanding and experiences with the material after having had access to the videos in the 9th trimester course. In other words, students did not have access to the pre-recorded, web-based practice management demonstration videos while enrolled in the 8th trimester financial management course; however, the videos were made available to those students during the 9th trimester course in the business sequence. Students were encouraged to access the video tutorials as a refresher to the information presented previously.

Approximately 130 adult students were enrolled in the course and 91 were in attendance on the day of survey administration. First, students were asked to reflect on their experiences and learning after having completed the initial financial management course, which was lecture-only (pre-CAL). Next, students were asked to answer several questions about their learning and experiences after having reviewed and interacted with the technology-based instructional aids (post-CAL).

Instrument

The survey consisted of Likert-type questions, best choice questions, basic demographic items (sex and race), and open-ended comments inquiring about the students' understand of course concepts, use of pre-recorded web-based video tutorials, their understanding and knowledge of the material presented in the tutorials, and their learning styles.

Data Analysis

Descriptive statistics were used to explore basic demographic variables. Paired t tests assessed the differences between students' pre- and post-CAL appraisals of the course's learning outcomes.

Variables

Variables for the study consisted of students' ratings of the helpfulness of the lecture (pre-CAL) and instructional aid (post-CAL) conditions with regard to learning the business curriculum, as well as measurement of student ratings across the course's four learning outcomes (LO): (1) How would you rate the value of having accurate financial documentation, (2) how would you rate the value of implementing ethical financial management practices, (3) how would you rate your preparedness to complete insurance billing accurately, and (4) how confident are you in your ability to explain to others how to prepare insurance billing accurately?

Table 1 - Aggregated Pre- and Post-CAL Percentile Scores For Student Learning Outcomes (LO)

	Visual, $n = 13$		Aural, $n = 13$		Reading/Writing, $n = 21$		Kinesthetic, $n = 39$	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
LO 1	76.9	84.6	84.6	100.0	90.5	100.0	94.9	89.7
LO 2	84.6	84.6	84.6	92.3	100.0	100.0	97.4	100.0
LO 3	23.1	23.1	15.4	38.5	38.1	42.9	35.9	38.5
LO 4	15.4	23.1	7.7	15.4	33.3	38.1	30.8	28.9

Df, degrees of freedom.

LO 1: How would you rate the value of having accurate financial documentation? LO 2: How would you rate the value of implementing ethical financial management practices? LO 3: How would you rate your preparedness to complete insurance billing accurately? LO 4: How confident are you in your ability to explain to others how to prepare insurance billing accurately?

Percentiles for pairs 1 and 2 represent an aggregation of value (highly value + moderate value). Percentiles for pair 3 are an aggregation of preparedness (highly prepared + moderately prepared). Percentiles for pair 4 are an aggregation of confidence (highly confident + moderately confident).

RESULTS

Response Rates and Demographics

A total of 91 students attended class the day of survey administration and received a survey; 86 completed surveys were returned, resulting in a 95% response rate. Test–retest reliability was calculated for all four student learning outcomes assessed pre- and post-CAL across all four learning style groups. Demographic review revealed the majority of participants were male, white, and had a primary learning style of being kinesthetic learners. Self-reported cumulative grade point average (CGPA) and age appear relatively stable across groups. Learner demographics are representative of the general student body of the college.

Helpfulness of Lecture or Video Conditions

Students were asked to report their perceptions of how "helpful" their initial lecture (pre-CAL) and the corresponding video instructional aids (post-CAL) were in learning various business skills. Except for the reading/writing group, all groups reported decreases in the helpfulness of the video compared to the lecture for all groups concerning their learning financial spreadsheets (visual 60%, 30%; aural 58%, 45%; reading/writing 50%, 50%; and kinesthetic 45%, 32%).

A similar declining pre–post trend also was observed across all groups for students' reports for how helpful they felt the lecture and videos were for learning insurance billing (visual 42%, 22%; aural 92%, 28%; reading/writing 91%, 35%; and kinesthetic 80%, 40%). Although in the case of the visual group the decline was approximately half, more drastic declines were observed for the other groups.

Students' Appraisal of Learning Outcomes

Table 1 reports students' responses to questions gauging the course's learning outcomes with regard to the lecture (pre-CAL) and video (post-CAL). Of the course's four student learning outcomes, respondents within each group rated their learning within each outcome higher in the post-CAL phase with a few exceptions.

The kinesthetic group exhibited a slight decline in their perception of the value of having accurate financial documentation in LO 1, as well as a slight decline in confidence in their ability to explain to others how to prepare insurance billing. The visual (86.4%) and reading/writing (100%) groups' pre- and post-CAL scores were unchanged with regard to their valuation of implementing ethical financial management practices. The visual group's pre- and post-CAL scores also remained the same concerning their preparedness to complete insurance billing accurately.

Paired *t* test analysis provided both indications of test–retest reliability (bivariate correlations) as well as which pairs of learning outcomes significantly differed between pre- and post-CAL conditions.

Test–Retest Reliability

Assessment of reliability occurred using the typical reliability thresholds for reliability measurement of Pearson product moment correlation coefficients,[15] wherein a threshold of 0.70 or greater indicated high reliability.[15] Reported in Table 2 are the test–retest correlation coefficients for reliability. Nine pairs would meet the threshold and would be considered stable measures. The 7 that did not meet the 0.70 threshold were: LO 3 for the visual group; LO 1 for the aural group; LO 1, 2, and 3 for the reading/writing group; and LO 1 and 2 for the kinesthetic group.

Of the bivariate correlations reported above, all significant relationships discovered were positive correlations, meaning that as one score increases, the other increases in lockstep. For instance, the visual and kinesthetic groups' pre- and post-CAL scores indicated significant correlations for LO 1. Additionally, significant correlations of pre- and post-CAL scores for LO 2 were exhibited by the visual, aural, and kinesthetic groups. All groups indicated significant correlations between pre- and post-CAL scores for LO 3. In addition, all groups indicated significant correlations between pre- and post-CAL scores for LO 4.

Comparison of Pre- and Post-CAL Conditions

Despite numerous significant correlations, few pre- and post-CAL scores significantly differed. Reported in Table 3

Table 2 - Paired *t* Test Correlation Coefficients (CC) and *p* Values (*p*)

	Visual, $n = 13$		Aural, $n = 13$		Reading/Writing, $n = 21$		Kinesthetic, $n = 39$	
	CC	*p*	CC	*p*	CC	*p*	CC	*p*
Pair 1	.818	.001	–.222	.465	.233	.310	.524	.001
Pair 2	.923	.000	.763	.002	.316	.163	.436	.006
Pair 3	.592	.033	.721	.005	.640	.002	.708	.000
Pair 4	.788	.001	.926	.000	.835	.000	.757	.000

Pair 1 = How would you rate the value of having accurate financial documentation? Pair 2 = How would you rate the value of implementing ethical financial management practices? Pair 3 = How would you rate your preparedness to complete insurance billing accurately? Pair 4 = How confident are you in your ability to explain to others how to prepare insurance billing accurately?

are the relevant paired *t* test statistics for each pre- and post-CAL measure. For instance, only chance differences were found for all pre- and post-CAL measures of the course's learning outcomes concerning the visual and aural groups. LO 1 (pre-mean = 3.48, post-mean = 3.90) and 2 (pre-mean = 3.67, post-mean = 3.95) pre- and post-CAL measures were significantly different for the reading/writing group. For both student learning outcomes, the post-CAL scores were significantly higher than the pre-CAL scores.

Significant differences also were found for the kinesthetic group (pre-mean = 3.59, post-mean = 3.79) concerning LO 2. Similar to the other findings, the post-CAL scores were significantly higher than the pre-CAL scores for the kinesthetic group for LO 2.

DISCUSSION

The goal of our study was to uncover the potential impact of a technology-based instructional aid on students' appraisal of mastering a course's learning outcomes. Unsurprising were the significant relationships found between pre- and post-CAL measures of the learning outcomes for the visual and kinesthetic groups. Visual and kinesthetic learners might be inherently drawn to, and learn best from, instructional aids that are visually-based and require hands-on application, and the results show that they were correlated significantly on all four learning outcomes. The action of viewing the videos requires accessing the website, and to use a keyboard and mouse to play the videos. During the tutorials, the student also was free to stop, fast forward, or replay the video. To this end, increased outcome appraisal after the treatment makes sense.

Surprising, however, was that all learning style groups exhibited significant pre- and post-CAL appraisal relationships with learning outcomes 3 and 4. Despite the visual and kinesthetic groups saying that neither the lecture nor video was helpful with learning insurance billing, increases in their preparedness to complete and confidence in their ability to explain insurance billing appears encouraging for the treatment condition. Although one confound to this result was the approximate 2-month time-lag between the initial lecture and the treatment (instructional aid), wherein students could have directed their own learning outside the classroom with regard to insurance billing, we believe that this is not the case.

Although LST offers one means of explaining the significant results of our study, another involves the intersection of the content being taught and the technology used to teach it. For instance, opponents of LST might assert that the content being taught within this course dovetailed nicely with the use of Microsoft Excel. Because students tend to be more technologically inclined and teachers increasingly are using technology as instructional aids,[3] matching course content with the appropriate technology for teaching purposes may have created an emotional meaning–making event that resulted in students' significant appraisal of the learning outcomes. However, because our study lacked conclusive evidence for LST and the oppositional viewpoints, at best we can conclude only that a relationship exists within this study between the course content, use of technology, and students' appraisal

Table 3 - Paired *t* Tests and *p* values for Learning Outcomes (LO) 1 to 4

	Visual, n = 13			Aural, n = 13			Reading/Writing, n = 21			Kinesthetic, n = 39		
	t	Df	*p*	*t*	Df	*p*	*t*	Df	*p*	*t*	Df	*p*
LO 1	–1.389	12	.190	–.898	12	.387	–2.905	20	.009	–1.071	38	.291
LO 2	–1.477	12	.165	.000	12	1.000	–2.828	20	.010	–2.454	38	.019
LO 3	.000	12	1.000	–1.897	12	.082	–.810	20	.428	–.298	38	.767
LO 4	.562	12	.584	–1.000	12	.337	–1.000	20	.329	.000	37	1.000

Pre, pre-CAL; Post, post-CAL.

LO 1: How would you rate the value of having accurate financial documentation? LO 2: How would you rate the value of implementing ethical financial management practices? LO 3: How would you rate your preparedness to complete insurance billing accurately? LO 4: How confident are you in your ability to explain to others how to prepare insurance billing accurately?

of learning outcomes. The exact nature of the relationship remains unclear.

Limitations

One limitation of our study was that the pre- and post-CAL questions were asked in the same questionnaire. Another is the indirect measures used to assess students' perceptions of learning. Although it is a better practice to use directed measures to assess students' actual learning, by design, we wanted to understand how the use of technology mediated respondents' perceptions of learning.

This design may have led to recall bias within the pre-CAL questions and a potential overestimation of the treatment effect for the post-CAL questions. Likewise, students had access to course grades before completing the survey, which could have led to recall bias. Another limitation concerns the potential self-directed learning of students over the break between the end the pre-CAL and post-CAL terms. While not likely, had all students completed the survey, the results may have been different. In addition, the administration method of this survey, paper-based instrument, may have been geared unintentionally to a particular learning style. For these reasons, future studies should incorporate multiple survey methods administered to students before availability of learning videos to account for the varying learning styles.

The final limitation concerns self-report bias. Self-report bias is problematic because respondents might perceive that they could be identified by the researchers or others within the study, and thusly may give fraudulent responses on the survey, which may skew the overall results. With self-report bias, respondents might be inclined to be more conservative in their response, or they may overexaggerate their responses depending on what perception they wish others to have of them (given the respondents' assumption that they could be, and are being, identified by researchers or others). As such, self-report bias is a general limitation of all survey research. Because self-report bias is of greater concern in research that might seek to understand behaviors offensive to current social mores (eg, domestic violence, sexual deviance, drug and alcohol addiction, and so forth), we believe there to be minimal self-report bias within the context of the current study.

Future Research

Because technology continues to advance and become more user-friendly, this topic should continue to be an area researched by educators because of the potential to reach students. First, studies using experimental design strategies are needed to control more fully for extraneous confounding variables. In addition, more conclusive studies regarding learning styles and their use in classroom assessments are needed within the fields of education and chiropractic.

CONCLUSION

The purpose of our study was to examine the relation of instructional aids to learning, through the lens of learning style theory. Although significant correlations for students' pre- and post-CAL appraisals of the courses learning outcomes and the findings of chance differences between the pre- and post-CAL appraisals are surprising, this evidence would suggest that the instructional aids appear to augment student learning across multiple learning styles. However, our study exposes one of the major criticisms of LST: Do students have one or two ways of receiving information that allows them to learn best (ie, visual, aural, and so forth), or is it more the case that, as instructors become better skilled in their craft of teaching, they find appropriate teaching modes that dovetail with course content to create an emotional exchange for students that may allow for more effective learning? This elusive question remains to be answered conclusively between LST proponent and opponent camps.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

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