21ST ANNUAL BOLLINGER-ROSADO

Teaching & Learning Effectiveness Symposium

October 1, 2013

Research-Based Learning

Sponsored by the faculty of ERAU Worldwide

EMBRY-RIDDLE Aeronautical University WORLDWIDE

Bollinger-Rosado Teaching & Learning Effectiveness Symposium

The purpose of the Bollinger-Rosado Teaching and Learning Effectiveness Symposium (TLES) is to foster the community of Embry-Riddle Aeronautical University scholars sharing research practices and findings to ignite academic discussions among faculty and the interested public. In 2011, at the bequest of the Worldwide Faculty Senate responsible for the TLES proceedings since 1991, the Rothwell Center for Teaching and Learning at the Worldwide campus (CTLE-W) began providing blind reviews of the papers selected by the Faculty Senate.

Each submission undergoes multiple blind reviews by a team of CTLE-W reviewers using the TLES Journal Article Reporting Standards Rubric covering both content and format. All of the submissions receive feedback for improvements, but only the top scoring paper is professionally edited by CTLE for this publication.

Contact information for the contributing authors, when provided, is included in the Author Note for each paper.

For more information on the TLES Rubric or CTLE-W, please contact Dr. Wendi Kappers, Director of CTLE-W, at kappersw@erau.edu or wwctlew@erau.edu.

The Rothwell Center for Teaching and Learning Excellence – Worldwide Campus

The mission of the Center for Teaching and Learning Excellence at Embry-Riddle Aeronautical University-Worldwide (CTLE-W) is to be an educational beacon for all Faculty by providing developmental and pedagogical resources required for maintaining and improving didactical skills across educational modalities.

In 2010, the Worldwide Faculty Development Office was renamed as The Bruce A. Rothwell Center for Teaching and Learning Excellence and began offering additional faculty development courses. The four-week long instructor-led courses span topics from Blackboard learning management system, faculty orientation, and pedagogical exploration designed to strengthen the teaching skills of Worldwide faculty. CTLE-W services also include monthly EV-anars using the EagleVision (EV) in support of the University's Quality Enhancement Plan (QEP). CTLE-W currently serves approximately 1700 full-time and part-time faculty on a yearly basis.

To learn more about the CTLE-W, please visit the Rothwell CTLE-W Blackboard (Bb) Organization site found within the ERNIE portal.

Panel of TLES 2013 CTLE-W Reviewers and Editors

Reviewers

- Jessica DeWall, M.S.
- Jan G. Neal, MAS
- Sara Ombres, M.Ed.
- Kim Szathmary, MAS
- Alpesh Makwana, Ph.D

Editors

- Wendi M. Kappers, Ph.D. (Senior Editor)
- Joan Miller, M.G.A.
- Jan G. Neal, MAS
- Stephanie Cutler, Ph.D

To view these or past proceedings, please visit the Hunt Library at http://library.erau.edu and use the keywords "Bollinger Rosado" as your search terms.

Disclaimer

This product was produced by the Bruce A. Rothwell Center for Teaching and Learning Excellence (CTLE), ERAU – Worldwide (W) in support of the Bollinger-Rosario Teaching and Learning Excellence Symposium (TLES). Any opinions, findings, and conclusions or recommendations expressed in this product are those of the contributors and do not necessarily represent the official position or policies of CTLE-W, its reviewers or editors.

Twenty-first Annual Bollinger/Rosado Teaching and Learning Effectiveness Symposium

Theme

Research-Based Learning

Table of Contents

This symposium is dedicated to Dr. Art Rosado and Mr. John Bollinger who served Embry-Riddle and their country with pride and distinction. These two gentlemen set the standard for excellence in teaching at Embry-Riddle Aeronautical University Worldwide. By a unanimous vote of the faculty, this symposium is named in their honor.

SECTION A

Developing Creative Problem Solvers Using Inquiry–based Instructional Strategies in an Aviation Curriculum

Roy John Caligan, Jr.

Embry–Riddle Aeronautical University – Worldwide

Author Note

Roy John Caligan, Jr., College of Aeronautics, Embry-Riddle Aeronautical University – Worldwide.

Correspondence concerning this article should be sent to Roy Caligan via Email: roy.caligan@erau.edu

ABSTRACT

The aviation industry has a need for innovators and problem solvers. An educator's role is to develop students with the proper knowledge, skills, and abilities to meet those needs. However, the students must be intrinsically motivated toward these pursuits in order to be effective, and educators should not introduce factors that discourage creativity and inquisitiveness. This theory–oriented paper identifies the specific skills that students should master and offers a model of instruction that encourages creativity through research, along with recommendations for improvements to the curriculum. Finally, the author provides a select bibliography of strategies for implementing inquiry, creativity, and research activities.

Filling the Need for Problem Solvers

As the aviation industry continues evolving into the 21st century, businesses need employees that can evolve along with them. A survey by the American Management Association (2010) showed that businesses need employees who are not just technically competent, but who can also "think critically, solve problems, innovate, collaborate, and communicate more effectively—and at every level within the organization" (p. 2). Wagner (2012) also builds a case for developing innovative problem solvers when he conducted case studies of different businesses, organizations, and a variety of pre– and post–secondary schools. One particular business leader told Wagner that, "There isn't anyone who doesn't need to be a creative problem solver" (p. 9). The aviation industry recognizes the need for problem solvers as well as Air Washington (2012), a collaboration of aviation manufacturers, government, and community and technical colleges in the State of Washington, listed problem solving as one of the essential skills than new aviation workers must learn before beginning their careers.

The focus on problem–solving abilities does not diminish the need for knowledgeable workers. Knowledge is important, but what people do with that knowledge is becoming more important. The ease of access to information makes learning instant and easy. Anyone can use an internet–connected smart phone or tablet to gain knowledge on demand and use that new knowledge in a manner that fits their current need. This transformation is not unlike the transformation that occurred when Martin Luther translated the Bible into the common tongue. Luther made the teachings in the Bible available to everyone, and the unfiltered availability of that knowledge was an essential moment in the Protestant Reformation (Hamilton, 2007). The world changed during that period not just because knowledge was readily available, but also because people acted in transformative ways by using that knowledge. In today's world, the

internet and smart phones are filling the same role as the printing press and binderies did in the 16th century, and that ease of access to information is transforming the way students learn and how they will benefit in the future (Collins, 2006). Wagner (2012) stresses the importance of this shift, stating that "knowing how to apply [knowledge] in new situations or to new problems...matters most" (p. 52). Ramsey (2009) explains the combination of knowledge and behavior more succinctly, stating that success "is 80% behavior and only 20% head knowledge" (2009, p. ix).

This transformation is also changing the roles of teachers and students. If Embry–Riddle desires to develop their students' inquisitive nature and interest in research through the Quality Enhancement Program, *Ignite*, then the university must focus their efforts on developing student behaviors while simultaneously broadening their knowledge. However, efforts to produce these kinds of students will not benefit the industry if the students see the research activities as nothing more than another requirement needed for graduation. If Embry–Riddle wants students to develop a lifelong passion for inquiry and research (instead of periodic efforts that end when they receive their diploma), then the university must create an "environment that is conducive [*sic*] to stimulating thinking that is receptive to original ideas, and [develop] personality traits such as willingness to take a risk and having a sense of humor" (Karkockiene, 2005, p. 54). In short, the desire to be inquisitive and to conduct research must come from within and not be driven by temporary and external reasons (Breen & Lindsay, 2009).

The purpose of this paper is to explore different methods of course and curriculum design that improve the Ignite program's effectiveness while also filling the industry's need for innovators and problem solvers. The research will examine research–based learning and comparable learning methodologies, identify their commonalities, and recommend course and

curriculum improvements that will help develop students into lifelong problem solvers and innovators.

Research–Based Learning and Complimentary Methodologies

When teachers expose students to research activities and research–based learning (RBL), they may need to help the students understand the real–world benefits of research and to avoid thinking of it as an academic exercise with no real purpose outside of the classroom (Annerstedt, Garza, Huang–DeVoss, Lindh, & Rydmark, 2010). In actuality, the researcher is a tool that schools, businesses, and organizations can use to create innovative ideas that help fill needs or solve problems. Shaban and Abdulwahed (2012) explain the purpose and benefits of RBL in detail:

> The central focus of RBL is on the development of the learners as independent researchers. This approach is designed to promote, amongst the learners, a commitment to making a difference in the world through intellectual inquiry and creative expression leading to useful and innovative solutions for real–life problems. (p. H4A–16)

The definition and purpose of RBL classifies it as one of the active learning methodologies in constructivist learning theory, in the same family as problem–based learning, project–based learning, and inquiry learning. Activities conducted under these methods are student–led and instructor–guided, which gives the students a measure of autonomy. Critical thinking, research, and analysis are also common, along with goal setting and decision-making. If students are working in a group, they require the students to collaborate. Finally, active–learning activities foster a desire for lifelong learning (see Abdullah, 2001; Carder, Willingham, & Bibb, 2001; and Savery, 2006, for descriptions of specific active–learning methodologies). While all of these methodologies are slightly different, they are all active learning methodologies

because each of them requires the students to take an active role in their learning instead of receiving information passively (Bonwell & Eison, 1991; Felder & Brent, 2009).

Bloom's revised taxonomy (Figure 1) shows that students must receive information and utilize the lower–order thinking skills (LOTS) of remembering, understanding, and applying before utilizing the higher–order thinking skills (HOTS) of analyzing, evaluating, and creating. Kirschner, Sweller, and Clark (2006) discouraged the practice of using active–learning exercises to teach without first providing a foundation of knowledge using traditional, passive–learning methods. Both LOTS (passive learning) and HOTS (active learning) are necessary in order to develop a student's knowledge and performance fully.

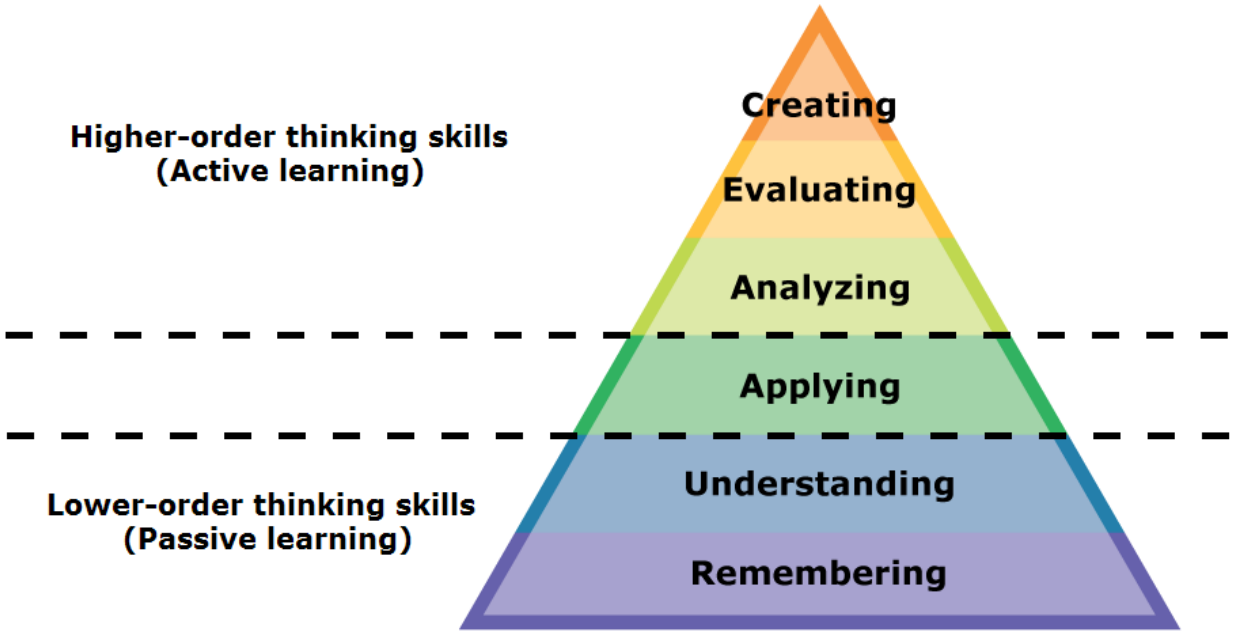


Figure 1. Bloom's revised taxonomy with LOTS and HOTS. The applying skill can be classified as either a LOTS or a HOTS, depending on its usage. If the student applies the knowledge to an existing scenario, then it is a LOTS. However, if the student applies the knowledge in a new and different way, then it demonstrates higher–order thinking. Adapted from "Bloom's Taxonomy" by H. Coffey, 2008. Copyright 2008 by LEARN NC, School of Education, University of North Carolina at Chapel Hill. Adapted with permission.

One notable benefit of active learning is that the method can be used in a variety of courses, even those that are not commonly associated with research. Research activities in

mathematics, social sciences, and humanities courses can develop RBL skills even if the subject of the research activity differs from the course material (Brown & Hargis, 2008; Craig & Hale, 2008; Goodman, 2010). By including research activities in a variety of subject areas, students learn to use their entire body of knowledge to help solve problems instead of limiting themselves to the knowledge gained in their core concentration (Sternberg, 2008). This practice should be encouraged. Students should understand that innovative ideas stemming from other fields of study are welcomed in research, and that information and knowledge does not need to be restricted to the current course of study. This thinking is reflected in the Department of Aeronautics undergraduate capstone course, where students are required to demonstrate critical thinking by drawing from multiple sources of information in order to solve problems (Embry–Riddle Aeronautical University [ERAU], 2013).

After examining the common traits of active–learning activities, it becomes easy to see how well they align with the skills that employers look for in today's workers:

1. Critical thinking and problem solving
2. Collaboration across networks and leading by influence
3. Agility and adaptability
4. Initiative and entrepreneurship
5. Accessing and analyzing information
6. Effective oral and written communication
7. Curiosity and imagination (Wagner, 2008, Chapter 1)

Students can learn and develop these key skills by performing RBL and other active–learning activities. It is also worthy to note how Wagner's seven key skills align with the Ignite program's student learning outcomes (see Table 1). By creating research activities that follow

Ignite's student learning outcomes, teachers can help their students develop the proper behaviors and skills that businesses desire today.

Table 1

Alignment Between Ignite Student Learning Outcomes (SLOs) and Wagner's Seven Key Skills

Ignite Student Learning Outcomes	Corresponding Key Skill
SLO–1. Define and/or articulate a research problem	Critical thinking and problem solving, Initiative and entrepreneurship, Curiosity and imagination
SLO–2. Design a course of action to solve a research problem using, as appropriate, multi–disciplinary principles	Agility and adaptability
SLO–3. Apply ethical principles in research	Leading by influence
SLO–4. Conduct research independently and/or collaboratively	Collaboration across networks
SLO–5. Reach decisions or conclusions based on the analysis and synthesis of evidence	Accessing and analyzing information
SLO–6. Communicate research results	Effective oral and written communication

Note. Adapted from "Quality Enhancement Plan, 2012–2017", by Embry–Riddle Aeronautical University, 2012; and "The Global Achievement Gap: Why Even Our Best Schools Don't Teach the New Survival Skills Our Children Need—and What We Can Do About It," by T. Wagner, 2008.

Designing the Curriculum to Grow Problem Solvers

If Embry–Riddle wants to grow problem solvers for the industry, the curriculum must not only provide the tools and knowledge to perform research, but it must also help students realize their own intrinsic desire to be inquisitive and creative (Gitenstein, 2012). The need to foster each student's intrinsic desire for creativity and curiosity needs more emphasis if they are to continue using their research skills after graduation (Tsai, 2012). Knowles (1973) explains an adult's approach to learning as one that derives from an immediate need to solve a specific

problem. We can see evidence of this in our own behaviors: If we are presented with a specific problem, whether it is a serious problem or not so serious, and we do not know the answer, we search for the answer online. Alternatively, if we are trying to organize a group to do something, we coordinate efforts through social media. When we run through this process of self–directed learning and group coordination, we demonstrate many of the seven key skills that Wagner (2008) describes. What unlocks those skills is the person's intrinsic motivation to learn or to do.

Wagner (2012) describes three elements necessary to foster intrinsic motivation in students: "play, passion, and purpose" (p. 26). Play allows students to examine ideas, problems, and solutions without penalty. By engaging in play, students develop passions. They are exposed to a variety of topics and discover areas of study that intrigue them, and think nothing of the amount of analysis and research required to understand them fully. Over time, their passions develop a purpose, and they begin on work that fills a need or provides a solution to a problem that is existential and meaningful. By using the play–passion–purpose model to motivate students, teachers give students the freedom to create, to explore, and to apply the information they have learned in innovative ways.

Yew, Chng, and Schmidt (2011) showed that student learning increased by continually running students through the "cycle of problem analysis, self–directed learning, and a subsequent reporting" (p. 449). The Ignite Integration Model provides a systematic method of running students through this cycle by first assessing each student's abilities and providing remedial instruction when necessary. Once the students begin matriculation, they are assigned small research activities that familiarize the student with Ignite's Student Learning Outcomes and allow them to practice and improve their problem analysis, research, and writing skills. As they

repeat the cycle, the research activities grow more complex, eventually culminating with the capstone project that demonstrates mastery of the learning outcomes (ERAU, 2012).

However, the emphasis on play—the freedom to think creatively—is essential to this task. Time for creative thought should be allowed. The goal during this time is to help each student discover their inquisitive selves and allow them to explore ideas freely, even if the activity does not follow the typical RBL method (Fasko, 2000). Helping students develop their research skills is still necessary, but secondary. Barnett (1992) best explains the reasoning behind this:

> It is much more important that the student is given an understanding of a conceptual structure, is able to take up stances within it, to understand something of the fundamental debates taking place within it, to see the difference between sense and nonsense, and to be able to stand back and form critical evaluations of the wider social role of the form of thought. (p. 634)

Introducing Play Into Worldwide Courses

Most of Embry–Riddle's courses are already designed with the proper tools to encourage creativity, inquisitiveness, and research; those tools just need to be used in different ways in order to utilize each student's intrinsic motivation. The courses use three different tools to evaluate student performance: quizzes/tests, class discussions, and writing assignments. The quizzes and tests are good tools to evaluate the LOTS. However, the HOTS activities of the class discussions and the writing assignments are not designed to help students develop the behaviors of an inquisitive researcher. Neither of these activities (as they are currently designed) motivate the students towards creative thinking and research for two reasons: First, the activities measure the student's understanding of the course material but give very little feedback about the

student's behavior during the process. Second, the activities can shift the student's motivation from intrinsic to extrinsic if the student feels that he/she must sacrifice creativity in order to earn a high grade.

If Embry–Riddle wants their students to become successful researchers and innovators, then teachers must design research activities that emphasize the process of inquiry instead of just the product (Yew, Chng, & Schmidt, 2011). The current focus on the product instead of the process produces negative effects that become apparent when students take the undergraduate capstone course. The capstone course requires two tasks in the first two weeks. First, the students come up with a topic for their capstone. The instructor does not provide topics. Second, they must address that topic from a problem–solving viewpoint and use critical thinking and analysis skills to help solve their stated problem. For many students, this will be the first time they have been asked to think and perform in this manner because their previous courses did not motivate them to think creatively or inquisitively, nor did they help them develop problem–solving skills. Because of those deficiencies, many students do not continue past the proposal phase of the capstone course, and they drop the course or fail. Brown and Hargis (2008) elaborate:

> The typical term paper is little more than an exercise, and the typical student recognizes it as such. Few students perceive the term paper as an intellectual endeavor that should aim to produce results with inherent and enduring scholarly value. (p. 153)

Embry–Riddle can potentially fix this problem by redesigning the discussions and the paper assignments into an activity that promotes inquisitiveness and creativity along with the application of knowledge. Instead of using the discussions and the paper to evaluate the students' understanding of the course material, teachers can turn them into tools that they use in a creative or problem–solving exercise. At the beginning of the term, the instructor can combine the

students into a research–study group (or groups, depending on class size), and then task each group to come up with a creative solution that fills a course–related need or problem. The ideas can come from the instructor, the university, or, ideally, from the students themselves. Each group should work on the same problem the entire term instead of focusing on something different each module. As the term progresses, the students will be required to collaborate through the discussion boards, and near the end of the term, each group produces a report that describes their efforts and the results. This method requires the students to alternate between passive–learning and active–learning modes during the term, and the instructor should allow for these shifts and adjust their teaching style accordingly (Fasko, 2000).

Assessing Student Behavior and Outcomes

When assessing each student's performance of the inquiry activity, it is essential to remember that the instructor should be grading the student's behavior during the inquiry process, and that the student's grade should not simply be a reflection of the final product. Over–emphasizing the importance of the final product can shift the student's motivation in the wrong direction, from intrinsic to extrinsic, and discourage students from taking courses that offer creative challenges, opting instead for the higher grades that come from easier courses (Harter, 1978). Hunaiti, Grimaldi, Goven, Mootanah, & Martin (2010) elaborate:

> If the assessment is carried out not for demonstration purposes but with a learning aim in mind, then it becomes a vital part of the learning process, and as such will come with its own intrinsic motivation, rather than being a task that is carried out for an external motivation or reward or for a mark. This is an important point, because intrinsic motivation in the learning process can enhance the student's autonomy and create students who are more likely to become lifelong learners. (p. 191–192)

If Embry–Riddle wants to foster a culture of inquisitiveness in their classes, teachers must not penalize students if they explore ideas that initially seem silly, outrageous, or absurd. Fred Smith, the founder of FedEx, and the story about his term paper at Yale University, provides one famous example. Smith's professor awarded a grade of C with an accompanying note stating that, "that the idea would never work" (Reichert, 2001, p. 42). Fortunately, Smith did not discard his idea after receiving that feedback, but no one knows how many other creative ideas were abandoned because of similar feedback from instructors.

This is not to say that Embry–Riddle should eliminate all standards of performance. However, the university should set performance standards and evaluate students in a way that does not shift student motivation from intrinsic to extrinsic. To do this, teachers must change what they grade and how they grade it. Barge (2010) explains the types of assessments instructors should use in problem or project–based learning activities:

> Forms of both formative (status seminars, peer evaluation, supervisor feedback, etc.) and summative assessment (portfolio assessment, etc.) may be implemented. The greater portion of assessment activity is dedicated to formative assessments, which are designed to develop students' abilities to provide feedback to others and assess their own progress. (p. 18)

One way instructional designers can evaluate the active–learning process is by developing a rubric that evaluates the student's performance of Wagner's (2008) seven key skills: critical thinking and problem solving, collaboration across networks and leading by influence, agility and adaptability, initiative and entrepreneurship, accessing and analyzing information, effective oral and written communication, and curiosity and imagination. This rubric should evaluate each student, even in collaborative projects (Barge, 2010), and use

pass/fail scoring instead of calculated numerical scores. If teachers ask their students to be creative and then numerically score the results, then the students may sacrifice inquisitiveness in order to earn a high score. Finally, teachers should remember that the pass/fail grade should not be the only feedback the student receives. The students should get ample feedback from the instructor and their peers during the inquiry process. The goal is to help the students develop the proper behaviors and to encourage creativity without shifting their motivation in the wrong direction.

Sustaining Motivation Though Graduation and Beyond

As each student's inquisitive nature matures through play, the student will eventually discover passions for specific areas of study. These passions will then lead them toward a sense of purpose in their research (Wagner, 2012). The Ignite Integration Model promotes this transition from play to passion and purpose by providing a comprehensive, co–curricular support system that provides information on research opportunities and helps students hone their research and writing skills (ERAU, 2012). One key component is collaborative research, where students and research faculty collaborate on research projects. Dean and Kaiser (2010) offer a model for collaborative research that places the faculty member in the role of the principal investigator in the research effort, while the students fill roles as research apprentices for the principal investigator. This puts the student in direct contact with the "community of practice," (p. 43) a group of faculty principal investigators that regularly apply their research skills. The community of practice can be expanded if the university also engages with private industry to act as a research and development laboratory for developing new technologies. Philbin (2008) describes this expanded method as, "a tool by collaboration practitioners from both academia and industry in order to help facilitate new research collaborations, enhance the transfer of the resulting

technology and improve the level of innovation and value creation arising from the technology" (p. 497–498).

By including students in the interaction between research faculty and industry partners, the students can see how their research efforts have a direct impact, thus fueling their passion and focusing their purpose. This kind of collaboration also helps the students learn the research process as they observe the direct application of research methods by the faculty principal investigators. However, it is important to note that faculty principal investigators can have a significant positive or negative effect on the student's motivation. Hu, Kuh, and Gayles (2007) explain the significance of the student–faculty relationship in collaborative research:

> In terms of doing research with a faculty member, the impact of the experience surely must depend on the quality of the relationship between student and faculty member, the length and nature of the research project, the role of the student, and the nature and frequency of feedback the student receives during the endeavor. (Discussion section, para. 5)

As students transition from curricular to co–curricular research, the university may enforce more rigorous standards for performance and grading, but it must conduct these activities in a manner that sustains each student's intrinsic motivation. Otherwise, the experience may deter the student from conducting research after graduation. For example, as each student discovers their passion, they may want to examine the same subject from a different point of view. If this happens, Embry–Riddle must not be overly zealous in their enforcement of the self–plagiarism rules. Otherwise, the desire to stay out of trouble becomes an overriding extrinsic motivator. The university should continue to prohibit students from reusing papers in different

courses, but should not discourage students from building a body of research about a particular subject.

Finally, it is important to note that the university may not have enough co–curricular opportunities to accommodate all students enrolled in Worldwide. If applying for co–curricular activities becomes a competitive process, the university should distinguish between students who are intelligent and students who are creative, and favor the latter. Research by Gomez (2007) found a relationship between intelligence and creativity, but not necessarily a correlation, stating that,

> Perhaps the most prevailing view today is that beyond a minimum level of intelligence necessary for mastery in a given field, additional intelligence offers no guarantee of a corresponding increase in creativity. The idea that the more intelligent individual is necessarily the most creative person is fallacious. (p. 32)

One criterion that the university can use to make the distinction is the student's SAT verbal score, where Noftle and Robins (2007) found that "being a verbally intelligent individual has more to do with being creative, imaginative, and inquisitive than it does with being hard working, organized, and industrious" (p. 127).

Conclusion

Embry–Riddle has the capability to produce graduates who can help solve the problems the aviation industry will face in the coming years. Their graduates should be educationally well rounded, technically competent, and naturally inquisitive. They should also have the knowledge, skills, and ability to conduct research that will benefit the aviation industry. However, the motivation to do so must come from within. By introducing creative–learning activities in undergraduate courses, giving students the creative license to explore ideas, and then focusing

the scope of those activities over time, their graduates will gain a reputation of being critical thinkers and innovative problem solvers. That recognition will also bring credit upon the university, and may create more opportunities for the university to engage in collaborative research, thus creating more opportunities for the students to make a meaningful impact on the industry.

References

Abdullah, M. H. (2001). Self–directed learning. *ERIC Digests*. Retrieved from http://www.eric.ed.gov/PDFS/ED459458.pdf

Air Washington. (2012, January 25). *Air Washington executive advisory board meeting minutes*. Everett, WA: Author. Retrieved from http://www.a2m2.net/documents/airwashingtonadvisoryminutesjan25.pdf

American Management Association. (2010). *AMA 2010 critical skills survey*. New York: Author. Retrieved from http://www.amanet.org/training/articles/3727.aspx

Annerstedt, C., Garza, D., Huang–DeVoss, C., Lindh, J. and Rydmark, M. (2010). Research–able through problem–based learning. *Journal of the Scholarship of Teaching and Learning, 10*(2), 107–127. Retrieved from http://www.eric.ed.gov/PDFS/EJ890734.pdf

Barge, S. (2010). *Principles of problem and project based learning: The Aalborg PBL model*. Retrieved from http://files.portal.aau.dk/filesharing/download?filename=aau/aau/2010/~/pub/PBL_aalborg_modellen.pdf

Barnett, R. (1992). Linking teaching and research: A critical inquiry. *Journal of Higher Education, 63*(6), 619–636. Retrieved from http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/205307848

Bonwell, C. C., & Eison, J. A. (1991). Active learning: Creating excitement in the classroom. *ERIC Digest*. Retrieved from http://www.eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=ED340272

Breen, R. & Lindsay, R. (1999). Academic research and student motivation. *Studies in Higher Education, 24*(1), 75–93. Retrieved from

http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/219580091?accountid=27203

Brown, P. S., & Hargis, J. (2008). Undergraduate research in art history using project based learning. *Journal of Faculty Development, 22*(2). Retrieved from http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/214586915

Carder, L., Willingham, P., & Bibb, D. (2001). Case–based, problem–based learning: Information literacy for the real world. *Research Strategies, 18*(3), 181–190. doi: 10.1016/S0734–3310(02)00087–3

Coffey, H. (2008). *Bloom's taxonomy*. Retrieved from http://www.learnnc.org/lp/pages/4719

Collins, A. (2006). How society can foster self–directed learning. *Human Development, 49*, 225–228. doi: 10.1159/000094369

Craig, J., & Hale, S. (2008). Implementing problem–based learning in politics. *European Political Science: EPS, 7*(2), 165–174. doi: 10.1057/eps.2008.6

Dean, J. M., & Kaiser, M. L. (2010). Faculty–student collaborative research in the humanities. *CUR Quarterly, 30*(3), 43–47. Retrieved from http://www.cur.org/download.aspx?id=194

Embry–Riddle Aeronautical University. (2012). *Quality enhancement plan, 2012–2017*. Retrieved from http://spa.erau.edu/Resources/QEP/FINALQEP.pdf

Embry–Riddle Aeronautical University. (2013). *ASCI 490 course outline/faculty guide*. Retrieved from https://ernie.erau.edu/dav_portal/portal/faculty/worldwide/course–guides/files/undergraduate–cg/asci–490–cg–2013b.doc

Fasko, D., Jr. (2000). Education and creativity. *Creativity Research Journal, 13*(3 & 4), 317–327. Retrieved from http://deved.org/library/sites/default/files/library/education_and_creativity.pdf

Felder, R. M. & Brent, R. (2009). Active learning: An introduction. *ASQ Higher Education Brief, 2*(4). Retrieved from http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/ALpaper(ASQ).pdf

Gitenstein, R. B. (2012, September 17). Colleges must produce not only technicians, but thinkers and problem–solvers [Letter to the editor]. *Chronicle of Higher Education*. Retrieved from http://chronicle.com/article/Colleges–Must–Produce–Not–Only/134494/

Gomez, J. G. (2007). What do we know about creativity? *The Journal of Effective Teaching, 7*(1), 31–43. Retrieved from http://uncw.edu/cte/et/articles/vol7_1/Gomez.pdf

Goodman, R. B. (2010). Problem–based learning: Merging of economics and mathematics. *Journal of Economics and Finance, 34*(4), 477–483. Retrieved from http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/887542912?accountid=27203

Hamilton, A. (2007). Lutheranism: Word and faith. In *Christianity's family tree: What other Christians believe and why* (pp. 43–57). Nashville: Abingdon Press.

Harter, S. (1978). Pleasure derived from challenge and the effects of receiving grades on children's difficulty level choices. *Child Development, 49*(3), 788–799. Retrieved from http://www.jstor.org/stable/1128249

Hu, S., Kuh, G. D., & Gayles, J. G. (2007). Engaging undergraduate students in research activities: Are research universities doing a better job? *Innovative Higher Education, 32*(3), 167–177. doi: 10.1007/s10755–007–9043–y

Hunaiti, Z., Grimaldi, S., Goven, D., Mootanah, R., & Martin, L. (2010). Principles of assessment for project and research based learning. *International Journal of Educational Management, 24*(3), 189–203. doi: 10.1108/09513541011031574

Karkockiene, D. (2005). Creativity: Can it be trained? A scientific educology of creativity. *International Journal of Educology, Lithuanian Special Issue,* 51–58. Retrieved from http://www.eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=ED494897

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem–based, experiential, and inquiry–based teaching. *Educational Psychologist, 41*(2), 75–86. doi: 10.1207/s15326985ep4102_1

Knowles, M. (1973). *The adult learner: A neglected species*. Retrieved from http://www.eric.ed.gov/ERICWebPortal/contentdelivery/servlet/ERICServlet?accno=ED084368

Noftle, E. E. & Robins, R. W. (2007). Personality predictors of academic outcomes: Big five correlates of GPA and SAT scores. *Journal of Personality and Social Psychology, 93*(1), 116–130. doi: 10.1037/0022–3514.93.1.116

Philbin, S. (2008). Process model for university–industry research collaboration. *European Journal of Innovation Management, 11*(4), 488–521. doi: 10.1108/14601060810911138

Ramsey, D. (2009). Introduction. In *The total money makeover: A proven plan for financial fitness* (3rd ed., p. ix). Nashville, TN: Thomas Nelson.

Reichert, B. (2001). A review of overnight success: Federal Express and its renegade creator. *Journal of Business Leadership, 11*, 33–58. Retrieved from http://www.anbhf.org/pdf/reichert.pdf

Savery, J. R. (2006). Overview of problem–based learning: Definitions and distinctions. *Interdisciplinary Journal of Problem–based Learning, 1*(1). Retrieved from http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1002&context=ijpbl

Shaban, K. B., & Abdulwahed, M. (2012, August). *Research–based learning in computing courses for senior engineering students*. Paper presented at the 2012 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TALE), Hong Kong. doi: 10.1109/TALE.2012.6360355

Sternberg, R. J. (2008). Interdisciplinary problem–based learning: An alternative to traditional majors and minors. *Liberal Education, 94*(1), 12. Retrieved from http://search.proquest.com.ezproxy.libproxy.db.erau.edu/docview/209824623/fulltextPDF?accountid=27203

Tsai, K. C. (2012). The necessity of creativity development in adult learners for lifelong learning. *International Journal of Learning and Development, 2*(4), 170. doi: 10.5296/ijld.v2i4.2114

Wagner, T. (2008). *The global achievement gap: Why even our best schools don't teach the new survival skills our children need—and what we can do about it*. New York: Basic Books.

Wagner, T. (2012). *Creating innovators: The making of young people who will change the world* [Amazon Kindle edition]. Retrieved from http://www.amazon.com/Creating–Innovators–Making–People–Change/dp/1451611498

Yew, E. H. J, Chng, E., & Schmidt, H. G. (2011). Is learning in problem–based learning cumulative? *Advances in Health Sciences Education, 16,* 449–464. doi: 10.1007/s10459–010–9267–y

Appendix
Resources for Instructors and Instructional Designers

There is a vast amount of information promoting inquiry and research in higher education, but information about strategies for implementing these exercises is necessary as well. The following is a list of resources that can help instructors and instructional designers in a variety of disciplines tap into their students' intrinsic motivation and create a culture of inquisitiveness, creativity, and research.

Brown, D. & Osman Yürekli, O. (2006). Integrating inquiry/discovery based activities into the mathematics curriculum. *Mathematicians and Education Reform Newsletter, 19*(1). Retrieved from http faculty.ithaca.edu dabrown docs scholar ER.pdf

Careers Research and Advisory Centre. (n.d.). *Vitae: Realizing the potential of researchers*. Retrieved from http://www.vitae.ac.uk/researchers/169081/Researcher–booklets.html

Carrol, J. M., & Borge, M. (2007). Articulating case–based learning outcomes and assessment. *International Journal of Teaching and Case Studies, 1*(1/2), 33–49. Retrieved from http://itol.org/bakup/uploads/images/articles/Articulating%20case–based%20learning%20outcomes%20and%20assessment.pdf

Cartwright, N. (2012). *Research based learning: A coastal engineering case study*. Paper presented at the meeting of the Australasian Association for Engineering Education 2012 conference, Melbourne, Australia. Retrieved from http://www.aaee.com.au/conferences/2012/documents/abstracts/aaee2012–submission–32.pdf

Cheaney, J. & Ingebritsen, T. S. (2005, November). Problem–based learning in an online course: A case study. *International Review of Research in Open and Distance Learning*. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/267/433

Cleese, J. (1991). A lecture on creativity [Video file]. Retrieved from http://youtu.be/f9rtmxJrKwc

Cole, D. G., Sugioka, H. L., & Yamagata–Lynch, L. C. (1999). Supportive classroom environments for creativity in higher education. *Journal of Creative Behavior, 33*(4), 277–293. Retrieved from http://deved.org/library/sites/default/files/library/classroom_environments_for_creativity_in_higher_education.pdf

Edelson, D. C, Gordin, D. N., & Pea, R. D. (1999). Addressing the challenges of inquiry–based learning through technology and curriculum design. *Journal of the Learning Sciences, 8*(3–4), 391–450. Retrieved from http://www.worldwatcher.northwestern.edu/userdownloads/pdf/JLSEdelsonetal.pdf

Loehle, C. (1990). A guide to increased creativity in research—inspiration or perspiration? *Bioscience, 40*(2), 123. Retrieved from http://users.cms.caltech.edu/~keenan/creativity.pdf

Marcus, G., Taylor, R., & Ellis, R. A. (2004). *Implications for the design of online case based learning activities based on the student blended learning experience*. Paper presented at the ASCILITE 2004 conference in Perth, Australia. Retrieved from http://www.ascilite.org.au/conferences/perth04/procs/pdf/marcus.pdf

Vajoczki, S., Watt, S., Vine, M. M., & Liao, X. R (2011). Inquiry learning: Level, discipline, class size, what matters? *International Journal for the Scholarship of Teaching and Learning, 5*(1). Retrieved from http://academics.georgiasouthern.edu/ijsotl/v5n1/articles/PDFs/_Vajoczki_et_al.pdf

SECTION B

Empowering Research through a Strategic Mentoring Program

Dr. Heather L Garten

Embry-Riddle Aeronautical University – Worldwide

Author Note

Heather L. Garten, College of Arts and Sciences, Embry-Riddle Aeronautical University – Worldwide.

Correspondence concerning this article should be sent to Heather L. Garten via Email: gartenh@erau.edu

ABSTRACT

Embry-Riddle Aeronautical University Worldwide has campuses all over the world, including 90 military bases, in addition to offering several innovative methods of online learning. With this type of extensive campus, both mentoring and research can become difficult, leaving students without the necessary guidance to succeed. This paper outlines all the critical steps in establishing The Embry-Riddle Worldwide Mentoring Institute from attracting and retaining industry leadership to the unique leadership needed to implement this research-based institute. With the dynamic structural change at Embry-Riddle Worldwide allocating additional teaching resources in addition to Ignite's mission, now is the time to create such an institute.

Empowering Research through The Mentoring Institute: Motivation

Embry-Riddle Aeronautical University Worldwide has campuses all across the globe, in addition to a large student population strictly utilizing online instruction. This poses a great challenge for Embry-Riddle Aeronautical University Worldwide leadership: How to ensure all students have the opportunity to work with field experts in support of Ignite's mission?

Unlike a traditional liberal arts college/university, Embry-Riddle Worldwide has a focused mission: Embry-Riddle is the leader in Aeronautics Education. The Aviation Industry is one of the most dynamic industries and will continue to expand in unpredictable ways. As with the expansion of Embry-Riddle Worldwide's student body, this unpredictable expansion poses a large challenge for Embry-Riddle Worldwide' prestigious reputation. The only way for Embry-Riddle Worldwide to remain on the forefront of the Aviation Industry is to develop and grow strategic industry partnerships that immediately impact educational practices. Given the emphasis on accreditation and the stringent accreditation requirements, this type of structure is impossible when traditional avenues are utilized.

Thus Embry-Riddle Worldwide faces two pressing challenges: How to academically engage students in the most recent aviation advancements and continue to exceed accreditation requirements, such as those goals reflected in Ignite. Fortunately these challenges have an ingenious solution, benefiting all parties involved: Creating a Mentoring Institution that bridges the gap between industry and education through research.

There are mentoring programs for all industries from retail to healthcare to manufacturing (A New Chapter, 2010). Some of the most comprehensive mentoring programs are those that retain characteristics inherent in trade schools and apprenticeships. Unfortunately most educational institutions today lack the industry-specific, hands-on mentoring that trade schools

offered and continue to offer, thus making trade schools a powerful workforce entity (DeFilippo, 2010).

One of the most prominent North American trade schools is the Newport News Apprentice School. The Newport News Apprentice School began in 1919 and has been fully accredited since 1982. Currently owned by Newport News Shipbuilding, part of Huntington Ingalls Industries, the school is projected to continue strong given the over 70 million dollars Huntington Ingalls is investing in downtown Newport News (Crafting, 2012). The Apprentice School enduring success combines both education and employment as students are simultaneously enrolled in the school and employed at Newport News Shipbuilding. Students are mentored both in the classroom and on the job front; the most important part of this is to realize the mentoring is simultaneous (The Apprentice School, n.d.).

Mr. Steve Garten graduated the Apprentice School in 1975, and since then has held a position at every stage of the manufacturing industry: From floor man to trainer to manager to human resources to executive leadership to entrepreneur. Working with top companies such as Lockheed Martin, Northrup Grumman, Raytheon, and NASA, Mr. Garten clearly sees the lack of mentoring in education today opposed to his own education, which has been continuous since he first entered the Apprentice School. Speaking candidly, Mr. Garten explains that:

> Graduates from college may be able to hold a conversation at a cocktail party, but they cannot talk machining let alone actually perform the needed tasks. Moreover, the attitudes of superiority, due much to our current society's beliefs surrounding college education, presents an even greater challenge for Leadership such as myself to mentor these potential future leaders. Their technology skills are great, and I would love to harness them, but with the lack of hand-on skills coupled with an ego it is difficult for me

> draw this knowledge out of the young talent let alone teach them the necessary skills to succeed in manufacturing today (S. Garten, personal communication, June 13, 2013).

Mr. Garten went on to describe the ideal educational setting for the future of manufacturing, highlighting mentoring:

> Educational institutions today need to embrace the structure of the Apprentice School and successfully mold the two models. We need two types of mentoring: Those experienced Manufacturing Leaders to mentor the college graduates on how to use their skills, and the college graduates to impress leadership through their ability to clearly transfer their knowledge to us through reverse mentoring. I have spent more time teaching myself technology that could have been saved if my junior team members would have been receptive to the ingenuity of a mentoring partnership (S. Garten, personal communication, June 13, 2013).

From an industry point-of-view, the ability to apply an idea and reap a positive ROI is crucial. Moreover, from an economic point-of-view, we need more entrepreneurial leaders that can surpass the rapidly changing world by generating and implementing ideas. Although imposed restrictions often limit the conscious growth of evolution, a mentoring program can create a dynamic leverage that can be utilized when industry is barred from implementation and conversely when education faces imposed curriculum restrictions. The power of reverse mentoring cannot be overlooked and, with the continual changes in technology, is a vital component of any mentoring relationship (Kulesza & Smith, 2013).

The following events demonstrate how a mentoring partnership between industry and educational leaders can change a problem into an opportunity through research, clearly demonstrating the need for Ignite.

Example: Industry Utilizing Educational Partners.

Recently the Boeing 787 Battery Fire demonstrated how innovation (in this case the use of composite materials) can instantly receive much negative press, endangering the much needed advancement of manufacturing in aviation. This incident demonstrates a huge challenge industry faces: In light of many successes, one failure can lead to drastic actions causing severe economic consequences. Boeing, which has strong educational ties, began immediately investigating the incident with the help of the educational community. An Embry-Riddle Worldwide graduate student chose this topic for his thesis, and found a sleuth of mentors throughout the duration of his capstone project as researchers from Boeing, supporting industries, and educational institutions collaborated to find a solution to the challenge faced by Boeing. The Embry-Riddle Worldwide student was able to work with leaders from other educational institutions in addition to Embry-Riddle Worldwide, all of which served as mentors to this student. The student contributed to the research effort to ensuring the safety of composite materials, earned his aste r's degree, and is now using his capstone project as the basis for his PhD dissertation.

This example of an industry and educational partnership demonstrates the power of the combined entity. Moreover, the aste r's student benefited greatly as he naturally inherited industry mentors in addition to his academic mentors. Being able to see how his theoretical work applied in industry, the student was inspired to continue his education and enroll in the Embry-Riddle Worldwide PhD program. This is a very important point: The student was not planning to continue his education prior to obtaining strong mentors from both industry and education. These mentors guided the student, without pressure, to explore the possibilities of his work, and the student realized he could continue learning while being an integral part of industry.

Embry-Riddle Worldwide's Military Population

A large portion of Embry-Riddle Worldwide students are active military due to Embry-Riddle's mission and the flexible learning platforms of Embry-Riddle Worldwide. Military personal differ from typical students in several ways: Military students are typically in hostile/remote areas, plan to continue their military career versus obtain a position in industry and, as with many adult learners, are often timid about higher education. Thus Embry-Riddle Worldwide industry mentors must include the Department of Defense employees and the appropriate subcontractors.

Given Embry-Riddle Worldwide's technological capabilities, the goal is to find mentors in remote areas where Embry-Riddle students and campuses are located. Furthermore, Embry-Riddle Worldwide must create ways to reward these remote mentors, ensuring the mentors benefit as much as the students from this relationship. As with any caregivers, especially those within the military and/or Department of Defense, the work related stress often carries over into personal relationships, a component that is not wanted in a mentoring relationship. In order to address all military student and mentor needs, emphasis must be placed on creating a positive and safe mentoring environment that also addresses these hostile issues the military faces (Military Mentoring, 1993).

Embry-Riddle Worldwide Mentoring Capabilities

Embry-Riddle Worldwide alumni are dedicated to Embry-Riddle Worldwide's mission, and continue to support Embry-Riddle Worldwide at conferences, through speaking engagements, and assuming instructor roles at Embry-Riddle Worldwide. These alumni have expressed a great interest in a mentoring program between at Embry-Riddle Worldwide. However, the majority of the mentoring would be on a volunteer-basis since a large majority of

these companies have yet to adopt a volunteer/mentoring program. Thus the mentoring platform must be convenient, easy to navigate, and easily accessible.

Blackboard. Embry-Riddle Worldwide utilizes the Blackboard platform for all its online courses, and is easily adaptable to a mentoring program. The Blackboard platform allows for a group of mentors to respond to questions posed by students in a discussion board format so that all users can benefit from the question and answer. Additionally Blackboard has a built-in wiki and blog function, allowing mentors to create their own blogs for students to follow. Additionally email is built into the Blackboard platform, which proves to be an easy and quick means of communication (Brotherton, 2001).

Benefit to mentors. Mentors themselves are creating a network through this mentoring process. oreover, any writings (including blogs) are the mentor's personal property, therefore offering a creative outlet that is typically not found within the workplace. Keeping the content in Blackboard assures that mentors will be paired only with Embry-Riddle Worldwide students, and that students will be receptive as all Embry-Riddle Worldwide students utilize Blackboard. Finally the importance of reverse mentoring must be stressed to the mentors. Having direct communication with students and educational leadership enables the mentors to receive necessary mentoring that may be lacking in their workplace.

Pairing mentors and students. Pairing mentors to specific Blackboard sites can be done in a variety of ways. First mentors can be assigned by employer. Many Embry-Riddle Worldwide students have specific ideas on which businesses they would like to work for, and thus performing a quick search for that specific business on Blackboard would be very convenient. Second it may be more beneficial to pair mentors by their field of expertise, or even their Embry-Riddle degree. There are various choices here, all of which will be explored to

determine an optimal arrangement for mentors and mentees. Optimally each mentor would have his/her own Blackboard site enabling students to search for a mentor through several fields such a place of employment, degree, etc. This broader search structure also allows students to gain an interconnected view of education and industry, and the unlimited diversity of a single degree. Moreover, this fully supports and promotes the interdisciplinary goal of Ignite.

There are numerous methods available to match mentors to students from personality tests to oral recommendations. Furthermore psychological factors must also be considered, such as those specific to military students, adult students, and truly all students as each has their own unique needs (Ishiyama 2007). Employing a personality test or any other pairing mechanism would take additional time; given students actually respond to these tests. Since the goal of The Mentoring Institute is to allow students to explore different possibilities to find the optimal mentoring relationship for their needs, initial pairing would be left up to the students, the entor ing Institute's Leadership, and the Industry entor s. Thus the mentoring program is designed with ultimate flexibility and options. Students are encouraged to explore all the mentors to invoke curiosity outside their specific degree curriculum, thus facilitating multidisciplinary research.

Growing the relationship. It is anticipated there will be students who wish to work with the mentor beyond the capabilities of Blackboard. The choice is left to the mentor, and students are made aware of the limited availability of the mentor. If a student and a mentor agree to undertake a joint project, discuss further job duties, etc., Embry-Riddle Worldwide offers EagleVision, an online conferencing tool powered by Saba. EagleVision offers face-to-face conferencing, document sharing, slide presentation, whiteboard use, and much more. Note all sessions using this tool are recorded, and can be viewed as needed.

Industry benefits. Learning from the Apprentice School model, it is imperative that students use the skills learned in the classroom in applied problems. The Embry-Riddle Worldwide Mentoring Institute takes this one step further by integrating problems facing industry into the curriculum. This has numerous benefits for all parties involved: Industry is now partnering with research professionals, Industry is obtaining a fresh perspective on problems without the labor costs, mentors have the opportunity for advancement in their workplace when success is reached on a given problem, students experience first-hand what it is like to work for a company without any commitment, and most importantly, society benefits from the uniquely creative solutions. Here is case example to explicitly explain these intricate relationships.

Case Example: Industry

Mentor. Suppose E.R. Industry is a graduate of Embry-Riddle Aeronautical University and is a current employee of Industry. Mr. E.R. Industry has been doing extensive research and investigation regarding the current Boeing battery fire incident, and thus composite materials.

Course. Dr. University is teaching Math 412: Probability and Statistics, and integrating actual data into the course. Students will be guided on how to use statistical analysis to interpret this data, while encouraged to explore the data and look for any patterns that may prevail.

Procedure. Dr. University stays in contact with E.R. Industry throughout the duration of the data analysis. Given E.R. Industry's feedback, Dr. University modifies the data analysis as needed.

Students are introduced to E.R. Industry and E.R. Industry is given access to the Math 412 Blackboard site (this is not the same site E.R. Industry would use for mentoring purposes).

Results. Dr. University will ensure E.R. Industry has all analysis results, and will work with E.R. Industry to prepare results for presentation. Furthermore, given a superior level of

achievement by students, Dr. University will facilitate undergraduate research with the student and E.R. Industry and/or another representative from Industry.

Reflection. Clearly this type of relationship that utilizes actual industry problems has potential far greater than the outline above. Note that the amount of time E.R. Industry spends with the ath 412 c ourse is flexible and conducive to E.R. Industry's schedule. Furthermore students are performing analysis that has the potential to greatly alleviate Industry's workload and, most importantly, offer a unique perspective unattainable through any other means.

Students in Math 412 will gain an immediate understanding of industry, interaction with at least one industry expert, and exposure to the workplace environment without ever leaving their computer. Furthermore students have to opportunity to expand their work into a research paper, which will prepare them for the workplace and /or graduate school.

Case Example: Military

Mentor. Suppose E.R. Military is enlisted in the United States Military, and is a former graduate of Embry-Riddle Worldwide (or Embry-Riddle Aeronautical University Daytona Beach or Prescott Campus). E.R. Military is facing a critical problem: Increased global temperature and seemingly unpredictable weather patterns continually delay strategic action. These delays deplete resources, including human resources, and thus must be resolved.

Course. Dr. University is teaching Math 250: Calculus 1, which focuses on rates of change (derivatives). Dr. University, utilizing the Blackboard discussion board assignments, integrates E.R. i litary's problems into the course. First students investigate atmospheric conditions (specifically Carbon Dioxide levels) by creating a linear model that will predict the level of CO_2 at a point in the near future. Second students will research the temperature for a specific location in E.R. i litary's AOR (Area of Responsibility), and, using rates of change

determine whether there is significant evidence suggesting an increase in temperature. Third, for this same location within the AOR, students will model weather patterns and determine whether there is evidence that the overall weather patterns are changing. Fourth, students will compile this data, and using the skills learned in Math 250, make suggestions for E.R. Military as to the optimal time to conduct military activity.

Procedure. Students are introduced to E.R. Military in the Start Here portion of Blackboard, and E.R. Military is given access to the Math 250 Blackboard site (this is not the same site E.R. Military would use for mentoring purposes).

Dr. University stays in contact with E.R. Military throughout the duration of the course to obtain the most relevant data including additional concerns E.R. Military may want students to address. Given E.R. i litary's feedback, Dr. University modifies the direction of the discussion board.

Results. Dr. University will ensure E.R. Military has all analysis results, and will work with E.R. Military to prepare results for presentation. Furthermore, given a superior level of achievement by students, Dr. University will facilitate undergraduate research with the student and E.R. i litary and or another representative from E.R. i litary's unit.

Reflection. Clearly this type of relationship that utilizes actual industry problems has potential far greater than the outline above. Note that the amount of time E.R. Military spends with the ath 250 c ourse is flexible and conducive to E.R. ilitary's unpredictable and dynamic schedule. Furthermore students are performing analysis that E.R. ilitary's unit needs, often due to severe military budget cuts that depletes the unit's much needed manpower (Viljoen, 2005).

Students in Math 250 will gain an immediate understanding of the i litary's crucial role and hostile conditions, which of which are never seen in the classroom. Furthermore students have to opportunity to expand their work into a research paper and possible include members of E.R. ilitary's unit, thus providing much needed positive motivation to those serving, including reverse mentoring. This research collaboration will prepare the Math 250 students and E.R. Military and/or his participating unit members for future leadership roles.

Mentoring and Research: A University-Wide Bridge

The level of problems incorporated into the courses will vary. Some will be relatively straight forward in a basic mathematics course where other problems will be research heavy. The two preceding examples use a mathematics courses as a foundation, yet clearly additional academic specialties apply.

The problem faced by E.R. Industry could also be used in Embry-Riddle Worldwide's Fire Sciences courses, Engineering Courses, and Economic Courses. Similarly, the problem posed by E.R. Military would fit nicely into a Weather, Physics, and Engineering Course. The ultimate goal is to create a curriculum that spans as many colleges at Embry-Riddle Worldwide as possible to ensure students success. Therefore an added benefit of this type of mentoring program is that it serves as a structural basis for a bridge uniting academic departments across the university. In industry every department must be able to communicate effectively to ensure a successful final product. This communication breaks down in most educational institutions (as it does often in industry) as educational institutions continue to segregate departments and add additional layers through stringent degree requirements (Evans, 2008).

Application of Research Skills for both Faculty and Students

The Embry-Riddle Worldwide Mentoring Institute fully supports the Ignite Mission at Embry-Riddle Worldwide: As stated in the Executive Summary of Quality Enhancement Plan 2012-2017 Ignite document, "Faculty and staff will engage students in scholarly activities and facilitate research through curricular or co-curricular learning opportunities," and "Students will obtain the skills to investigate hypotheses, solve problems and advance knowledge utilizing various disciplines." First and foremost The Mentoring Institute creates a myriad of possibilities for co-curricular learning opportunities for both the faculty and student body at Embry-Riddle Worldwide. The faculty, students, and industry partners have complete flexibility on the depth and scope of the research. By being cross-disciplinary in their inherent nature, industry research problems will naturally provide faculty and staff opportunities for strategic partnership between the newly developed colleges at Embry-Riddle Worldwide. As the previous examples demonstrated, industry research problems demand the ingenuity found only by employing a multi-disciplinary approach. Thus students have an exciting opportunity to expand their problem solving skills and knowledge through the need of interdisciplinary solutions.

Applying the Ignite Research Model

The Mentoring Institute will follow the Ignite Research Model when implementing problems into the course discussion boards and/or through independent research between the industry mentor and the students/faculty. First and foremost industry leaders (or perhaps faculty/students who have identified an industry problem through their own research) will define and/or articulate a research problem. Next, using the discussion boards (for research problems that are integrated into the courses), faculty will design a course of action to solve a research problem using, as appropriate, multi-disciplinary principles. The Director of the

Mentoring Institute will facilitate this as needed by mentoring faculty. Once a course of action is instated, guidelines will be developed to ensure ethical principles in research are practiced at all times. These guidelines will be clearly communicated to the Industry Partner to ensure the research is deemed scholarly and thus has the potential to expand far beyond the given project. Next the research will commence, and students and faculty, with the guidance of the Industry Partner will conduct research both independently and collaboratively (discussion boards). For problems that are integrated across disciplines, students from all disciplines involved will have access to discussion board of the sister courses. There are fine details to examine here that can easily be addressed through the cooperation of leadership. As with any research project, faculty will guide students to reach decisions or conclusions based on the analysis and synthesis of evidence. Finally the research results will be communicated to the industry mentor, and the need for further research, collaboration, possible student internship, etc. will be explored. Clearly the Mentoring Institute supports the Ignite Model.

The Critical Leadership Needed for the Mentoring Institute

Embry-Riddle Worldwide must develop the appropriate structure to grow and foster The Mentoring Institute. A balance of strategic business acumen, technical expertise (including extensive hands-on industry work experience), and strong, innovative leadership that is empathetic to both Industry (business) and Educational challenges is pertinent. Furthermore, this leadership must have a broad spectrum of knowledge that enables the easement of industry problems into ERAU Worldwide courses across disciplines and colleges. The leadership must be an accomplished researcher and life-long learner, able to balance the academic research and publication aspect. Finally, this leader must have a background working with Military personnel and Department of Defense Contractors to ensure the Military environment is understood and

accommodated appropriately. The unlimited potential of this program depends solely on its leadership.

Conclusion

With the rapid increase in technological advancements, students of all races, ages, gender, and even socioeconomic background have the opportunity to learn about any subject at any time. The challenge is to ensure students have the proper guidance to expand and utilize what they learn to become the leaders of tomorrow through today's education. The unique structure of the Embry-Riddle Worldwide Mentoring Institute empowers students to become future leaders by igniting research through mentoring (Murphy, 2012).

References

Brotherton, P. (2001). Students connect with mentors through e-mail. *Techniques, 76*(8), 38-40.

A New Chapter. (2010). *Nursing Standard, 25*(14), 63.

Crafting the next generation of shipbuilders. (2012). *Marine Log, 117*(9), S10-S11.

DeFilippo, D. (2010). Mentoring. *Leadership Excellence, 27*(9), 16.

Evans, J. (2008). Mentoring magic. *The Scientist, 22*(12), 70-72.

Ishiyama, J. (2007). Expectations and Perceptions of Undergraduate Research Mentoring: Comparing First Generation, Low Income White/Caucasian and African American Students. *College Student Journal, 41*(3), 540-549.

Kulesza, C. S. & Smith, D. (2013). Reverse mentoring- something for everyone! *Strategic Finance, 94*(10), 21-23,63.

Military Mentoring. (1993). *The Science Teacher, 60*(2), 42.

Murphy, Wendy (2012). Reverse mentoring at work: Fostering cross-generational learning and developing millennial leaders. *Human Resource Management*, *51*(4), 549-573

The Apprentice School (n.d.). Retrieved from http://www.apprenticeschool.com/index.html

Viljoen, C. (2005). Mentoring. *Accountancy SA* ,21.

SECTION C

Biometrics for Authentication/Monitoring Academic Integrity: Surveying ERAU-W Student Acceptance and Insights

David D. Hernandez

Embry-Riddle Aeronautical University – Worldwide

Author Note

David D. Hernandez, College of Aeronautics, Embry-Riddle Aeronautical University – Worldwide.

The author wishes to convey special thanks to: Anne Marie Casey, Kathleen Citro, Bruce Conway, Heather Garten, Amy Jefts, Wendi Kappers, Robin Lawther, Joseph Mondello and the ERAU IT Team, Katherine Moran, Ian McAndrew, Kevin Norris, Patricia Puzzo, Jason Ruckert, Todd Smith, and Rebecca Vasquez - all of whom either shared ideas that were incorporated into the publication of this paper or assisted in obtaining student response to the survey.

Correspondence concerning their article should be sent to David Hernandez via Email: hernad17@erau.edu

ABSTRACT

A confidential survey, mirroring a previous study, was used to investigate the effect of demographic differences in ERAU-W's student body on authentication/monitoring – directly applicable to Ignite as it relates to remote modalities. Over 8,000 randomly selected ERAU-W students – both graduate and undergraduate – were invited to participate. After an introduction, with definitions and basic concepts, students answered 11 questions online. The study attempted to differentiate between student acceptance of biometrics for academic integrity as implemented by the University and the same implemented by a third party partner. Additionally, the study investigated differences in perception of video/audio-based monitoring versus non-visual

sensors. The author investigated correlations between age, military status, gender, and graduate/undergraduate status, respectively, and the specific preferences expressed in the survey. The selected sample of ERAU-W's student body exhibited negativity toward third party implementation, but not with the same intensity as the previous study. Students revealed a predilection for fingerprint-based biometrics over video/audio monitoring.

Introduction

With the topic of this year's Bollinger Rosado Teaching and Learning Effectiveness Symposium being "Research-Based Learning" and a recent focus on promoting research activities which are embedded within the courses taught in the various Embry-Riddle – Worldwide (ERAU-W) modalities, it is important to consider how this shift towards student research will be affected by the remote-learning concept that ERAU-W continues to encourage and refine. The ERAU Ignite Integration Model (Embry-Riddle Aeronautical University, 2012), which at its core is meant to create a research-supportive culture, faces unique challenges when combined with remote-learning. A critical component in promoting a research mindset, as well as expanding and enhancing the aviation-related courses offered by ERAU-W, will be the ability to provide foster an environment that supports academic integrity. This capability affects not only the perception of fairness and equity among students but also the reputation of the University and the overall validity of online course offerings. It is becoming increasingly clear in the online delivery of courses that mirroring standard, brick-and-mortar methods of maintaining academic integrity is insufficient. Stated succinctly by Semple, Hatala, Franks, and Rossi (2011),

> The reality is that some college students cheat in face-to-face classrooms; however, the potential for on-line fraud exceeds that of traditional classroom protocols. Because of reduced personal contact, on-line teaching requires additional ways to prevent cheating and to authenticate authorship of course submissions. (p. 181)

As Embry-Riddle continues to expand degree offerings, the ability to conduct laboratory work remotely via *virtual labs* currently in development and the availability of electronic textbooks and primary source materials will become increasingly important. In attempting to establish a remote undergraduate engineering program through the "2+2" initiative and, more

recently, the Associate of Science in Engineering degree program, it is apparent that ABET, Inc. accreditation (ABET Engineering Accreditation Commission, 2012) is dependent on the integration of research skills - taught by engaged/versant/practicing faculty - and hands-on laboratory work into the curriculum. With such a targeted, systematic focus on both faculty and student research, intellectual property considerations will take center stage, as research leads to new discoveries and patentable methods and products. Imagine the legal questions that could arise from a working student accessing ERAU's educational resources from a shared company computer with automatic password retention, only to have those academically-licensed resources used for private company work in the development of a significant, profitable new technology. All of the discussed functions – access to laboratories, equipment, and software; access to third party research materials; and final ownership of work – depend first and foremost on the ability to accurately identify the individual with whom ERAU-W is interacting remotely and to ensure that the credential used to log on to all of our systems – currently accessible through a "single sign-on" username and password – is not being misappropriated accidentally or maliciously.

Where malicious misappropriation is concerned, in one-on-one discussions between the author and ERAU-W personnel from the full-time faculty, the Instructional Design and Development Department (IDD), the Rothwell Center for Teaching and Learning Excellence (CTLE), and the Department of Online Learning, it was repeatedly stated that the perceived increase in opportunity online, combined with the additional incentives for students to artificially inflate their performance, were of particular concern to ERAU-W. Because of the differing demographics of the Worldwide student base as compared to those of traditional universities, the temptation to participate in unethical behavior can have a different fundamental impetus. Some military personnel and business professionals, receiving tuition reimbursement in proportion to

their academic performance, for example, have a financial incentive for achieving better grades that may be absent from other students.

The advent of new methods of teaching and interacting with students has similarly led to new methods of misrepresenting academic performance. One need only consult websites such as http://boostmygrades.com/ or http://essayshark.com/ to see that businesses are already profiting from the new opportunities for impropriety created by online instruction and inexpensive/instantaneous/ubiquitous communications. Similarly advanced methods and technologies will need to be employed to deter and counteract academic misrepresentation. Critical to making sound decisions in this area is a solid understanding of user perceptions and potential acceptance when it comes to two critical areas: *Authentication* – ensuring that someone is who they say they are (can be one-time or continuous); and *Academic Monitoring* – continuously reviewing user content and behaviors to ensure propriety.

While the extent of academic integrity problems in ERAU-W has not been quantified as yet, anecdotal evidence suggests that proactive steps can be taken to make improvements, irrespective of the current state. Indeed, more than one study (King, Guyette, & Piotrowski, 2009, for example) has concluded that something as simple as establishing clear, consistent statements of expected behavioral norms – a university code of ethics and standardized classroom policies, for example – is sufficient to affect students' behavior in this area. Students can take advantage of ambiguous academic policies to circumvent the intended practices or even to obstruct more stringent proctoring and oversight, siting personal privacy concerns and a lack of sufficient notification. The first step in soliciting willing cooperation from all students, faculty, and administration is to ensure that policies are clear from the outset (for students, at first enrollment in the degree program).

Regardless of ERAU-W's preferred academic integrity approach, outside influences may necessitate a different one, with varying resultant cost and complexity. In this area, foresight of the forces in play and thorough understanding of the University's available responses will become important. In the Higher Education Opportunity Act (HEOP), the U.S. Department of Education (2008) includes the statement,

> requires an institution that offers distance education or correspondence education to have processes through which the institution establishes that the student who registers in a distance education or correspondence education course or program is the same student who participates in and completes the program and receives the academic credit. (sec 496.B.ii)

With national standards evolving, ERAU-W may be required by state/national accreditation bodies or even institutions providing educational funding to utilize techniques for authentication and monitoring that go well beyond the currently-employed username and password method. In addition, legal definitions of privacy can become a factor with the array of information transactions that online institutions require in order to perform regular activities. Consider, for example, compliance with the Family Educational Rights and Privacy Act (FERPA). As McConahay and West (2012) point out:

> …conducting business online with students we never meet in person is particularly complex and challenging… Institutions offer an array of information displays and services to enable their students to conduct business from remote locations. Often, this information can be accessed only by the student to whom it pertains. Ensuring that the information is available only to intended recipients relies on sufficient assurance in the

> links among user, credential, and record. …how certain can you be when a particular physical individual says, "That digital dossier is about me"? (p. 60)

It is possible to envision a scenario where it is argued that online username and password systems, established for convenient accessibility by a remote user and initialized by a remote individual, are an insufficient safeguard against the unauthorized access of personal information.

In spite of the mounting evidence that new technology approaches to academic integrity will gain traction, multiple researchers (Cluskey, Ehlen, & Raiborn, 2011) point out that the high cost associated with deploying enhanced authentication/monitoring technologies and the unlikelihood of student acceptance of the practices calls true feasibility into question. Cluskey, et al. (2011) recommend employing several less-costly alternatives which, the authors contend, can achieve similarly beneficial results. Indeed, many of the technologies which yield the lowest risk of repudiation rely on biometrics – features of an individual that can be used to uniquely identify that individual (e.g., fingerprint, iris, gesture patterns). In order to deploy such systems, Universities generally need to license the technology from third parties. The cost and complexity is relatively high in comparison to non-technological alternatives, and a study by Levy, Ramim, Furnell, and Clarke (2011) concluded that student acceptance of third party vendor implementation of biometrics may prove problematic. In addition, recent disclosures about U.S. government monitoring of communications have created an increased media focus on privacy with regard to internet use (Luckerson, 2013). This increased public awareness and increase in demand for anonymity runs directly contrary to the concept of authentication and monitoring of remote users. Regardless of the need and appropriateness of deploying such technology, in the current public opinion climate, all actions toward individual identification and monitoring may prove difficult or impossible to implement.

Research staff from the ERAU Hunt Library assisted the author in performing an exhaustive literature search in this area; minimal quantitative data on student acceptance of authentication/monitoring technology was available. To address this lack of data, and to contribute to the general advancement of knowledge, an ERAU-W survey was developed to provide insights about the Worldwide-specific student body. Given the various approaches available for addressing the academic integrity issues, the apparent predilection of key accreditation and funding organizations for more robust solutions, and the specific conclusion of the Levy et al. (2011) survey, the author worked with the ERAU Office of Institutional Research to test the applicability of the Levy et al. (2011) conclusion to ERAU-W. The specific questions addressed through the survey were as follows: Will acceptance and adoption of biometric technology solutions be different among ERAU-W's unique student population from the resistance encountered in the Levy et al. (2011) study? To what extent do age, educational level, or military status affect respondent perceptions? Secondarily, the author attempted to elucidate other potential student body issues, such as usability of authentication technology and security/privacy concerns, which could have direct implications for the Ignite integration model as it relates to remote learning.

Methods

The author conducted an ERAU-W student body survey, sufficient in scope to address the fundamental question of third party biometric authentication, mirroring the aforementioned Levy et al. (2011) study. The survey questions and format were approved by the ERAU Office of Institutional Research in advance, and survey participation was entirely optional for all participants. The survey was sent via email to over 8,000 randomly selected ERAU-W students –

both graduate and undergraduate. Figure 1 is a graphical representation of the four research cells defined by the author.

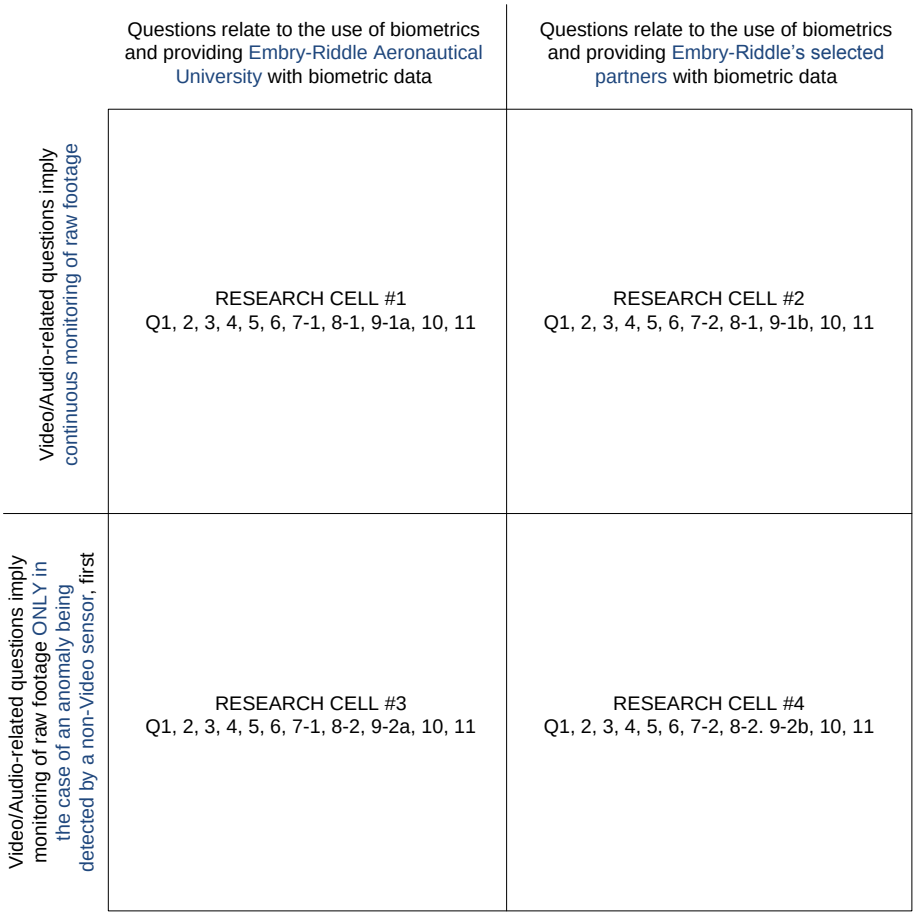


Figure 1. Key features of four independent (no repeat participants) research cells and corresponding question selections. See Appendix B for full questionnaire text.

All research cells were opened to accept responses simultaneously, from 4/23/13 until 6/9/13. The survey was originally planned to be conducted over one calendar month, but poor initial participation made it necessary to keep all cells open until such time as sufficient responses were collected to provide statistical significance comparable to the Levy et al. (2011) study, with comparable variance assumptions. Prior to undertaking the ERAU-W study, the author used the statistical variance results from the Levy et al. (2011) study as the basis for a Mathworks Matlab simulation of normally distributed participant responses, both with and

without anticipated potential biases. Applying Analysis of Variance (ANOVA) techniques to these simulated responses using the OpenStat application, the author set a minimum threshold of 85 participants per cell in order to ensure that the resultant standard error of the means would be small enough to ensure meaningful insight into such biases within the general format of the survey questions – five discrete categories of response from "Strongly Disagree" to "Strongly Agree."

These discrete response choices were represented numerically, in the order and orientation originally presented in James, Pirim, Boswell, Reithel, and Barkhi (2006) – the journal paper cited for the formatting of the questions in the Levy et al. (2011) study. For some reason, this latter study chose to reverse the order and numeric values of the responses. The author did not suspect this of introducing a new bias, but reverting to the original response orientation allowed us to rule out any unintended effects due to the manner in which the responses were ordered.

Included as part of the invitation email sent to students was a link to a downloadable or web-viewable (via MediaFire.com) Microsoft PowerPoint Show (.ppsx) introduction to biometrics, lasting approximately ten minutes in duration. The purpose of the introductory presentation was to ensure a common understanding of technical fundamentals and terminology – how biometrics work, potential security risks, and privacy considerations. This introductory presentation is included in Appendix A. The link to the password-protected survey instrument was contained at the end of the presentation, thereby increasing the likelihood that survey participants would review the presentation material and subscribe to consistent definitions, prior to answering survey questions.

The survey instrument consisted of an online (administered through SurveyMonkey.com) questionnaire, comprised of 11 questions in length. The study attempted to differentiate between student acceptance of biometric authentication/monitoring for academic integrity as implemented by the University directly and the same technology implementation by a third party partner. Additionally, the study investigated differences in student acceptance of video/audio-based monitoring ("remote proctoring") versus non-visual sensors used to detect anomalies. The method of elucidating differences in student attitudes toward these variables involved presenting slightly different question wording to different, randomly-selected groups of participants. The precise wording of all questions used is listed in Appendix B. The study allowed the author to investigate correlations between age, military status, gender, and graduate/undergraduate status, respectively, and specific preferences expressed in the survey. The Internet Protocol (IP) address of each responding computer was captured by the survey instrument so that that computer would only be allowed to access the survey once (barring malicious attempts to corrupt survey results).

The total rate of participation in the study was 5.9% of all students invited. Of 476 student respondents, across the four research cells, 10 were removed from the study due to failure to fully complete the questionnaire. Because of the nature of the invitation email – linked to an introductory presentation which was in turn linked to one of the four cells in the survey instrument – the students were selected for a particular cell in advance of being contacted. A Mathworks Matlab script was developed by the author to generate uniformly distributed pseudorandom numbers. This script assigned students to cells by populating a linked field in an encrypted Microsoft Access database. As student contact information was added to the database, the student was assigned a random identifying key by Access and a research cell by Matlab. From that point on, only the student's email addresses were viewed directly. All other

information about the student was masked by the identifying key. The participants in each cell were only provided links to view the questions associated with that specific cell. The introductory presentation content was the same for all cells, but four distinct presentations were used so as to provide four distinct links to the different cells of the survey instrument.

Both the introductory presentation and the online questionnaire were password-protected, so that only students invited to participate via email were expected to have access. Participant survey responses were maintained as confidential throughout. The questionnaire solicited student opinions with respect to the subject under investigation, but not personal information. The only participant-provided survey responses that could potentially constitute some form of identification were demographic in nature – age, military status, gender, grad/undergrad status. This information was only available to the author, maintained in the encrypted Microsoft Access database. Only totals and relative graphical representations are illustrated in this document.

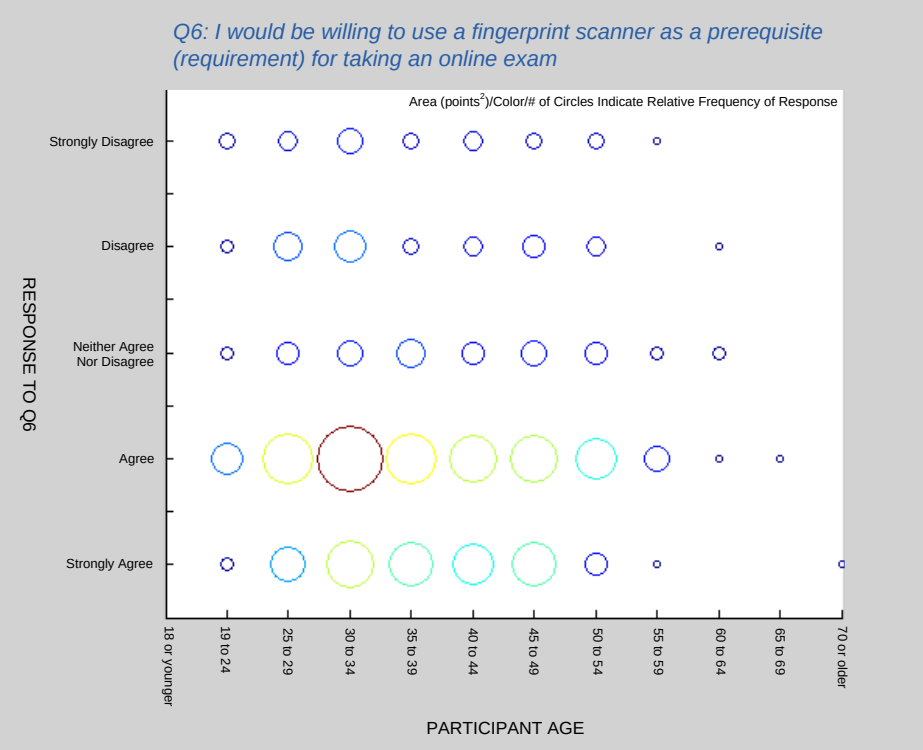


Figure 2. Correlation between attitude toward use of a fingerprint scanner and participant age.

Discussion

As the ERAU-W student body survey was designed to quantify opinions, generally on a discrete scale from 1 to 5, the summations of those opinions are presented graphically, on scatter plots and charts, which may reveal to the reader intuitive correlations between demographic data and the participant responses. Figure 2, for example, illustrates the greater frequency of "Agree" or "Strongly Agree" responses regarding survey question 6 – related to student attitudes towards fingerprint scanner technology – in the participants between ages 25 and 49.

The author also makes use of side-by-side comparison of results for similar questions, with slightly different terminology and connotations, in order to illustrate how participants may have responded differently to the choices of wording or how demographics may have played a role. By way of comparison, military status and gender (as illustrated in Figure 3) appeared to have no noticeable effects on the participants' response to the use of fingerprint technology. Participants claiming some form of United States military service comprised 58.2% of the total respondents. Females comprised 18.2% of total respondents. In order to compare demographics when there was a disparity in the number of participants, the responses were first normalized so that the sum of all response frequencies for a given demographic were equal to all other demographics. Only the relative differences across demographics, then, are apparent in Figure 3. In addition to visual representations, the author provides a table summarizing key comparisons in sample mean and in inferential population standard deviation, after Figure 16.

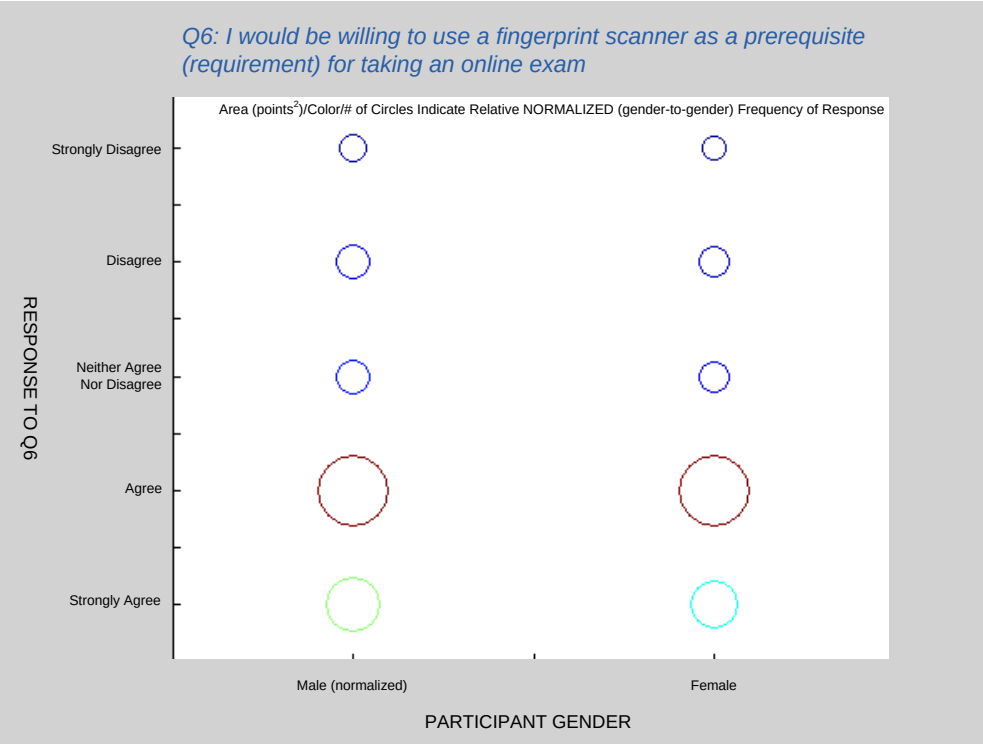


Figure 3. Male/Female normalized relative frequency of responses about fingerprint scanner are nearly identical although males represented a significant majority of the overall sample.

In the case of graduate versus undergraduate participation, graduate students comprised 56.4% of the total respondents. graduate normalized relative frequency of responses exhibited a small, but noticeable increase in positive attitudes toward fingerprint scanning technology vs. undergraduates. For undergraduate students, there appear to be less “Agree” and “Strongly Agree” answers and more neutral or negative answers, resulting in a shift of the sample mean, even though standard deviation for the two populations were relatively equal.

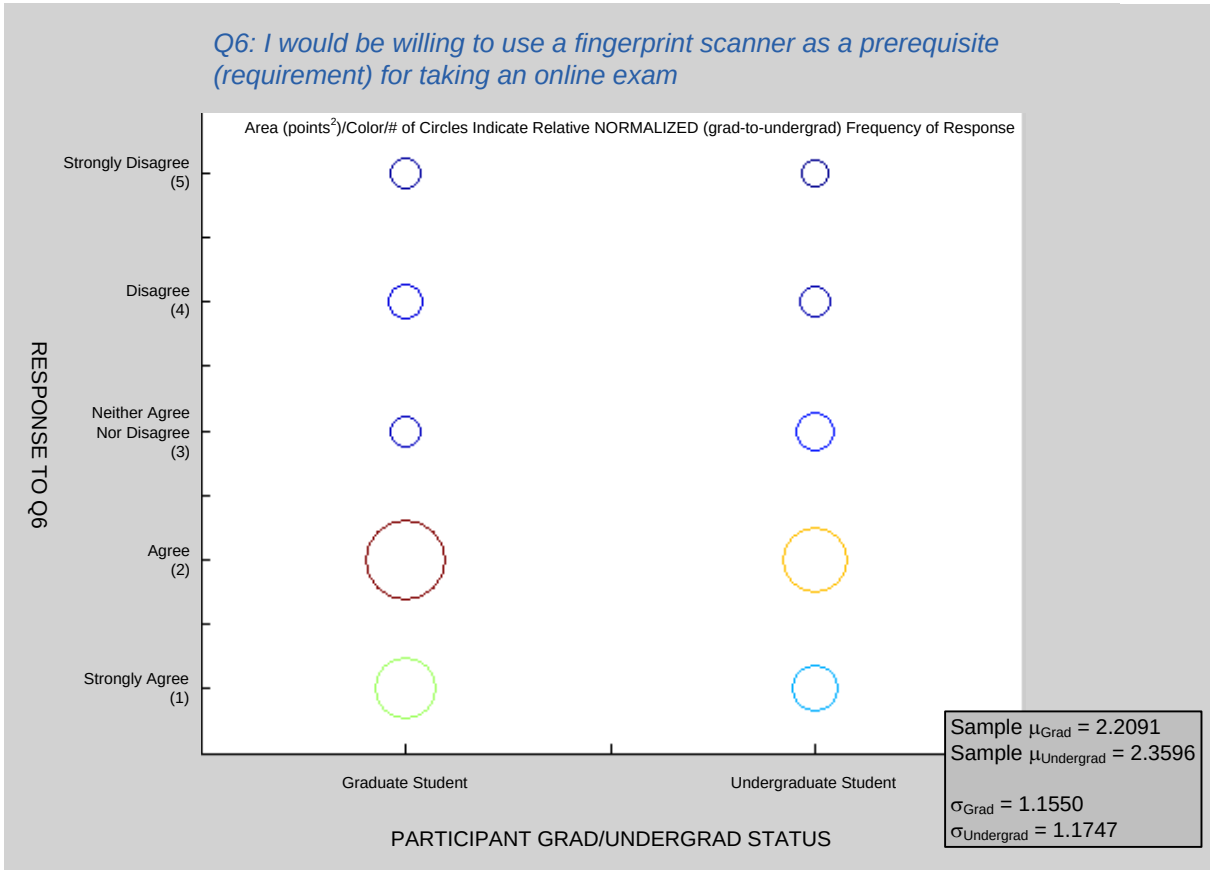


Figure 4. Relative normalized attitudes towards fingerprint scanner technology for exam academic integrity – graduate vs. undergraduate.

There appears to be only a slight difference between general agreeability toward fingerprint scanning – focused on the technology – and the institutional trust afforded to Embry-Riddle and ERAU's selected partners in implementing the fingerprint technology. Initially, the author was uncertain whether perception of usefulness or agreeableness towards a general technology would translate to trust in the institution using the technology or agreeableness towards the deployment. Figure 5 indicates that there is little noticeable disparity between user perception of the technology and user willingness to allow the institution to use the technology in the case of fingerprint biometrics.

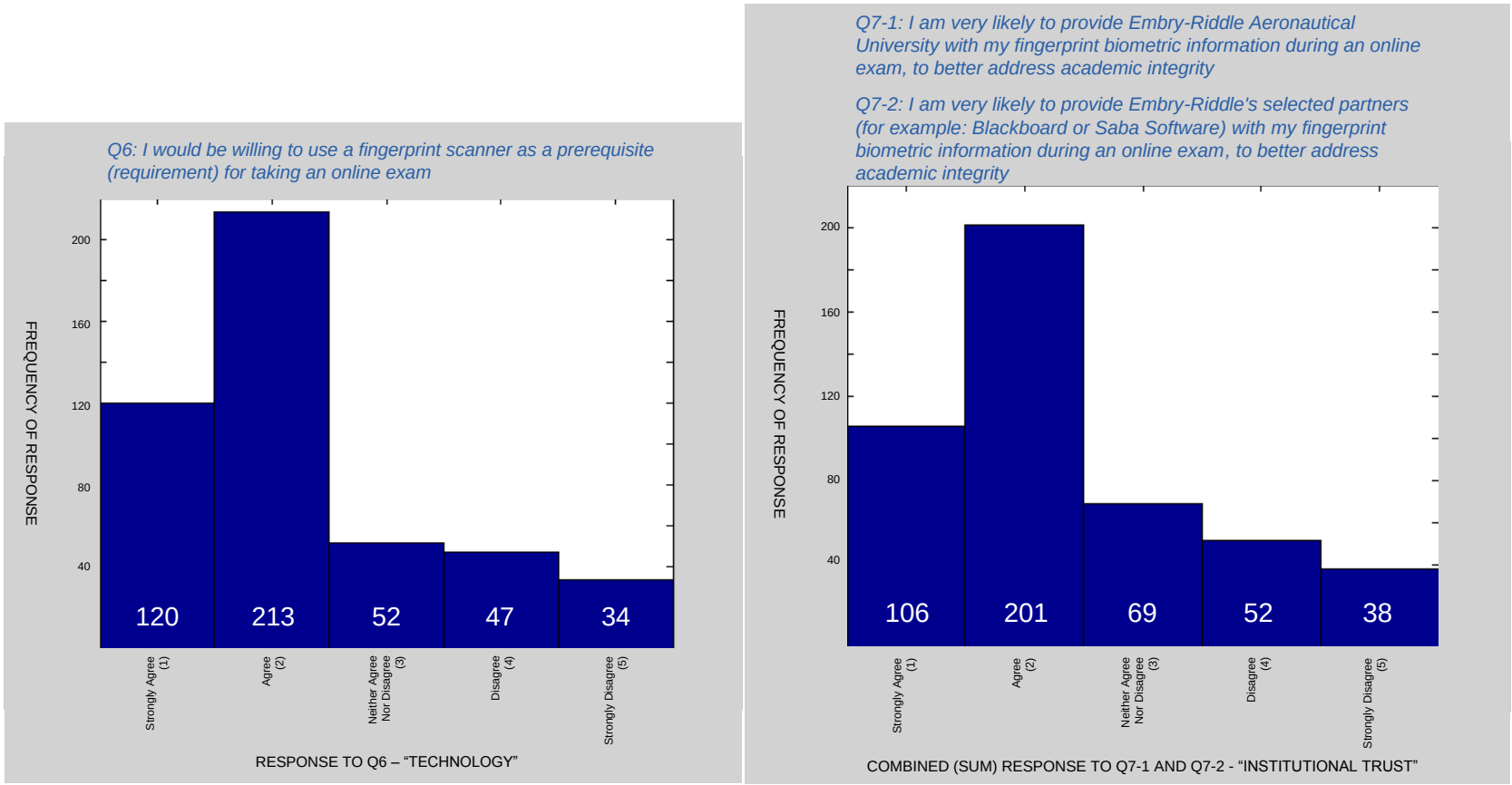


Figure 5. Histograms of student attitudes towards fingerprint technology versus institutional use of fingerprint technology – ERAU and selected partners.

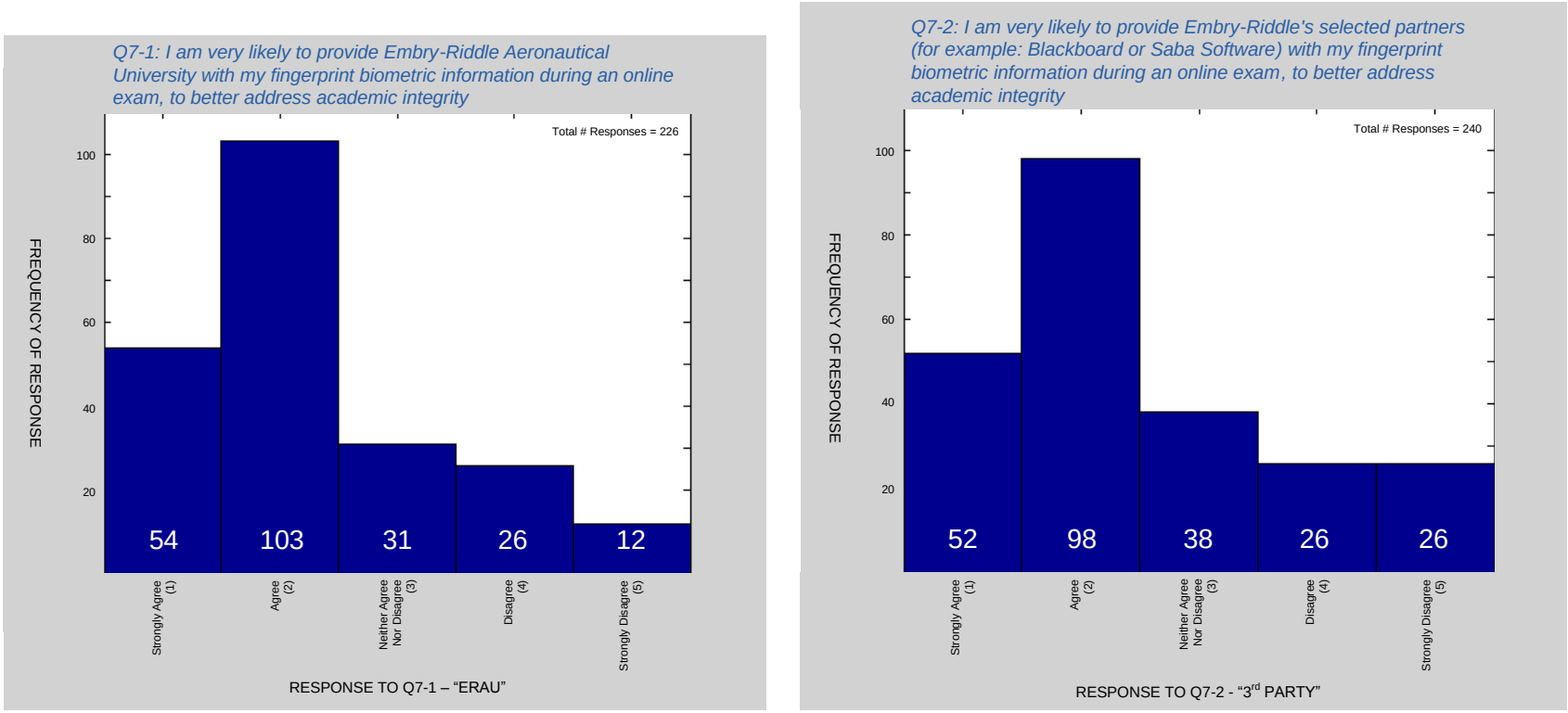


Figure 6. Histograms of student attitudes towards fingerprint technology implemented by ERAU versus ERAU's selected partners.

The two independent histograms look identical, with closely matching sample mean and standard deviation, listed in summary Table 1 (p. 30). The conclusion posited, then, is that the general ERAU-W student population would respond identically – agreeing or disagreeing with the use of the technology in general and with Embry-Riddle's use of the technology specifically – in approximately the same proportions as the sampled students. The link between third party implementation of biometrics and negative student attitudes, displayed in the Levy et al. (2011), is not apparent in Figure 6, in the case of fingerprint biometric technology. Though there is a slight shift in sample mean, it certainly does not appear to affect overall positive attitudes. This disparity with the Levy et al. (2011) study's results may stem from differences in ERAU-W's population or, perhaps, the phrasing of the ERAU-W study's question, which includes specific third party partners with which students already have some familiarity.

There appears to be a slight link between acceptance of video/audio and whether the video/audio is to be provided to Embry-Riddle or a third party. The histograms of Figure 7 mirror the conclusion of the Levy et al. (2011) study – that implementation of biometrics by third parties is sufficient to bias students' attitudes towards a negative response. The magnitude of the bias does not, however, appear to be as significant in the ERAU-W population as the previous study concluded. The use of video and audio, however, generates greater neutrality and even ambivalence in the respondent attitudes as compared to the results for fingerprint scanning.

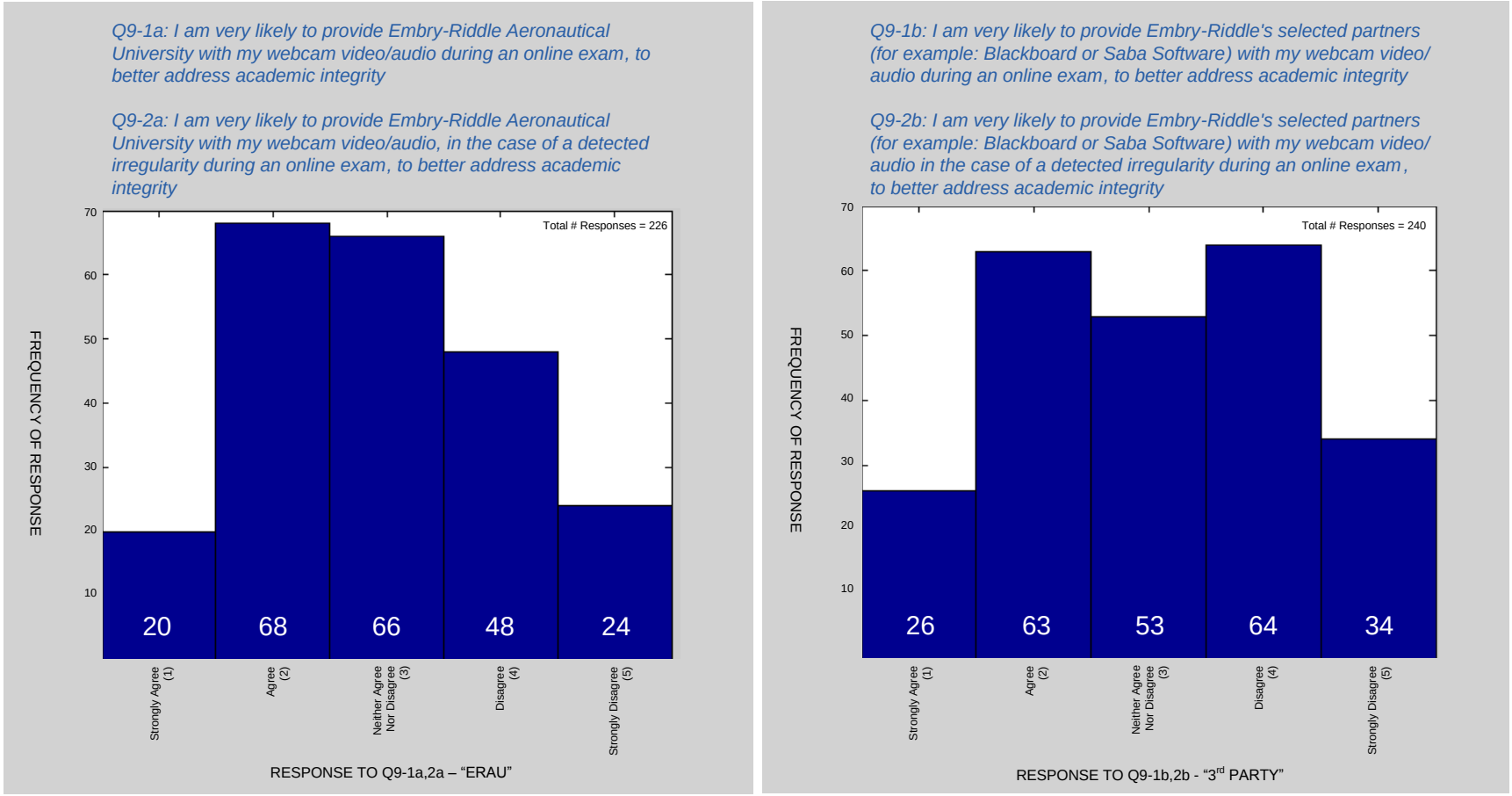


Figure 7. Histograms of student attitudes towards the use of video audio administered by ERAU versus ERAU's selected partners.

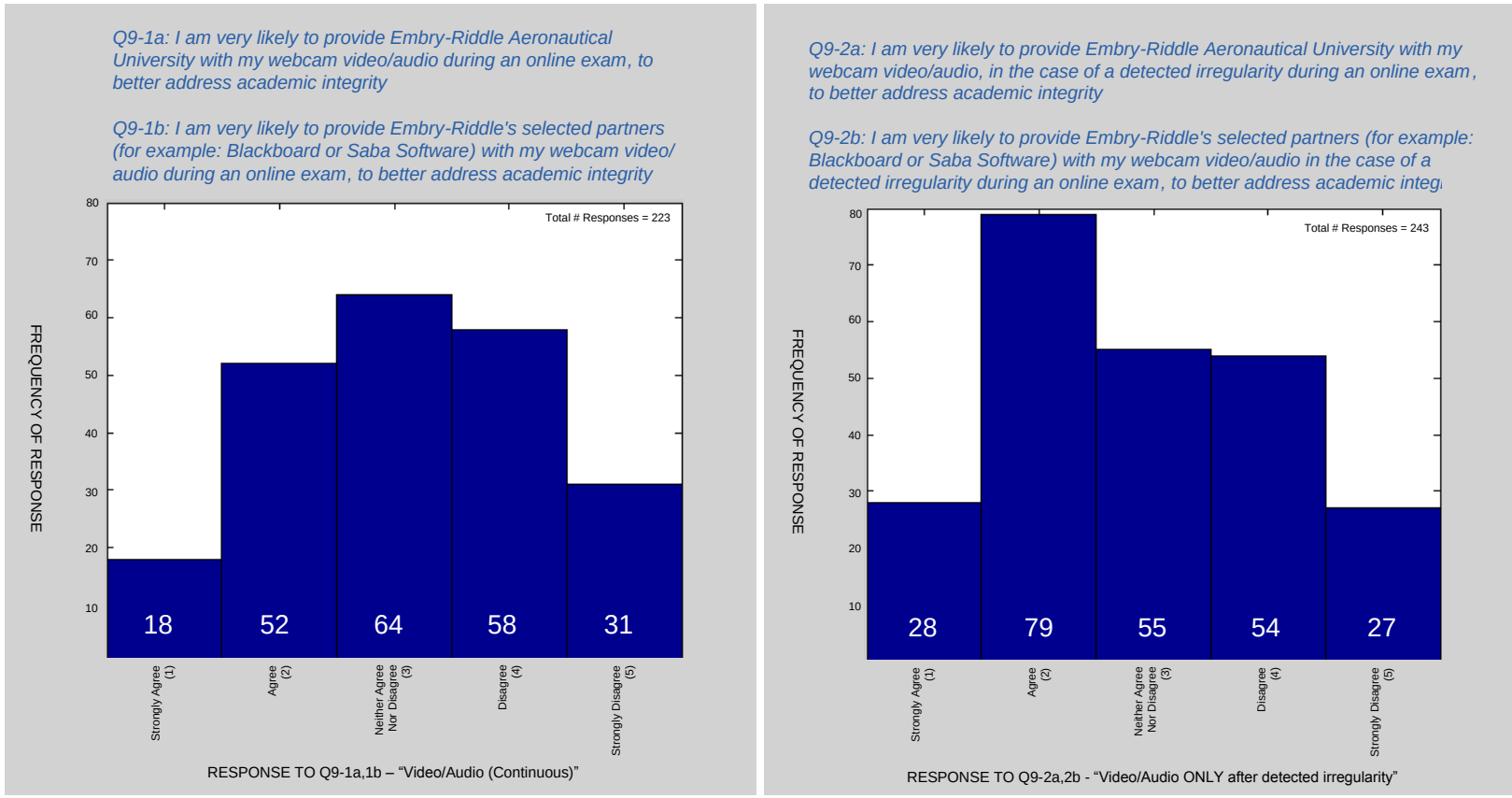


Figure 8. Histograms of student attitudes towards the use of video/audio in general versus the specific case of a detected irregularity.

Figure 8 appears to illustrate a link between student acceptance of video/audio biometrics and the knowledge that the video is only to be captured in the case of an irregularity being detected first, as opposed to unlimited use of video/audio.

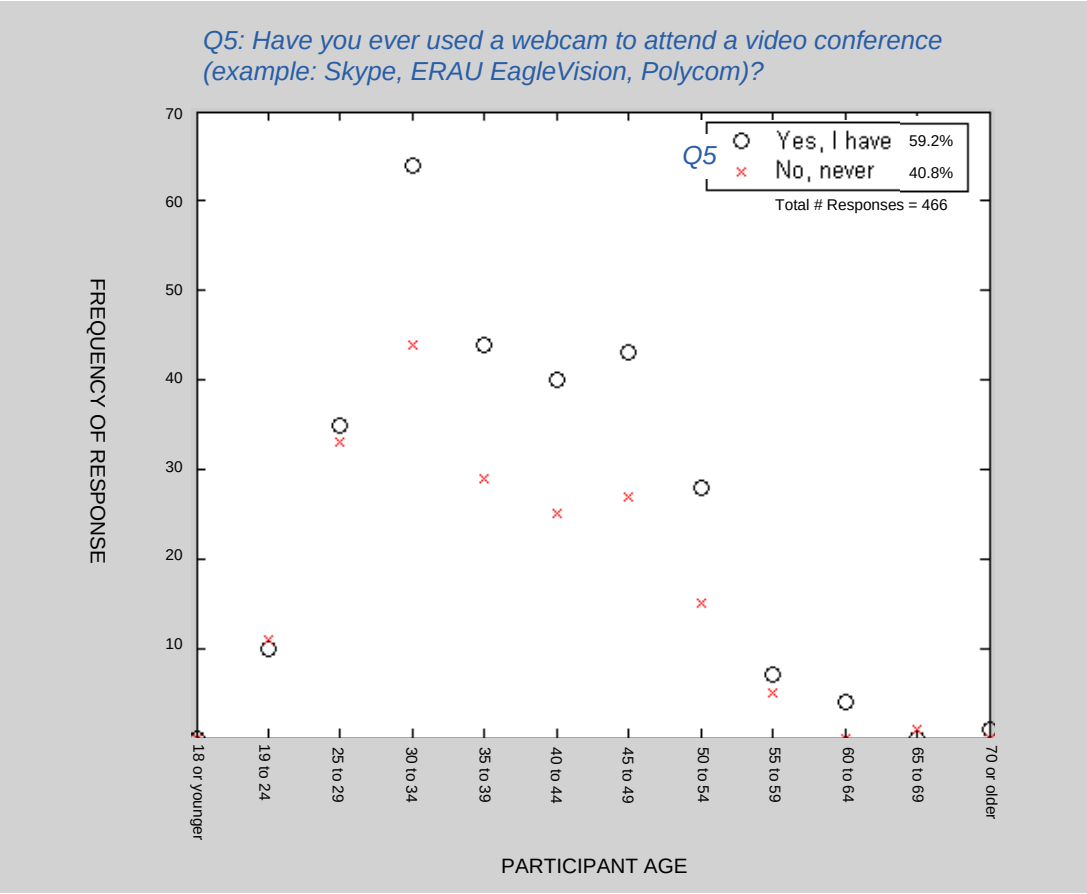


Figure 9. Scatter plot of student age versus frequency of participation – distinction between those with prior experience using video conferencing and those students who claimed no such experience.

In Figure 9, there seems to be a noticeable increase in the experience of using webcams among the age 30 to 54 participants. The author finds this increase to be intuitive, given the historical timeframe for deployment of video conferencing technologies and participants access to them. It is worthy of note, however, that even with the EagleVision modality offered by ERAU-W, only about 59% of students claim to have ever used this technology.

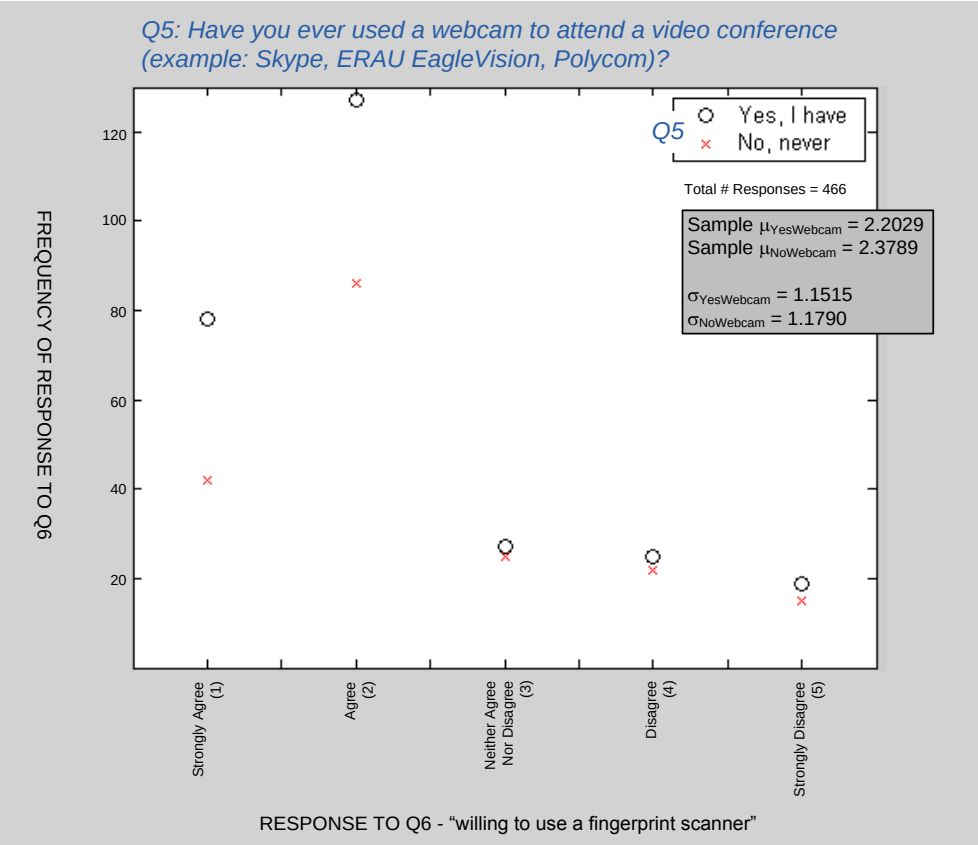


Figure 10. Scatterplot of student attitudes towards fingerprint scanners – distinction made relative to prior video conferencing experience.

From Figure 10, one can conclude that being neutral or ambivalent towards use of fingerprint scanners is a phenomenon independent of previous webcam/video conferencing experience. Agreeing or strongly agreeing, however, with the use of fingerprint scanner technology does appear to have some correlation with previous webcam experience. While correlations do not imply causal relationships, displaying the webcam information together with the same subjects' responses in relation to fingerprint scanner technology does lend interesting insight. The author interprets the implication of Figure 10 to be either that subjects with previous webcam/video conferencing experience would be more likely to elect to use fingerprint technology or that the nature of people willing to use fingerprint authentication technology is such that those same people would also be likely to make use of other network technologies,

such as video conferencing. This has applicability to understanding the tendencies of EagleVision users.

Figure 11 shows an interesting trend. It has already been stated that approximately 59% of the student body has participated in a video conference via webcam – more participants having used the technology than not. The relative frequencies in Figure 11 are revealing. It would appear that attitudes towards the concept of a remote proctor being the equivalent of an in-person proctor – both positive and negative – appear to hover around neutrality or ambivalence, irrespective of prior experience with video conferencing technology. While those participants claiming webcam experience did shift the sample mean slightly towards neutrality, neither group demonstrated a positive attitude towards the technology. The author puts forward the theory, backed by student email comments, some of which were captured in Appendix C, that negative attitudes towards remote proctoring do not stem from technology concerns, but rather those of privacy/invasiveness/inconvenience.

With respect to the technologies addressed in this ERAU-W questionnaire, student responses implied a clear preference for fingerprint biometric over video/audio-based technology. Figure 12 shows comparative histograms of student responses relative to ERAU-W's deployment of each of these technologies. As it pertains to general pessimism towards third party deployment of authentication/monitoring biometric technology, the Levy et al. (2011) study does seem to capture student attitudes. The magnitude of the observed negativity, however, does not appear to be as pronounced with ERAU-W's student body. Figure 13 indicates the same student predilection for fingerprint scanning over video/audio monitoring, even in the case of third party providers. Video/audio clearly generated primarily neutral or ambivalent responses.

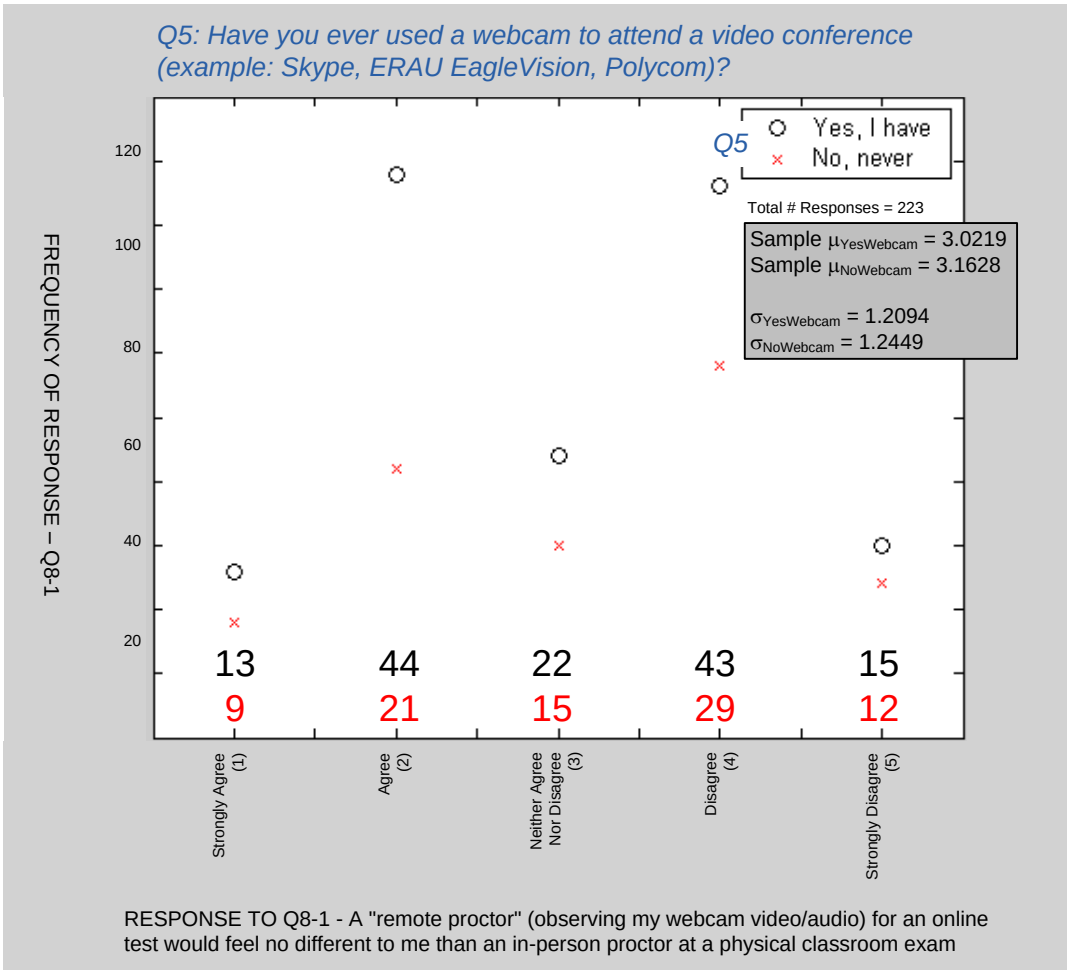


Figure 11. Scatterplot of students' agreement with equivalence of remote proctor concept versus in-person proctor – distinction made relative to prior video conferencing experience.

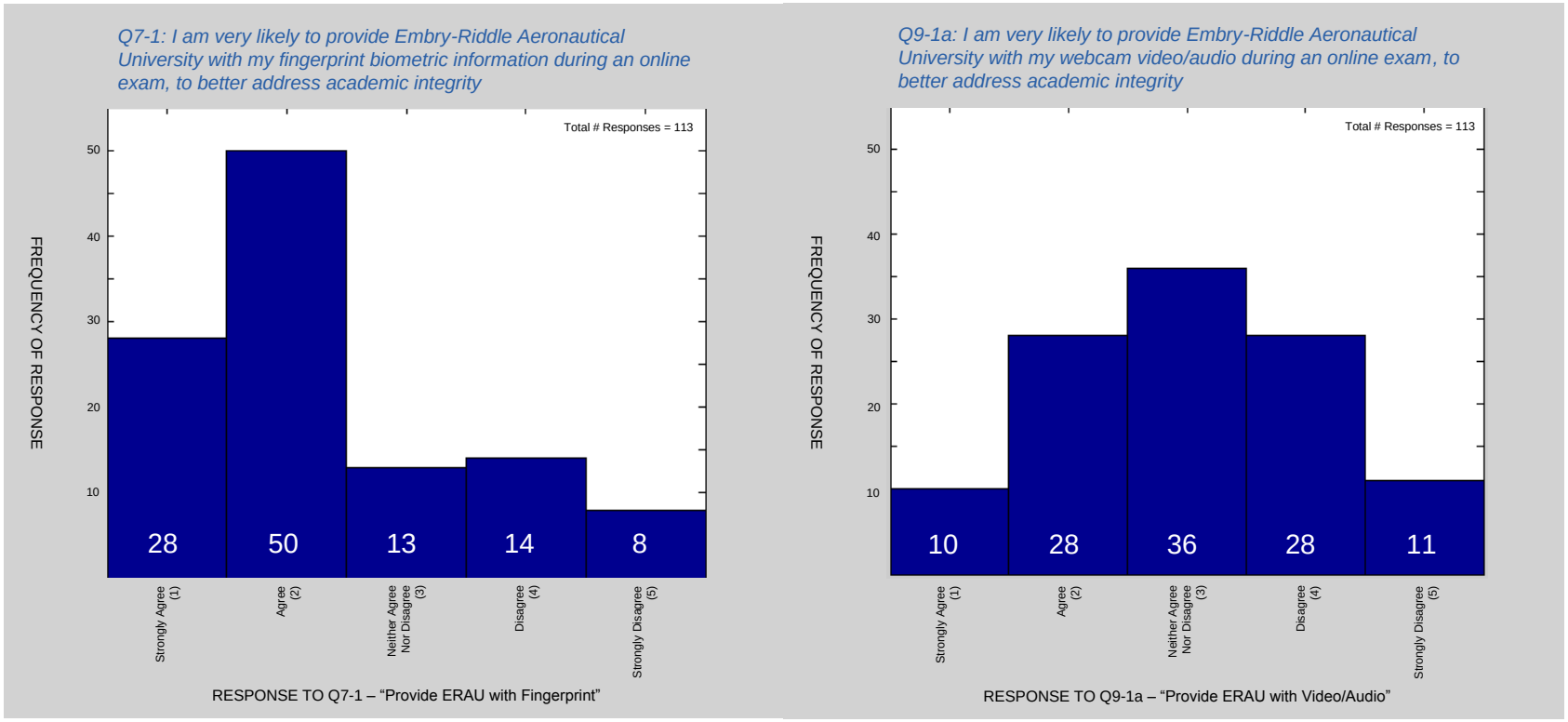
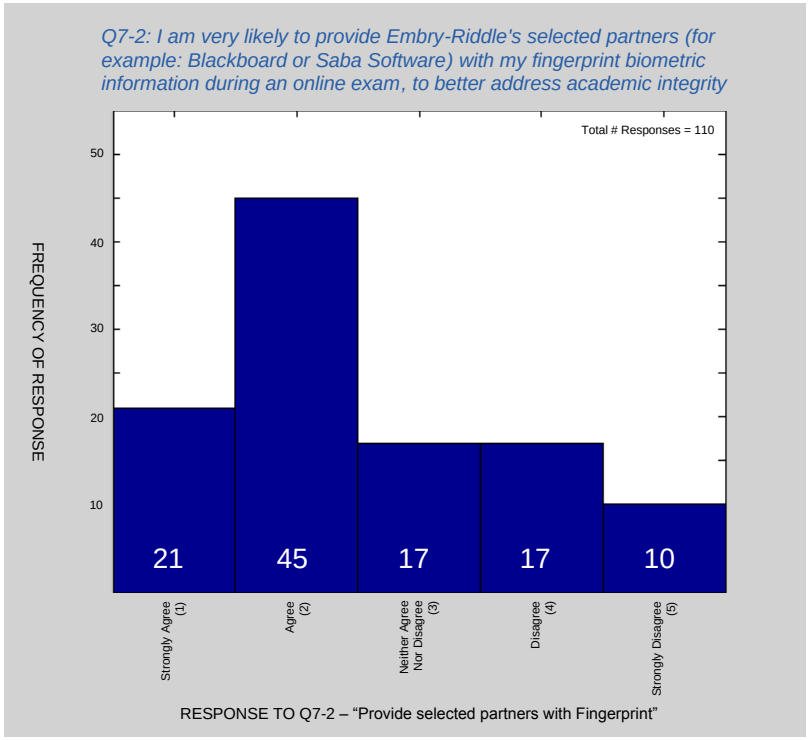


Figure 12. Histogram of student attitudes towards ERAU deployment of fingerprint scanning versus video/audio monitoring.



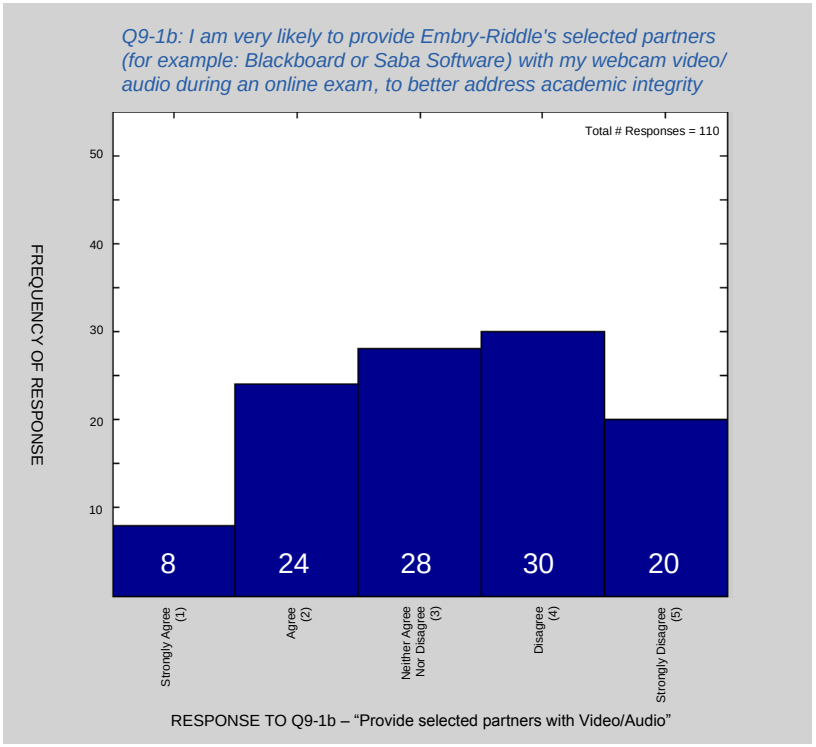


Figure 13. Histogram of student attitudes towards ERAU selected partner deployment of fingerprint scanning versus video/audio monitoring.

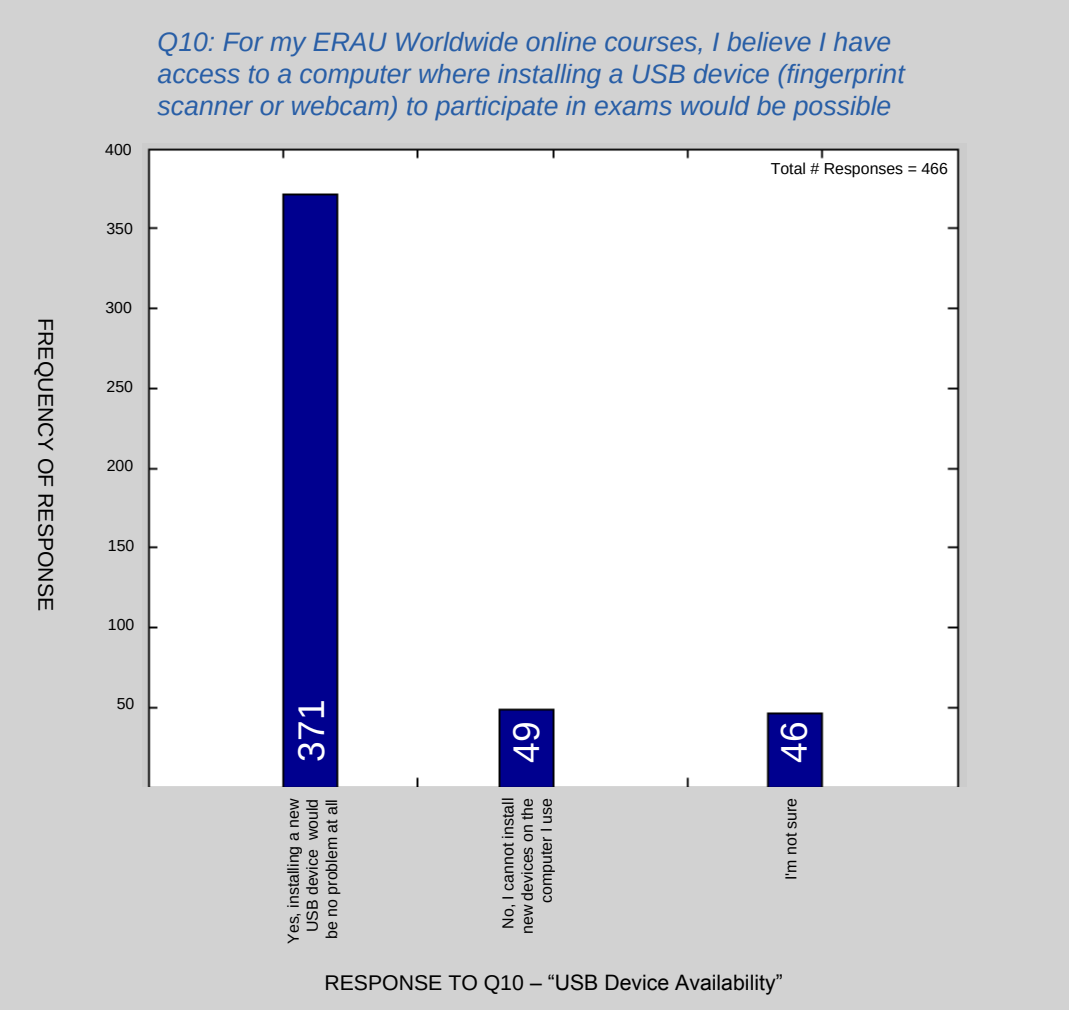


Figure 14. Chart of student responses with respect to the applicability of add-on USB devices.

In addition to technology preferences, cost, technical feasibility, and maintainability need be considered with any new deployment. In addition to increased network bandwidth usage associated with some USB devices, such as a webcam, a significant number of ERAU-W's students expressed either an inability or an uncertainty in adding any USB device to the computers they use for schoolwork. Figure 14 depicts this data, illustrating that nearly 20% of ERAU-W students could pose a technology installation problem.

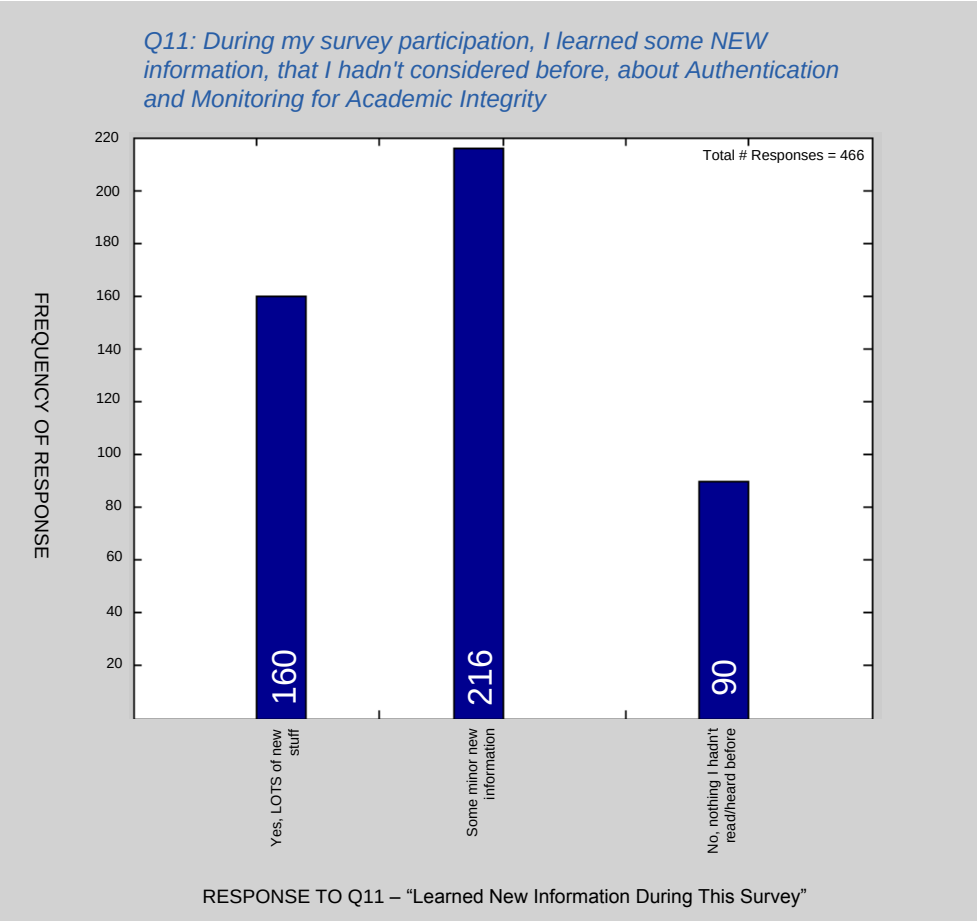


Figure 15. Chart of student responses about new information learned during the survey.

Figure 15 shows that over 80% of survey participants learned some new information during the course of the survey. This can be considered a positive for technology adoption, because it means that user opinions have not yet been fully established. There exists, potentially, a willingness to recognizing new information.

Figure 16 also illustrates what the author considers to be a positive outlook on the possibility of shaping student opinions. Reviewing the normalized responses for student knowledge gained (normalized number of respondents in each category: learned something significant new, learned minor new info, learned nothing new) versus the willingness to use fingerprint technology, it would appear that the most positive group was the group that believed they learned the most during the survey. The second most positive group was the group that

believed they learned “some new information.” The least positive group could be construed to be the group that responded that they had not learned new information during their participation. Interestingly, this chart shows that in terms of relative frequency of positive and negative responses, the respondents who learned something new in the presentation – who felt they were introduced to the technology – were the most willing to use the technology. The author interprets this data as offering support for a general approach of offering education for students on the pros and cons and general considerations surrounding the implementation of new technologies. The concept would be intuitively similar to simply informing students that a campus library exists and that they must make use of the resource versus showing them the benefits of the library and providing coursework in which the use of library materials is beneficial. This is also an area where faculty mentorship can lend positive results. A student working with a faculty member that regularly uses biometric technology to access labs and research resources may find the technology less threatening than a student who has not been introduced to the technology by a trusted advisor or observed clear examples of the benefit.

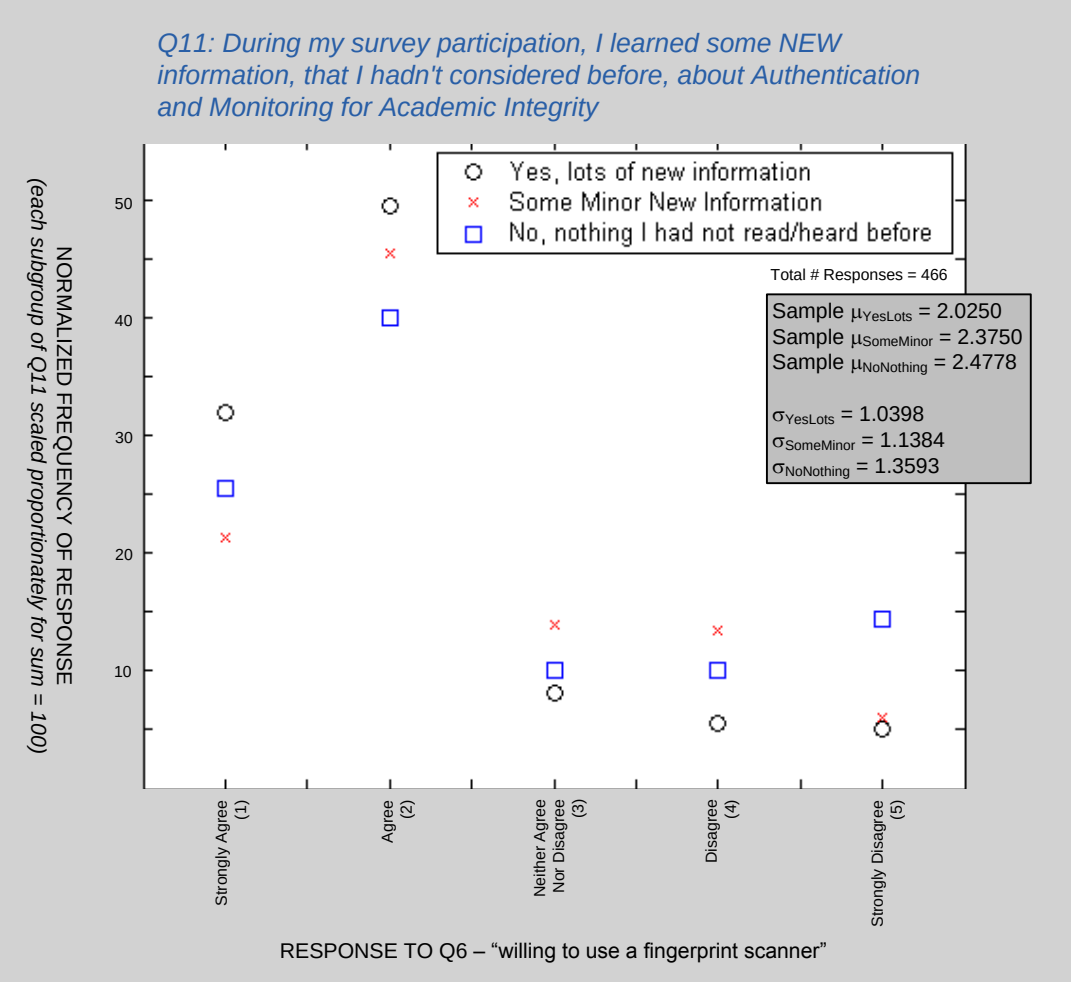


*Figure 16.*Scatterplot of students' willingness to use fingerprint scanning technology - distinction made relative to student learning of new information during the survey.

Table 1 offers a summary of key statistics and parameters related to student responses. Each row represents a comparison between similar or related pieces of information that the author chose to investigate. Differences in the sample means and standard deviations, across rows, tell us that students may have responded differently to the factors which the alternative wording of questions was meant to draw out. Similarly, when means and standard deviations are closely matched, this can be construed to mean that students did not respond differently to the differing factors in the questions.

Table 1

Summary of key statistics/parameters for responses reflecting student attitudes

Item under consideration (Data compared row-by-row)	Question	Specific factor emphasized in question	Sample mean	Std dev	Alternate question	Specific factor emphasized in alternate question	Sample mean	Std dev
Fingerprint biometric acceptance	Q6	General attitude towards Fingerprint Technology	2.27	1.16	Combined Q7-1, Q7-2	ERAU Institutional Trust with Fingerprint	2.39	1.19
Fingerprint biometric acceptance	Q7-1	ERAU-administered fingerprint	2.29	1.11	Q7-2	Selected-partner-administered fingerprint	2.48	1.25
Video/audio biometric acceptance	Q9-1a, Q9-2a	ERAU-administered video/audio	2.95	1.14	Q9-1b, Q9-2b	Selected-partner-administered video/audio	3.07	1.24
Video/audio biometric acceptance	Q9-1a, Q9-1b	Continuous video/audio monitor	3.14	1.17	Q9-2a, Q9-2b	Video/audio monitor only after detected irregularity	2.89	1.20
Technology Preference - via ERAU	Q7-1	ERAU-administered fingerprint	2.29	1.11	Q9-1a	ERAU-administered video/audio (continuous)	3.02	1.12
Technology Preference - via Partners	Q7-2	Selected-partner-administered fingerprint	2.48	1.25	Q9-1b	Selected-partner-administered video/audio (continuous)	3.27	1.20

Note. mean values '3' = Neutral; '1' = Strongly Agree; '5' = Strongly Disagree

Areas for Future Research

The collected data meets the conditions for performing an ANOVA analysis of the data across the four cells of the study, using the OpenStat software package. ANOVA would provide a more quantitative representation of the statistical significance of the noted differences among cell responses. It would also allow for a direct comparison between Embry-Riddle's survey participants and the ANOVA examination previously applied to the sample population from the Levy et al. (2011) study. Similarly, although the survey well exceeded the sample size targets for each cell, we did not calculate effect size. Calculation of a quantitative measure, such as Cohen's d, will provide will lend insight as to the practical importance of some of the statistical differences thus far observed.

There are several variants of academic integrity technologies which were not addressed specifically in this high-level survey – among them voice recognition/identification and facial recognition. Making a distinction between video and audio, including the way they are used, could change student opinions of those technologies. In addition, some companies are specifically working on solidifying the security and integrity of test taking, going so far as to develop systems designed to operate and follow regulations involving student record data (FERPA) and commercial best practices with regards to the safeguard and transfer of personally identifiable information (Turning Technologies, n.d.). Investigating other available options, together with third parties, may be fruitful.

In addition, this survey was not fully encompassing in the area of biometrics; iris scanning, typing cadence/pattern recognition, and detection of anomalous behavior weren't specifically addressed. Knowing what level of invasiveness ERAU-W students would tolerate and accustom themselves to is important for future technology deployment.

From personal student insights that were shared via email (the vocal majority of which may not be representative of the entire student body, but nonetheless lend insight), concerns about biometrics seemed to be influenced greatly by concerns about security and data integrity, not so much the intended use of the technology itself. A follow-up study to refine this understanding and to provide a more robust explanation of potential security measures and University policies' effects in relation to negative student reactions is warranted.

It should be noted that some invited students – less than 1% – seemed to have a strong, even emotional reaction against their "privacy" being infringed upon, simply by being offered a chance to participate in this voluntary study. Certainly, if an email from faculty can be viewed as invasive to privacy, this is counter to the research culture the University is attempting to foster, and future studies or the deployment of biometric authentication/monitoring might be met with even harsher criticism from some students. The author is interested in whether something can be done in the future to allay those very strong reactions on the subject of privacy.

Conclusions

On a recent trip to an amusement park, the author's family was subjected to a fingerprint biometric scan. The scan was incorporated into the park experience, in order to make it appear enjoyable and innocuous, but the information captured and the ramifications were no less serious than a security background check or bank transaction. Airports have similarly promoted biometric scanning as a "privilege" rather than a requirement – offering the voluntary participant a faster route through security lines. Biometric usage will continue to expand in modern society.

ERAU-W has invested significant capital and intellectual resources to provide our students with the finest education and accredited degrees available online. The Ignite Integration Model will continue to steer ERAU toward a systematic, research-centric curriculum, which will

only serve to spotlight authentication issues and the legal ramifications associated with policy that can quickly grow outdated relative to technology and the invitation of willful misrepresentation which remote learning appears to augment. Ironically, one of the fundamental research skills taught in any research methods course is that of evaluating sources – establishing the criteria used to determine the credibility and reliability of materials used in the research process. The same attention has not, as yet, been applied to validating human sources of information and intellectual capital in the educational realm. The Worldwide Campus has been ahead of the curve in distance education methods and technologies for years. The potential erosion of academic integrity represents a sophisticated technological threat that must be met with equally sophisticated study and response. No university serious about online instruction can afford to take this challenge lightly. Similarly, despite the difficulties and costs, no university can assume that the technology already being used at local amusement parks is too sophisticated for student body acceptance. Societal norms are changing.

Recommendations

The author makes the following seven recommendations for ERAU-W.

Recommendation 1. It has been explained (King, et al 2009) how clear statements of policy are viewed as a significant boon to academic integrity. Many respected universities continue to operate primarily on an honor system, but in the absence of clear, unequivocal direction, students' views of what is right/wrong become surprisingly (to this author and to those that conducted the King et al. (2009) study) flexible and, occasionally, self-serving. Policy statements – both of expected behaviors and of consequences for actions contrary to University expectation – influence the risk/reward ratio students perceive with respect to academic

misrepresentation. The implementation of an ERAU-W student honor code, understood by all and signed by each student, is recommended.

Recommendation 2. The ERAU-W Instructional Design and Development team has made the author aware of course design approaches that fall under the heading of authentic assessment:

- Limiting the use of multiple choice questions
- Greater dependence on unique student projects rather than tests
- Capture of student and faculty work in easily accessible portfolio repositories, so that plagiarism is more readily detected.

All these approaches, the Online Exam Control Procedures (OECPs) listed in Cluskey et al. (2011), and the suggestions described in King et al. (2009) – not the least of which is the simple encouragement of active instructor involvement to reduce the likelihood of student misrepresentation – have been underway at ERAU-W and should continue to be explored and codified. Faculty mentorship is a core component in the implementation of ERAU's IGNITE integration model, because of the benefits to student motivation and the overall encouragement of research activities. Increased student/faculty face-to-face interaction also promotes academic honesty and integrity.

Recommendation 3. Ensure that policies consistent with and no less vigilant than brick-and-mortar universities for initial identification enrollment (drivers' license, social security#) are being followed, so that ERAU-W has a strong footing against the imposition of arbitrary/inefficient requirements from outside parties.

Recommendation 4. Begin actively engaging third parties on academic integrity technologies. Evaluate effectiveness, security and data-integrity, and cost of installation/maintenance as a necessary component of technology deployment. Perform voluntary

pilot tests with EagleVision students and intentionally placed cheat subjects before deploying any new technology – leveraging the EagleVision students' inclination towards the early adopter mentality as the proverbial "canary in the coal mine". Example technologies to investigate

- Acxiom Identify-X – queries student periodically, based on information in public databases (drivers' license number, previous addresses, etc.)
- Respondus lockdown browser – limits access only to instructor-approved resources
- Remote Proctor Fingerprint Scanning Technology – deployed fingerprint biometric service with claims of secure networking/database to protect personal data
- Remote Proctor or ProctorU Remote Video/Audio Monitoring Service – exam recorded via proprietary webcam and USB driver/software (potential installation issue); reviewed by assigned specialists

Video/Audio monitoring appears to elicit the strongest negative responses from students and presents difficulty for military personnel and other students with unreliable network connections. These types of options should be evaluated, but considered for actual deployment only after other alternatives have been exhausted. In addition, the outsourced, third party proctoring service appears to be the least desirable option, given the initial ERAU-W survey results.

Recommendation 5. The author recommends caution in investigating technologies generally perceived as being more invasive than fingerprint (ex. iris scan, handprint); Student acceptance levels demonstrated in this survey and the current public opinion climate do not support adoption of such technologies.

Recommendation 6. With ERAU-W's strong record of working with military personnel, it would be worthwhile to begin jointly investigating USB port access as a limiting factor. Even

simple deployment of the EagleVision modality requires a webcam. As less controversial, but necessary equipment becomes part of ERAU-W's day-to-day research and laboratory activities, investigating options for deploying USB connectivity for all students in a secure fashion will become increasingly important.

Recommendation 7. With any steps taken, communicate to the student body the nature of the deliberations and the consequences of both action and inaction. The participants exhibited strong, sometimes emotional responses to the survey topic. An author-selected, representative sampling of student comments - all received via email, separate from the actual survey instrument – has been included in Appendix C, so that the students' insights may be read in their own words. Both the quantitative data and the qualitative feedback give the impression that student attitudes can be swayed by clear communication and education.

References

ABET Engineering Accreditation Commission. (2012). *Criteria for accrediting engineering programs.* Retrieved from http://www.abet.org/uploadedFiles/Accreditation/Accreditation_Step_by_Step/Accreditation_Documents/Current/2013_-_2014/eac-criteria-2013-2014.pdf

Cluskey, G. R., Jr., Ehlen, C. R., & Raiborn, M. H. (2011).Thwarting online exam cheating without proctor supervision. *Journal of Academic and Business Ethics*, *4*, 1-7.

Embry-Riddle Aeronautical University. (2012). *Quality Enhancement Plan: 2012-2017.* Retrieved from http://spa.erau.edu/ignite/ignite.html

James, T., Pirim, P., Boswell, K., Reithel, B., Barkhi, R. (2006). Determining the intention to use biometric devices: An application and extension of the Technology Acceptance Model. *Journal of Organizational and End User Computing, 18*(3), 1-24.

King, C. G., Guyette, R. W., Jr., & Piotrowski, C. (2009). Online exams and cheating: An empirical analysis of business students' views. *Journal of Educators Online*, *6*(1), 11.

Levy, Y., Ramim, M. M., Furnell, S. M., & Clarke, N. L. (2011).Comparing intentions to use university-provided vs vendor-provided multibiometric authentication in online exams. *Campus-Wide Information Systems*, *28*(2), 102-113.

Luckerson, V. (2013).The Anonymous Internet: Privacy Tools Grown in Popularity Following NSA Revelations. *Time Magazine*. Retrieved from http://business.time.com/2013/06/20/the-anonymous-internet-privacy-tools-grow-in-popularity-following-nsa-revelations/

McConahay, M., & West, A. (2012).Establishing remote student identity: Results of an AACRAO/InCommon Federation survey. *College and University*, *87*(3), 59-66.

Semple, M., Hatala, J., Franks, P., & Rossi, M. A. (2011). Is your avatar ethical? On-line course tools that are methods for student identity and verification. *Journal of Educational Technology Systems, 39(*2), 181-191.

Turning Technologies. (n.d.). *Triton data collection system product details*. Retrieved from http://www.tritondatacollectionsystem.com/product-details

U.S. Department of Education. (2008). U.S. Department of Education Opportunity Act of 2008, HR4137(sec 496.B.ii), U.S. Department of Education, Washington, DC.

Appendix A
Introductory Presentation

Introduction to Authentication and Monitoring for Academic Integrity

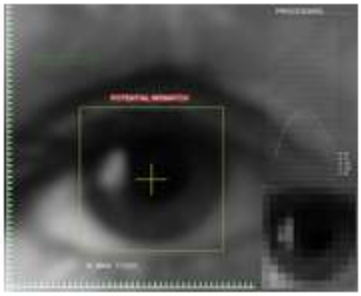
Dr. David Hernandez
Assistant Professor of Engineering Sciences
Embry-Riddle Worldwide

Some Definitions

- Authentication - verification that someone IS who they identify themselves to be (in a single instance/time/place)
- Monitoring for Academic Integrity – repetitive or continual review that students are complying with academic policies; Can consist of more than one instance of *authentication* or other repetitive monitoring methods
- Biometric - physiological features that can be used to uniquely identify an individual; Can include: facial recognition, voice identification, computer keystroke tendencies, movement recognition, fingerprinting, and iris scanning

Becoming More Commonplace

- Non-University organizations and accreditation bodies, including the U.S. Department of Education, are taking an increasingly active interest in methods of Authentication, particularly for online, distance-education programs
- In order to grant access, Biometric Authentication systems compare the biometric provided during a "login" attempt versus the template created during user enrollment



Easily Integrated Into Everyday Life

- Biometrics can be collected via specialized sensors or even using everyday items like webcams, microphones, or computer keyboards

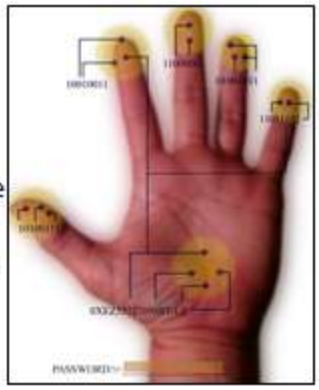
Pros/Cons of Biometrics

- Benefits of biometrics include:
  - **convenience** – this "passkey" is always with you (less to remember for the same or better level of security)
  - **security** – commonly expected that a properly implemented system will provide improved overall security as compared to non-biometric methods (passwords, keycards, etc.)
- Biometrics can also have negatives associated with them:
  - **individual discomfort** - perception of "invasiveness"
  - **privacy** - concerns over securing information from loss or misuse; Biometrics are biological features - not as easy to change as a typical password
  - **misuse** - how any biological information could be used in the future (to determine likelihood of a certain disease, for instance) is unknown; When you give your biometric, you are trusting the institution to use it ONLY for identification

Note: In a properly implemented system, it's impossible for any identifying information (including the biometric itself) to be transmitted outside the system

Monitoring for Academic Integrity

- Monitoring technologies during online exams can include a range of technologies - from asking the test taker repeated personalized identification questions (driver's license ID, mother's maiden name, date of birth, childhood home address, etc.) to sensing unauthorized use of alternate web pages (Google) during an exam



- Some companies even provide a "remote proctoring" service, where the assigned proctor observes a student's webcam video/audio during an exam

Eye of the Beholder

- Monitoring does not necessarily make use of video, but could rather comprise a combination of sensors and computing, based on knowledge of the user – known as "multi-biometrics"
  - Video games that accurately monitor body movement using sensors are becoming increasingly popular

  - Monitoring Example: detecting that a student's typing/writing style during an exam is inconsistent with their previous typing/writing style throughout the semester

Not new… Not going away

- The first commercially available biometric device (hand geometry) came to market back in 1976.
- Since then, there have been a variety of commercially-implemented applications for biometrics:
  - Entry/security at some amusement parks
  - Government biometric databases to get you through airport security faster
  - Remote facial recognition for surveillance in casinos
  - Fingerprint-based security to prevent laptops from being accessed by unauthorized users
  - Medical applications using iris recognition to ensure medication/treatment is administered to correct patient

Online Survey

By clicking the link below, you acknowledge that:

- The purpose of the study, the proceduresto be followed, and the expected duration of your participation have been explained to you.
- No payment will be provided, and possible benefits of the study have been described.
- You have had the opportunity to obtain additional information regarding the study and that any questions you have raised have been answered to your full satisfaction.
- You understand that you are free to withdraw consent at any time and to discontinue participation in the study without prejudice towards you.

- Take the survey here: http://www.surveymonkey.com/s/XXXXX
  Password<ALL CAPS>: AUTH

THANKS, AGAIN, FOR YOUR PARTICIPATION!
- Dr. David Hernandez

References

- O'Leary, T. (2008). Acceptance and accuracy in biometrics. *Security Dealer & Integrator, Vol. 30*, Pg. 52.
- Wayman, J., Jain, A., & Maltoni, D. (2005). *Biometric systems: Technology, design and performance evaluation.* London, GBR.
- Adams, J. (2006). Biometrics: The keyboard has a good memory. *Bank Technology News,* Vol. 19(3), Pg. 31.

Appendix B
Full Questionnaire Content

Note: Each participant will be asked exactly 11 questions, in-total. The principal investigator will tailor the questions, as a function of the degree of participation and the ability to fulfill the mathematical requirements for analysis of specific cells.

Questions are numbered, with "-<#>" and "-<#><letter>" designations denoting possible alternative phrasing to be used in a different cell, with an independent group of randomly-selected participants.

1) What is your age?
   - 18 or younger
   - 19 to 24
   - 25 to 29
   - 30 to 34
   - 35 to 39
   - 40 to 44
   - 45 to 49
   - 50 to 54
   - 55 to 59
   - 60 to 64
   - 65 to 69
   - 70 or older

2) Have you ever served in any branch of the military, or not? <SM>
   - Yes, I have
   - No, I have not

3) Are you male or female?
   - Male
   - Female
4) Are you an ERAU-W graduate student?
   - Yes, I am currently enrolled in a graduate degree program
   - No, I am not currently enrolled in a graduate degree program

5) Have you ever used a webcam to attend a video conference (example: Skype, ERAU EagleVision, Polycom)?
   - Yes, I have
   - No, never

6) I would be willing to use a fingerprint scanner as a prerequisite (requirement) for taking an online exam
   - Strongly Agree
   - Agree
   - Neither Agree Nor Disagree
   - Disagree
   - Strongly Disagree

7-1) I am very likely to provide Embry-Riddle Aeronautical University with my fingerprint biometric information during an online exam, to better address academic integrity

   - Strongly Agree
   - Agree
   - Neither Agree Nor Disagree
   - Disagree
   - Strongly Disagree

7-2) I am very likely to provide Embry-Riddle's selected partners (for example Blackboard or Saba Software) with my fingerprint biometric information during an online exam, to better address academic integrity

   - Strongly Agree
   - Agree
   - Neither Agree Nor Disagree
   - Disagree
   - Strongly Disagree

8-1) A "remote proctor" (observing my webcam video audio) for an online test would feel no different to me than an in-person proctor at a physical classroom exam

   - Strongly Agree
   - Agree
   - Neither Agree Nor Disagree
   - Disagree
   - Strongly Disagree

9-1a) I am very likely to provide Embry-Riddle Aeronautical University with my webcam video/audio during an online exam, to better address academic integrity

   - Strongly Agree
   - Agree
   - Neither Agree Nor Disagree
   - Disagree
   - Strongly Disagree

9-1b) I am very likely to provide Embry-Riddle's selected partners (for example Blackboard or Saba Software) with my webcam video/audio during an online exam, to better address academic integrity

- Strongly Agree
- Agree
- Neither Agree Nor Disagree
- Disagree
- Strongly Disagree

8-2) A "remote proctor" (observing my webcam video audio ONLY in the case of a detected irregularity) for an online test would feel no different to me than an in-person proctor at a physical classroom exam

- Strongly Agree
- Agree
- Neither Agree Nor Disagree
- Disagree
- Strongly Disagree

9-2a) I am very likely to provide Embry-Riddle Aeronautical University with my webcam video/audio, in the case of a detected irregularity during an online exam, to better address academic integrity

- Strongly Agree
- Agree
- Neither Agree Nor Disagree
- Disagree
- Strongly Disagree

9-2b) I am very likely to provide Embry-Riddle's selected partners (for example Blackboard or Saba Software) with my webcam video/audio in the case of a detected irregularity during an online exam, to better address academic integrity

- Strongly Agree
- Agree
- Neither Agree Nor Disagree
- Disagree
- Strongly Disagree

10) For my ERAU Worldwide online courses, I believe I have access to a computer where installing a USB device (fingerprint scanner or webcam) to participate in exams would be possible

- Yes, installing a new USB device would be no problem at all
- No, I cannot install new devices on the computer I use

- I’m not sure

11) During my survey participation, I learned some NEW information, that I hadn’t considered before, about Authentication and Monitoring for Academic Integrity

- (1) Yes, LOTS of new stuff
- (2) Some minor new information
- (3) No, nothing I hadn’t read/heard before

Appendix C
Author-Selected, Representative Student Comments
(Received via Email, Separate from Survey Instrument)

"…my response was negative because at $495 per unit and an average of $200 per book per course I cannot afford to purchase any type of biometric ID device/video cam. Our household operates on cash debit only."

"Biometrics is going to be a good tool to increase authentication and fidelity of the online classroom."

"…3rd parties cannot be trusted with information in their possession. Blackboard cannot even upgrade their system without major inconveniences to worldwide students. Once an image/video is "out-there" there is no calling it back, privacy may be an issue with the video feed."

"In regards to the biometrics scanning type stuff, I'm not opposed to it in principle but I do have two concerns. First, I love ERAU but it is expensive. If this is something else I have to pay for then I would probably not like it…"

"I do business online so I trust large entities as far as using my financial data and such but I feel EARU would have to have a strong policy on protecting the bio data as well as some form of bond or insurance in case there is a leak. Also I think they would need an independent company to annually audit their procedures to be sure they are being adhered to."

"I would not participate in biometrics scanning if it was handled by a third part(sic) as I trust ERAU not someone else. I would in fact not continue my education with ERAU if they required biometrics and had it outsourced."

"You are NOT entitled to make any demands on me regarding surveys or anything else."

"…the military network will not allow for USB devices to be plugged in on the network. In some commands it will remove the computer completely from the network. For those in deployed locations that use the MILNET to access their classrooms, you may run into difficulty there."

"…I've also heard people bragging about their wives or others taking tests and doing papers. One student (not ERAU), boasted his wife did his entire master's degree for him -- start to finish."

"As for the video proctoring I have no issue with it I just don't see how that would work. ERAU has students in just about every time zone. One thing I love about ERAU is scheduel(sic) flexibility. If I had to adhere to a schedule so that someone could watch me test and such, I probably wouldn't be able to attend. When I did my undergrad with ERAU I had to drive 1.5 hours to their nearest extended campus to have exams proctored. I was fine with that because I still had the ability to schedule it when I was available."

“ an y of your students are military members or civilian DOD contractors or employees. On many occasions, these individuals are attempting to take your courses online while deployed. When deployed, these individuals are not able to access reliable, high speed broad band connections that would support heavy webcam network traffic…I myself have taken courses while deployed. Many times the videos and streaming medial(sic) are quite difficult using the satellite broadband connections.Please consider this factor as you look for solutions to academic fraud.”

“Over the last 8+ years, I've lived in Iraq and Afghanistan. As somebody who spent ~$80K on my twin bachelor's degrees, I was really offended at how pervasive and open the cheating is in online courses.”

“I would not have had any problem with biometric scanners prior to reading your power point presentation, but now I am unsure. No security is 100% and losing control of biometric information would be more serious than typical identity theft. If the US military cannot prevent their most secure secrets from being hacked, I doubt a college can guarantee the protection of any information they collect.”

“…my laptop has the capability to share video. I have the camera lense(sic) covered until such time that I need it, and here is why. When I work from home, sometimes I don't dress and shower for a couple of hours after I get up… I don't want my co-workers / classmates to see me in this state. Simple as it is, if it comes down to proctoring tests via video...I would probably rather go to the local campus and have one of them proctor… the convenience of this online course has allowed me… to enjoy and stretch my mind at my own pace.”

“I have enjoyed the online college experience. As a person working long and sometimes unpredictable hours the flexibility has been essential to my continued education (most of my schoolwork is done on the weekends), however I would have to give serious consideration to more conventional education if this is the future of online education, and I suspect it is. Unfortunately I cannot think of a better alternative to biometric scanning. If it were not for the security issue it would seem the perfect solution.”

“Something needs to be done. y degrees are being made worthless despite the huge investment in my time and my money. Essentially, the value of my degrees is being stolen -- there is no other way to describe this: theft.”

“Biometric authentication does offer the possibility of addressing some of this, but there are challenges. Down range the access rules change constantly, as do rules on the rights to install software or add USB devices. Internet access available one day, can then be blocked for weeks or months without notice.”

“…social networks, government agencies, and some workplaces have too much information and feel a certain entitlement to that. I would hate that my school would also get to that point.”

"This is scary for me because in order for any of these devices to work they must turn whatever information they gather (retna[sic]scan,finger print, voice recognition) into a digital file or packet; what safeguards would be there to make sure it wasn't accessed by unauthorized users? …The only reason why I would agree is that I feel like it gives my online education that much more credibility. So far in my studies at [E]mbry-[R]iddle I have never doubted the value of my courses, but there are those in our world that look down on an online education and feel like it is somehow not earned with the same level of accountability as an in person type of program. I would do anything I could to improve the image, and therefore add to the value of the degrees that all of us are earning."

"…I like that it is an area of research and think that as distance learning continues to evolve from its primitive form of videoconferencing on a one-to-many model to the modern distributed classrooms, anti-cheating solutions should evolve as well."

SECTION D

Qualitatively Informed Propositions for Teaching Research Methods to Aeronautical Science Students

Dr. Jeremy K. Hodges

Embry-Riddle Aeronautical University – Worldwide

Author Note

Jeremy K. Hodges, College of Aeronautics, Embry-Riddle Aeronautical University – Worldwide.

Correspondence concerning this article should be sent to Jeremy Hodges via Email: Jeremy.hodges@erau.edu

ABSTRACT

Recent changes to Embry-Riddle Aeronautical University's Master of Aeronautical Science program have been implemented with difficulty by the faculty who teach Research Methods, and the learning objectives have not easily translated into concepts quickly grasped by the students. In this qualitative, grounded theory study, I evaluated 126 comments from 196 Aeronautical Science students through an inductive approach to identify themes for improving the administration and execution of the Research Methods course. Positive and negative themes indicate that students seek clear expectations, examples, and feedback to improve understanding of these complex concepts. Four propositions are presented: infuse an inquiry-based learning approach using templates and examples, improve student readiness, present final project options, and sequence the program.

Introduction

In August 2010, Embry-Riddle Aeronautical University (ERAU) updated its Master of Aeronautical Science (MAS) program to include three options for a graduate capstone project (GCP). This adjustment removed the singular ASCI 605 Graduate Capstone Project Proposal course and introduced two courses: RSCH 665 Statistical Analysis and RSCH 670 Research Methods. The culminating ASCI 691 Graduate Capstone Project was modified from an individual project, much like a thesis, to allow the student one of three options: a comprehensive examination, an individual project, or a group project. As with any change of this significance in a large organization, issues arose during the implementation and execution of the new format.

ERAU recently adopted an inquiry-based teaching and learning approach as an initiative of faculty development to encourage research and discovery (George, 2012). This initiative champions the use of exercises that engage students' ability to apply prior knowledge to learn a new concept (George, 2012). The inductive approach to learning is similar to qualitative methods applied in research, as described in the RSCH 670 texts by Creswell (2009) and Leedy and Ormrod (2012), with the researcher exploring and gaining understanding of a subject. Educators in the Aeronautics Department face unique challenges when using this teaching style for this subject because many science-based courses are generally taught with a deductive approach (Prince & Felder, 2007). This paper addresses these challenges by offering propositions for the administration and execution of the Research Methods course.

My experience in this matter comes from teaching the Research Methods course, in online and lecture formats, to over 190 students in the MAS program as of October 2012 and having been a member of 62 graduate capstone project committees. This article is written from the point of view of the instructor, with a primary goal of recommending propositions to improve

student understanding during the course. In addition, elements of an inquiry-based approach could be used to better prepare aeronautical science students for the capstone project required to successfully complete the MAS program. A secondary goal of this article is to recommend strategies for improving AS students' readiness for introduction to research concepts and workload management by exploring the use templates, including what these templates should contain. Achieving these goals may provide a theoretical framework for future quantitative studies focused on making quality improvements to the Research Methods course and aid course instructors in teaching the course material through enhanced understanding of the unique needs of Aeronautical Science students.

Problem statement and significance. The problem investigated is that aeronautical science students at the graduate level at ERAU have difficulty grasping the concepts of research projects because a model of instruction for that subject is not widely applied among the faculty. The deficiency of instructor readiness stems from fundamentally misunderstanding the needs of aeronautical science students when making the leap from writing scientific papers to conducting research projects (Burke & Rau, 2010; Prince & Felder, 2007). This problem affects all students in the MAS program to varying degrees and will continue to cause frustration for them until the best ways to meet their learning needs are found and implemented. Propositions resulting from this study should be fully examined through direct assessment data to inform the format, content, structure, and sequence of the MAS program as it relates to preparing students to learn research methods to apply in their coursework.

Purpose statement. The purpose of this qualitative, grounded theory study was to explore concepts of research methods instruction for aeronautical science students at ERAU. The intent was to develop propositions concerning the techniques best applied when teaching

Research Methods and develop ideas related to course content, structure, and sequencing. The themes identified herein were discovered through analyzing feedback from Research Methods students. These themes were synthesized as they relate to student readiness to learn research methods and necessary attributes of the Research Methods course to meet students' learning needs.

Research question. The guiding research question for this study was as follows: What propositions best describe the ways that research method attributes should be presented to Aeronautical Science students so they can successfully apply research method concepts across the MAS curriculum and complete research projects at ERAU? This question was addressed by identifying themes in student comments concerning the Research Methods course, an inductive method for qualitative analysis as described by Creswell (2009). The resulting propositions were developed from an evaluation of these comments and the common threads of student opinions related to the attributes.

Limitations and delimitations. This study is limited in its scope; it is not intended to be a large-scale quantitative study. Rather, my specific observations and comments from my students were appropriate for the qualitative nature of the research problem. Approximately 40 comments could be used to derive the general themes and patterns for drawing inferences and making recommendations. Another instructor's students may have different experiences, resulting in different comments. The study is also limited by the time frame of the data being evaluated. The results of this study could inform future researchers, instructors, and planners concerning how to administer and conduct the Research Methods course. Subsequent studies of the same nature will be impacted by any changes to the course that occur after October 2012.

Literature Review and Background

Burke and Rau (2010) identified a gap between research and practice in management, and suggested ways to bridge that gap through education. Students prepared with thoughtful, methodical, and sound research techniques are more likely to be successful in completing the MAS program and in solving complex aerospace industry problems. This preparedness begins with their critical research education.

Reviewing the literature and framing a background for this study, I found three clear areas to be discussed. First, as a frame of reference, details of my initial assessment and interpretation of the course, as well as my strategies for delivering it to students in the most effective manner, are presented. Second, incorporation of the inquiry-based learning approach in education is discussed. Finally, reasons for using a qualitative method to explore this subject and the appropriateness of the grounded theory strategy of inquiry are discussed.

Initial assessment. In my initial assessment of the course format and content, three primary problems for students were anticipated: (a) A lack of understanding the purpose of the course, (b) a lack of understanding the required format for a research paper or complete research project, and (c) a lack of appreciating the workload to accomplish the requirements within the allotted time of the course. To investigate the first anticipated problem, students were asked to provide their background and goals in the introduction forum or discussion. Many students remarked that they were looking forward to how this course would prepare them for the GCP at the end of the program.

Although all courses are designed to enhance student success in the GCP, students were especially inclined to think that Research Methods was specifically a GCP-preparation course. Students anticipated that a proposal of sorts would be created in the Research Methods course

that would transfer directly to the GCP. However, such a proposal is not the intent of the course, and even after my repeated attempts to explain this concept, students were reluctant to accept it. Part of this confusion was propagated by the course material that discussed the requirements for the GCP, including the grading rubrics, discussion of program outcomes, and assignments based on the three GCP options.

To mitigate the lack of understanding of the required format for a complete research project, I created templates containing detailed instructions as an example of acceptable work for each assignment. Assignments in the course are related, in part, to the comprehensive examination, individual project, and group project options for the GCP. Example assignments that included title pages, abstracts, headings, discussion, citations, and references were provided, along with theory and requirements for each individual section. These were my templates because no camera-ready graduate capstone guide has been produced (although a draft exists as of November 2012) to standardize this information across the department.

Students are also largely unaware of the MAS program outcomes, and their role in demonstrating achievement of them in the GCP. Many students explained that they had never heard of the program outcomes before and struggled with how to integrate them into each of the three project options. Students had difficulty choosing a manageable research topic while including the required elements of the program outcomes.

Early in the course, students commented about the difficulty of understanding the complex material, the program outcomes, and the specifics of what a research project will entail. Students are told that extensions should not be expected and that work should be done correctly the first time. Many students have voiced a concern over a lack of leniency in the time allotted to complete the required Research Methods course assignments.

In the online version of the course (RSCH 670), students participate in a weekly discussion by responding to discussion board questions and replying to at least two other students' posts. These discussion questions range from expressing thoughts on ERAU's Institutional Review Board policy to developing a timing chart for someone attempting to obtain a private pilot's license. It is a stretch to say that all of these weekly discussion assignments are directly related to the course objectives.

The course assignments require students to write a comprehensive examination question (developing a question, not answering one) and to revise and write two additional questions. Abandoning the "Comprehensive Examination" thread, students write an introduction to an individual project proposal and group project proposal. Finally, each student chooses one of the three GCP options and writes a complete methodology section for the chosen proposal. The additional graded requirements for the course include an interview script and a final exam.

Incorporating inquiry-based learning. The learning process is informed by research (Burke & Rau, 2010), so using the inquiry-based learning approach to teach research methods makes sense. The role of the instructor is not only to teach but also to facilitate knowledge exchange (Locke, 1996). This process is easier at the master's level (Colbeck, 1998), probably because of the immediate application in the first major research project and paper presentation required for graduation.

Arbaugh, Hwang, and Pollack (2010) reported that, in studies of online and blended learning, faculty members were more apt to comment on their ability to accept online technology rather than their role in facilitation. The importance of shifting toward a research-minded and invigorated faculty was encapsulated in ERAU's "Ignite" initiative. The idea of infusing the

inquiry-based learning approach and fostering discovery among students is especially critical in the MAS program.

Getting science and math instructors to embrace and use the inquiry-based approach can be difficult. Inoue and Buczynski (2011) found that inquiry-based lessons were difficult for undergraduate pre-service teachers to incorporate into mathematics lessons. In the same context, concepts that are less abstract and more linear seem to be best suited for the deductive approach rather than the inductive approach as described by Prince and Felder (2007).

Inquiry-based learning offers great advantages when the student builds on previously known material. The idea is for the student to discover a concept, solve open-ended problems, develop a project, or evaluate a case (Prince & Felder, 2007). However, if the instructor is not prepared through experience or education, if the students lack subject knowledge, or if resources are lacking (i.e., time, approved course materials, case studies, and so on), then attempts to use the inquiry-based learning approach may not be appropriate (Prince & Felder, 2007).

A successful implementation strategy for an inquiry-based learning approach was presented by Zorfass and Copel (1995). In their study of seventh grade students, they tested a four-step process that immersed participants in a motivating theme, assisted students in developing their own research plans, assisted students in revision of plans, and finally evaluated student papers or presentations (Zorfass & Copel, 1995). The key theme of their research was that students who participate in guided research activities are more motivated and more engaged. Faculty members are responsible for planning, coaching, using a variety of sources, and assessing student work in order to effectively execute this teaching method (Zorfass & Copel, 1995). With a faculty consisting of members located worldwide, developing consistency in utilizing this method may be challenging, but rewarding.

Although experiential exercises that demand involvement, engagement, and application can teach information literacy (Devasagayam, Johns-Masten, & McCollum, 2012), it is important to provide a foundation and framework for that learning. Providing standardized language in a "boilerplate" document or template, at least for qualitative research, has been suggested (Colquitt, 2009), following Gephart (2004). The idea that a standardized format would help to develop understanding, give direction, and improve the effect of writing is not limited only to qualitative researchers but certainly could be extended to master's level students learning the basics of writing research reports.

Christensen and Carlile (2009) described the process of developing theory, another topic relevant to students in the inquiry-based class and to qualitative researchers. Students who participate in an inquiry-based exercise come to conclusions about their own understanding of the concepts and develop ideas through reflection and feedback. In a similar way, the descriptive stage of theory development for researchers involves observation, classification, and defining relationships (Christensen & Carlile, 2009). In each case, a phenomenon or central subject is being learned, and conclusions about correlation or causality are being formed. This sort of research-based approach to teaching demonstrates how to use inquiry-based learning methods in the classroom or through online activities.

Using a qualitative design. As described by Creswell (2009), quantitative and qualitative designs have their own characteristics, strategies of inquiry, and methods of data collection. The premise for research that delineates the two designs is that quantitative design focuses on the evaluation of well-established variables of a construct while qualitative design explores the nature of a construct, generally when variables or relationships are not understood. While quantitative data about opinions and attitudes related to specific course content, delivery,

and instructor were available to me through the end-of-course survey, I believed the nature of my research required a qualitative approach.

First, the observations, my position, and my role in the research provided me with direct and immersed access to the participants in their environment. Second, although I am concerned with improving the course content, delivery, and my teaching by reviewing feedback from students, it was important to take a holistic view of the uncategorized comments across multiple courses for this evaluation. Among the various strategies of inquiry related to the qualitative method, the grounded theory is used to derive an abstract view of a process or interaction that is grounded in the views of the participants (Creswell, 2009). Taking the comments from the end-of-course survey as observation points and coupling them with the interactive experience I had with the students enabled me to organize the data into a usable format. Creswell recommended identifying themes and patterns in qualitative data and using an inductive approach to develop a theory or proposition.

To present the methodology and the resulting propositions, the style described by Colquitt (2009) is used herein. Colquitt suggested showing the data in the body of the text, associating the interpretation with the research question, describing and presenting theories, and ensuring the use of an inductive approach. Problems with the qualitative write-up often include trying to present the qualitative methodology using quantitative tactics. These problems are overcome by remaining in the qualitative mindset when writing and reviewing, specifically, being less concerned with small samples and not trying to mix inductive and deductive strategies (Colquitt, 2009).

Methodology

The purpose of this qualitative, grounded theory study was to explore concepts of

research methods instruction for aeronautical science students at ERAU. Because of the exploratory nature of this study, an inductive approach was used for data collection and analysis (Creswell, 2009). Creswell recommended that raw data be organized and thoroughly reviewed, grouped into themes or patterns, and then interrelated and interpreted. In this study, data were gathered from 196 students enrolled in the Research Methods course between May 2011 and October 2012. The standardized university end-of-course feedback form, administered electronically, was used for data collection. Permission to use the student comments for this study was obtained from the ERAU Institutional Review Board Chair in October 2012.

The quantitative approach was not used because of the exploratory nature of the study (Leedy & Ormrod, 2012). The need to determine themes and attitudes across multiple course offerings was important to establish a reference point from which propositions could be developed to further the discussion on how to move forward with presenting Research Methods concepts to aeronautical science students. Quantitative studies may be appropriate in the future to investigate the conclusions of this report.

Two major themes were identified during the analysis. First, comments related to course or instructional deficiencies in such areas as material, format, structure, flow, and delivery were identified. Second, comments related to course or instructional proficiencies in such areas as delivery techniques, presentation, or additional information students deemed helpful in understanding the course material were also identified. These themes can be succinctly summarized as what students thought the course lacked and what students thought the course provided.

From nine courses, 109 of 196 students completed the end-of-course survey provided by the university. One hundred twenty-six written comments in various parts of the surveys were

examined for remarks about the two major themes. Comments were clustered for presentation to establish themes and meaning for application to the research question. Of these comments, 27 related to deficiencies while 12 were associated with positive attributes of the course material or instruction.

Results

To present the results, I chose to follow the suggestions of Colquitt (2009) by showing the data in the text while identifying themes as described by Creswell (2009). Comments related to deficiencies and proficiencies were sought throughout the student feedback and then were clustered into patterns. Finally, patterns were developed and described by an overarching theme that could be translated into informed propositions.

Comments related to deficiencies. The following comments addressed deficiencies in the course. They are presented in the order in which they appeared in the survey sets. Only the relevant wording of the comment is presented.

- "[I]t would be nice to have a couple of pristine examples of what some of the projects should look like. It was difficult to understand exactly what was expected up front."
- "[P]osting your example of a strong Individual Project Activity at the beginning of class would have helped and would have elminated [*sic*] a lot of the confusion at the beginning of the class."
- "I think ASCI 665 should be a prerequisite for this course."
- "You should have a good foundation in statistical testing methods and terminology prior to writing methodology for a graduate capstone project."
- "[T]aking this class early was a mistake."

- "[I]t would be nice to have pristine examples of some of the expected writings for the class to understand what is expected."
- "The intent of the GCP from ERAU was not accurately conveyed in 670."
- "[ ] ore information needs to be taught regarding the intent of the GCP."
- "[T]here should be an example of each [assignment] provided under resources to give students a framework from which to deviate from. It was not until we actually saw a sample IPA that many of us, myself included, had a clear picture of what was expected for this assignment."
- "[N]ot having a solid frame of reference to work from puts students a disadvantage, especially for such an important course."
- "Assignment instructions need to be clearer."
- "If you are going to use a template and have students fill in information then it needs to be clear where the students need to input their material."
- "This course could be made better by giving a few more examples of good comprehensive exam questions."
- "[W]ould be better if it were more tied in with 691."
- "I would recommend more examples of what the homework should look like as the examples given were a little light on details."
- "[F]eedback I recieved [*sic*] was strictly focused on the structure and format."
- "A little more how to and explanation in regards to format, style and what it is we are supposed to be writing."
- "Embry-Riddle needs to develop a technical writing course as none of my previous courses have prepared me to write at in the style required for the GRP."

- "I wish there were a better introduction and explanation of statistics."
- "I think ensuring the student have a good working knowledge of statistics prior to taking this class can help."
- "I would have liked to have seen LOTS of other research proposals to use in developing mine . . . . [I] think a bank of good proposals that can be used as 'case studies' perhaps would make up for the lack of one-on-one live instruction."
- "I am still confused about the differences in individual and group project requirements and program outcomes."
- "The objectives of the assignment were not very well presented."
- "I would recommend that there be a more clear discussion of the three different main assignments."
- "[A] narrated power point it would of [*sic*] helped clarify the information."
- "[D]iscussion boards are completely pointless and do nothing to add to the learning experience."
- "[C]omprehensive exam part of the course be explained in greater detail."

Several negative themes delineate the deficiencies that the students felt could be addressed or general misperceptions about the course's purpose. The first theme identified was the need for pristine examples of what the assignments should look like. Another negative theme in the comments was the desire for feedback on writing style. Finally, the students expressed regret concerning not being prepared with an understanding of statistics or the MAS program outcomes.

Comments related to proficiencies. The following comments addressed proficiencies or innovations in the course. They are presented in the order in which they appeared in the survey sets. Only the relevant wording of the comment is presented.

- "[The instructor] also clarified much of the ambiguity in ERAU's new MAS graduation requirements."
- "The assignments were not superfluous."
- "The other shells provided by the instructor were great."
- "Set the standard early."
- "[W]e need someone who is going to make sure we do what we need to do to produce high quality research."
- "[A]ppreciative that the course material was displayed [open for access] early."
- "The examples really helped with writing the project proposals."
- "I appreciated the examples provided as resource for assignments."
- "[P]roviding an example paper and breaking the sections down into weekly assignments was great."
- "[O]ffered critical feedback on all assignments."
- "The instructor's involvement and continual feedback was an important aspect of success in this course."
- "[T]he instructor's involvement coupled with the very specific examples for each assignment took a complex subject and advocated [*sic*] its understanding through electronic means in a very efficient manner."

Several key points related to the positive theme were found in the students' feedback. First, the students mention appreciation for set standards, clarity, and detailed information about

the requirements. I added a detailed example/template for each major assignment to the course content; in these examples, the students could see my interpretation as well as my expectations. Students expressed that these templates were immensely beneficial. Providing templates is necessary to accelerate understanding when students face a significant workload and depth of foreign concepts as they are in the Research Methods course.

The overarching theme attached to these types of comments is to provide clear expectations to the students, early and clearly. This theme is supported by some of the negative and positive comments received. The most relevant student feedback pointed toward a series of propositions that should be considered by the MAS program chair, MAS faculty, and specifically Research Methods instructors.

Discussion, Conclusions, and Recommendations

The overarching research question for this study was the following: What propositions best describe the ways that research methods attributes should be presented to aeronautical science students so they can successfully apply research method concepts across the MAS curriculum and complete research projects at ERAU? Developed from the themes found in the student comments, four propositions describe ways to present the Research Methods course to aeronautical science students to help improve their understanding of the concepts and increase the likelihood of their success in completing research projects. The propositions are related to using templates, informing students about the MAS program outcomes, adjusting the comprehensive examination material from RSCH 670, and sequencing the MAS program.

Proposition 1. Aeronautical science students benefit from the use of research project examples and templates, and doing so accelerates their understanding of research project structure, flow, and content requirements. The students asked for examples and templates that

illustrate exactly what is expected of them. The current examples provided in the online version of the course offer little detail, and there is no formal example usable for the lecturer. For the wide variety of research methods available for the MAS student to choose from, representative examples are lacking.

I recommend ERAU develop approved examples of the popular research designs and strategies of inquiry and instructors of the Research Methods course augment these examples with templates that specify exactly what the specific instructor expects for each section of a proposal assignment. Student projects will always be as diverse as the students. Student use of templates allows for faster internalization and standardization of formatting while also allowing them to be creative. In addition, the use of templates would standardize the assignments' format and depth requirements for all students. This standardization means easier objective evaluation of format by instructors, allowing them to focus feedback on the unique aspects of the proposed research.

The use and application of templates is not contrary to the inductive-learning approach. One key element of this approach is that students have a base for applying new concepts (Kolb & Kolb, 2005). The exercise, in this example, would provide students a framework for constructing a research paper while allowing them the freedom to discover their own abilities in designing the research. The mix of designs, strategies of inquiry, methods, problems, research questions, hypotheses, and data analysis techniques are applied based on the students' creativity. As students gain understanding of the appropriateness of certain designs for certain problems, they will refine their own applications of the appropriate methodology for their individual studies. This approach is also consistent with the inquiry-based learning strategy presented by

Zorfass and Copel (1995), as previously mentioned, that provides a process example of how to implement this proposition.

Proposition 2. Aeronautical science students should be fully informed of the MAS program requirements, program outcomes, and specific purpose of each course as they enroll in classes each term. An analysis of the pertinent feedback provided by students from these courses showed that many of them felt under-informed about the scope of the MAS program, program outcomes, and the specific purpose of the RSCH 670 course. Many students also vocalized this feeling to me on the first day of the class, indicating confusion and even uncertainty about being in the right class. A process of informing students with more fidelity should be institutionalized and include the possibility of a welcome video explaining the MAS program that each new student would be required to view.

Although I understand that the student shares the responsibility to be informed sufficiently about the course requirements when enrolling in the course, I recommend that the university develop explicit procedures to ensure the student is informed about the MAS program, program outcomes, and the specific purpose of each course. This part of student readiness could be achieved through the academic advisors, ERAU Worldwide campuses, and the registrar's office before the student even takes his or her first class in the MAS program.

Proposition 3. Comprehensive examination questions should be written by the faculty and not presented in the Research Methods course. The placement of the comprehensive examination question assignment in Research Methods is very confusing for MAS students. In general, they are not familiar with the comprehensive examination process, and the act of writing their own questions, which may or may not be used for ASCI 691, is frustrating and confusing

and does not add value to learning the principles of research methods. Time discussing the comprehensive examination option in Research Methods is not well spent.

I recommend that the comprehensive examination be created from a pool of questions, written by the faculty to accommodate MAS students with varying specializations. Doing so will allow a student who chooses the comprehensive examination option to focus on answering the well-written questions provided while using the techniques for research he or she learned in Research Methods. I acknowledge that the administrative concerns with a limited and controlled pool of questions. Question maintenance, academic integrity, discouraging plagiarism, and so on must be addressed. However, I believe the benefits of having a faculty controlled, generic set of questions, applicable to the core program outcomes and tailored for each specialization, outweigh the management, approval, and workload issues of reviewing and approving student-created questions each term.

Proposition 4. ERAU should examine the value of making RSCH 665 Statistics a prerequisite for RSCH 670 Research Methods. It appears that some students who have taken Statistical Analysis place a value on learning that part of the discipline before taking Research Methods. Although the Research Methods course does not go into detail concerning statistics and students do not need to use or apply statistics in the course, some students indicated they thought Statistical Analysis would add to their readiness to learn the content of Research Methods. This belief is likely a result of the similar terminology in both courses (such as *hypotheses*, *statistical test*, *accept/reject criteria*, etc.).

I recommend that the University examine the value of modifying the sequence of the MAS program by requiring students to take RSCH 665 Statistical Analysis prior to RSCH 670 Research Methods. I believe this sequence will facilitate learning in the latter course, mitigating

confusion and enhancing understanding. Furthermore, I believe the underlying principles taught in Statistical Analysis are reinforced in Research Methods, a relation that does necessarily hold in reverse.

Summary

Whenever feedback is given, the need exists to show sensitivity to those who are receiving the feedback, however constructive it may be. My objective in this article was not to criticize the tremendous work of my esteemed colleagues in the Aeronautics Department. Many of these men and women are more knowledgeable, more seasoned, and more insightful than I. It is my intent only to offer informed suggestions about how we might improve the experience of learning in the Research Methods course for our students, better preparing them for the GCP and the subsequent challenges of working in the aviation/aerospace industry.

As an instructor who has taught Research Methods nine times, I believe this experience and evaluation of my own learning process could lend some insight to my colleagues. I recommend the propositions presented be carefully evaluated for good measure. Future quantitative investigations could assess the value of any implemented processes, procedures, or modifications to test the validity of these claims.

References

Arbaugh, J., Hwang, A., & Pollack, B. (2010). A review of research methods in online and blended business education: 2000–2009. *Academy of Management Proceedings, 2010*(1), 1–6.

Burke, L., & Rau, B. (2010). The research-teaching gap in management. *Academy of Management Learning & Education, 9*, 132–143.

Christensen, C., & Carlile, P. (2009). Course research: Using the case method to build and teach management theory. *Academy of Management Learning & Education, 8*, 240–251.

Colbeck, C. (1998). Merging in a seamless blend. *Journal of Higher Education, 69*, 647–671.

Colquitt, J. (2009). For the lack of a boilerplate: Tips on writing (and reviewing) qualitative research. *Academy of Management Journal, 52*, 856–862.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.) Thousand Oaks, CA: Sage.

Devasagayam, R., Johns-Masten, K., & McCollum, J. (2012). Linking information literacy, experiential learning, and student characteristics: Pedagogical possibilities in business education. *Academy of Educational Leadership Journal, 16*(4), 1–18.

George, K. (2012). *FACD 801 transcript*. Embry-Riddle Aeronautical University, Daytona Beach, FL. Retrieved from https://erau.blackboard.com/bbcswebdav/pid-11153816-dt-content-rid-53811228_2/courses/FACD801_Ignite/FACD_801_transcript.pdf

Gephart, R. (2004). What is qualitative research and why is it important? *Academy of Management Journal, 7*, 454–462.

Inoue, N., & Buczynski, S. (2011). You asked open-ended questions, now what? Understanding the nature of stumbling blocks in teaching inquiry lessons. *Mathematics Educator, 20*(2), 10–23.

Kolb, A., & Kolb, D. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning & Education, 4*, 193–212.

Leedy, P. E., & Ormrod, J. E. (2012). *Practical research: Planning and design* (10th ed.). Upper Saddle River, NJ: Pearson.

Locke, R. (1996). *The collapse of the American management mystique*. New York, NY: Oxford University Press.

Prince, M. & Felder, R. (2007). The many faces of inductive teaching and learning. *Journal of College Science Teaching, 36*(5), 14–20.

Zorfass, J. & Copel, H. (1995). The I-search: Guiding students towards relevant research. *Make It Happen.* Retrieved August 31, 2013, from http://www2.edc.org/fsc/mih/article.htm

SECTION E

Weekly Discussion Board Questions Relationship to Grades

Ian McAndrew and Kent (Andy) Anderson

Embry-Riddle Aeronautical University – Worldwide

Author Note

Ian McAndrew and Kent (Andy) Anderson, College of Aeronautics, Embry-Riddle Aeronautical University – Worldwide.

Correspondence concerning this article should be sent to Ian McAndrew via Email: Ian.Mcandrew@erau.edu

ABSTRACT

To encourage in-class participation with online students and simulate face-to-face class experiences the weekly Discussion Board questions have been developed and applied as an integrated part of online learning. This research has investigated the relationship between grades for Discussion Board work and student achievement within a course. In particular how these findings can be used to meet ERAU's *Ignite's* objectives are addressed.

Keywords: Discussion Board questions, on-line learning, statistical analysis, research and student results.

Introduction

Discussion Board (Db) exercises are set in each module for online courses as it was initially conceived to be a way in which to encourage student in-class participation and thus simulate the experience of conventional class based education. Students are asked erudite questions in each module to discuss and respond to others. This weekly exercise populates the course's Blackboard site, shows students the site is active each week. It further offers the chance for students to share experiences and views between themselves that would otherwise go unrecorded by the classmates. Current aviation, specific problems or issues are integrated into these weekly tasks to enlighten students and instructors experiences A student is in effect forced to become involved and comment on others and have their works reviewed by others. With this work being graded it counts towards their final grade and cannot be ignore. This is not arguing that it is wrong; it is in effect a unique way to uniform this modality of study.

Discussion Boards

These weekly Discussion Boards do not replicate in-class experiences of a student that is quiet, not interested in responding and takes a passive role. Likewise if a student has lots to say or contribute with suitable experiences there are upper limits. Instructors are required to police and ensure all students are following the guidelines. An assumption has probably been made that a quiet student is likely to underachieve; many might argue opposite. This would normally happen in lectures in classic settings where class sizes of 200 plus could be expected, (Saunders, Saunders, Lewis, & Thornhill, 2011). Individual instruction or tutorials are where interaction is needed to develop the thought process with students, (Atman et al., 2010). Discussion Board questions are, in effect, a one size fits all for this scope of study and therefore will bring

advantages and disadvantages to all students at various levels. It has been suggested we do not need to engage students when they are working successfully, (Mertens, 2009). On the practical side this creates a weekly task where the instructor has to ensure and respond to postings that are weak or inclusive, for example, "… good post and interesting". When an online class is full this may mean the total number of postings over the week could approach 100 given a post that is presented and then two responses later on this discussion. Over a nine week course this will be in excess of 800 items to be read, commented on, critiqued for accuracy to ensure students do not have incorrect data or knowledge. Likewise, when a student that has posted their comments early that week they may have to wait until sufficient postings later that week to select which ones to respond. This may be an ineffective use of an Instructors time when their capability could be directing students at a higher level.

Methods

To evaluate the role of Discussion Boards as an indicator of research skills and ability/effort it is needed to divide the results into the separate categories; this is done here by when it is submitted *ipso facto* then started. The hypothesis of this research is:

H_o = students that achieve high grades for Discussion Board work achieve a higher grade overall

H_i = students Discussion Board results are not indicators of final grades

In addition, the relationship between the time when submitted and the final grade will also be investigated:

H_o = students that submit their Discussion Board work early achieve higher overall grades

H_i = students submission of Discussion Board work is independent of final grade

These will be analysis with using the Pearson Correlation co-efficient and a simple comparison of means between individuals and between the groups to determine trends and establish if the research hypotheses are correct.

Results

In Figure 1, below, is a breakdown from the authors' on-line courses of a distribution of the days of a week when students post on Discussion Boards. This figure separates out undergraduate and graduate ones. The data is from 2008 until present as is from 8 undergraduate and 7 graduate courses.

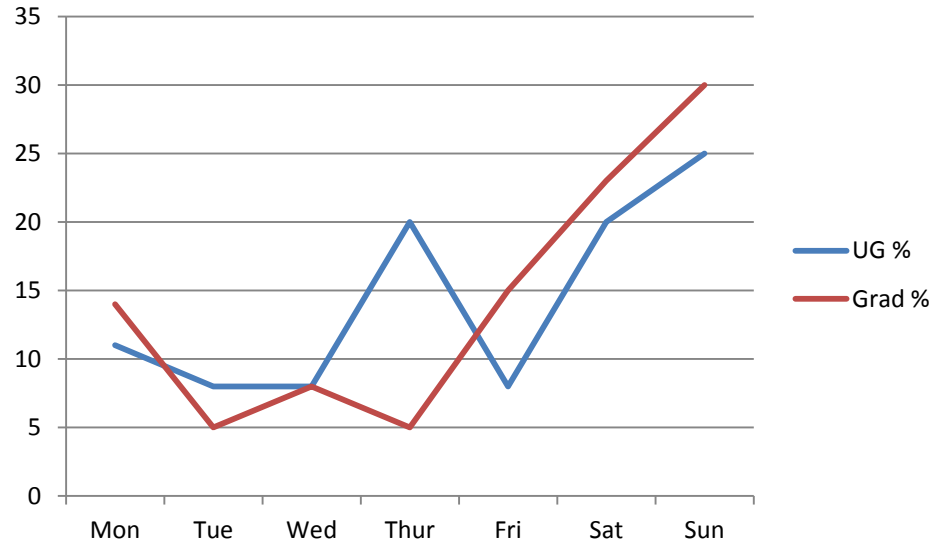


Figure 1. Percentage submission of work by day.

Figure 1, above, you can clearly see the breakdown in percentages of submissions by day of the week. There are similar trends between undergraduate and graduate students that may be explained by several principal reasons; however, this is in general terms only. Those that are graduate students may have more demanding jobs with travel and commitment that inhibit work during the week and they leave all to the weekend when time is less constrictive. Undergraduate students show a spike on a Thursday, catching up before weekends start is a possibility.

Nevertheless, the exact reasons are of secondary value and the distribution itself is critical, (Minner, 2010). For example, if we consider a student that posts on a Monday, they will have started the weekly module on-time and clearly dedicate sufficient time or concentrated on this item to start. They can post on others that have submitted early if these are not already reviewed, as such, they might have to wait until later in the week to complete the work. Having students that have to complete their study at a pace dictated by other students is not ideal. It could be addressed by allowing a student to comment on others regardless of how many posted responses already posted; although this would mean later posted work not reviewed at all. It would also make available weak work to be defended as a student would say "… if no feedback how was I to know otherwise?" Whatever way we justify the needs and reasons for discussion board work there will be limitations that need addressing or that will have consequences, (Lunenburg & Ornstein, 2011).

Relationships between submission of discussion board work and final grades. A trend was observed between the consistencies of the students' grades when they submitted their Discussion Board work. Those that submitted early each week consistently did so throughout the 9 modules of each course. The later submissions were less predictable; although a general pattern was observed. For the ease of comparison the data does not include any that had extensions to deadline, (Barnett, 2012).

Below, in Figure 2 is the correlation of average day of submission to final grade achieved for the weekly exercise. The undergraduate class had a correlation of, $r = -0.848$ whilst the Graduate was, $r = -0.953$. This suggests that those who start work and submit early are more likely to review the exercise with rigor and enthusiasm and produce work that will have a higher

grade. Differences between the undergraduate and Graduate could be explained by chance as there is no significant evidence to suggest otherwise.

A simple answer to this scenario is to enforce early starts to the work, an option that would be difficult to oversee fairly, given online is marketed as flexible, (Astin & Antonio, 2012). Alternatives could be to reward those that do; however, again this tries to condense each module. A negative side effect is that those that submit early tend to comment on the same people each week and those that submit later also tend to have the same situation. Without instructor supervision there is a risk of posting over generous comments.

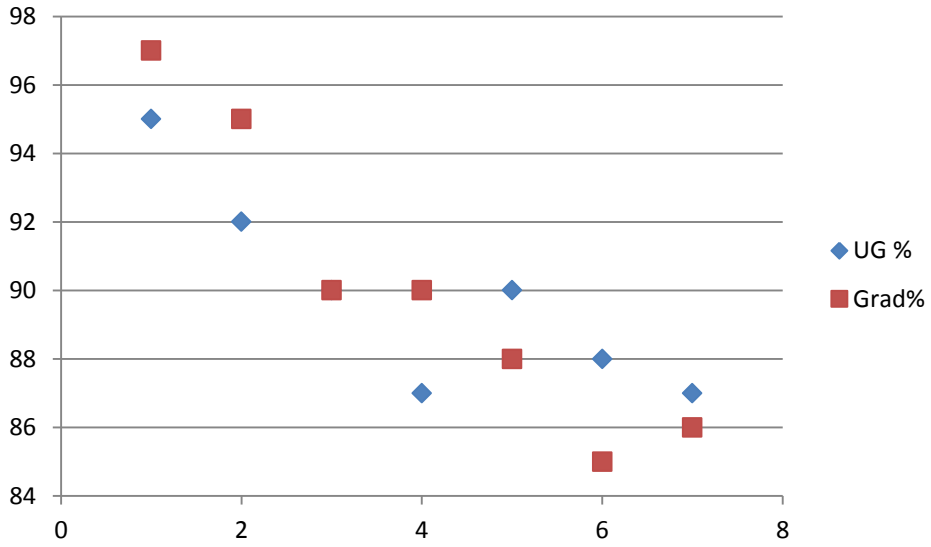


Figure 2. Relationship between grade and day of submission.

A comparison of discussion board grades against final grades is summarizes below in Table 1. Again, it can be clearly identified that there is a strong correlation between the earlier postings and an overall reported grade at the end of the course. This may of course highlight that higher achieving students have more time free to concentrate on their discussion board work, (Punch, 2009). This would be at odds with graduate students that can be argued to have achieved higher levels within their profession and certainly a greater commitment to time working. In

addition, given these results cover different courses, undergraduate and graduate, over an extended time period this suggests a trend that is validated further with the statistical results presented in Figures 1 and 2 above. Table 1 further goes to support that there is a link in the effort applied for discussion boards and final grades, regardless of day submitted; although this is indeed influential too.

Table 1

Percentage comparisons of grades.

Course	Early submission (Average)	Late submission (Average)	Pearson correlation co-efficient between early and final	Pearson correlation co-efficient between late and final
Undergraduate Discussion Board %	95	84	0.87	0.74
Undergraduate Grade %	94	88	0.84	0.78
Graduate Discussion Board %	97	82	0.89	0.81
Graduate Grade %	94	86	0.70	0.78

Table 1 shows the relationship between the time of submission each week for their discussion board and final grade for both undergraduate and graduate classes. Of particular importance is the Pearson product correlation showing not only a consistency of the relationship but a across both levels. The lowest level of correlation is from the graduate link of final grade compared to early submission of discussion board work. Clearly, this is demonstrating that there is a possible strong link between the enthusiasm for this type of work and commitment to research a problem. It can be counter argued that it is just students that starts early are more likely to have the time management skills to fully achieve higher grades. This view, of course possible, is not supported if you compare the consistency of grades within the groups and between the groups at both undergraduate and graduate level.

Discussion Board Questions as Research

If we consider the Discussion Board questions each week are an attempt to direct the students to address and review current or new developments then this is an area of consistency in research that need to be formulated and brought in-line with the *Ignite*. Research Learning Outcomes are at the center of all education within the Worldwide set of delivery modes. Given that in this represented sample of results showing the input we could argue that the Discussion Board aspect needs to be revised from its classic format to something more in line with research of a larger scale. Those, highlighted above, that not only focus on research activities but achieve consistent results, need to be supported in expanding and developing their research skills. In addition, those that are not so committed or struggling with this aspect need to be supported.

It cannot be left to RSCH 202 to be the seminal and principal driver of research that students undertake throughout their studies. ERAU Worldwide is committed to expanding the research skills of students at Undergraduate and graduate level, not just in the gaining of a degree but also as a life-long experience whilst working within their chosen career field. The Discussion Board exercises could be expanded to: make this part a larger contributor towards the final grade, increase the depth and complexity each week or combine these weekly exercises into a larger task.

Conclusion and Recommendations

What this paper and its analysis have demonstrated is that there is a significant link between the success and effort of working on the Discussion Board work to final grade. If it is universally accepted that Discussion Board work each week is an indicator of research skills then it must be questioned if this allotted work in each module is of significant benefit to maximize a student's potential. Further work is suggested to explore how this section of online can be

brought in-line with those of *Ignite* and improve the student's research skills. Furthermore, it is proposed that the expanding the tasks and depths of the research in discussion board work is undertaken. For example, do these results hold true for all their studies? If the link can be shown to be true for Discussion Boards and success based on research then the research aspect of Discussion Boards needs reviewing and a full and critical review of how we can integrate research into all courses.

References

Astin, A. W., & Antonio, A. L. (2012). *Assessment for excellence: The philosophy and practice of assessment and evaluation in higher education*. Rowman & Littlefield.

Atman, C. J., Sheppard, S. D., Turns, J., Adams, R. S., Fleming, L. N., Stevens, R., & Lund, D. (2010). Enabling Engineering Student Success: The Final Report for the Center for the Advancement of Engineering Education. CAEE-TR-10-02. *Center for the Advancement of Engineering Education*.

Barnett, R. (2012). Learning for an unknown future. *Higher Education Research & Development*, *31*(1), 65-77.

Lunenburg, F. C., & Ornstein, A. C. (2011). *Educational administration: Concepts and practices*. Wadsworth Publishing Company.

Mertens, D. M. (2009). *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods*. SAGE Publications, Incorporated.

Minner, D. D., Levy, A. J., & Century, J. (2010). Inquiry-based science instruction—what is it and does it matter? Results from a research synthesis years 1984 to 2002. *Journal of Research in Science Teaching*, *47*(4), 474-496.

Punch, K. F. (2009). *Introduction to research methods in education*. SAGE Publications Limited.

Saunders, M.K., Saunders, M., Lewis, P., Thornhill, A (2011). *Research methods for Business Students*, Pearson, India.

SECTION F

Application of Case Analysis to the Blended Modality in Graduate Coursework

D. Scott Worrells, Ph.D and Scott S. Burgess

Embry-Riddle Aeronautical University-Worldwide

Author Note

D. Scott Worrells, Graduate Studies, Embry-Riddle Aeronautical University-Worldwide; Scott S. Burgess, Undergraduate Studies, Embry-Riddle Aeronautical University-Worldwide.

Authors contributed equally to this study. This study in the initial report on a longitudinal study; accordingly there is no data available at this point.

Correspondence concerning this article should be addressed to D. Scott Worrells via E-mail: worrelld@erau.edu

ABSTRACT

Embry-Riddle Aeronautical University's Worldwide campus provides multi-modal curriculum delivery: Classroom, Online, Eagle Vision, Eagle Vision Home, and Blended. This manuscript describes a longitudinal research study on the implementation of inquiry-based learning using case-based teaching. The population of the study is students enrolled in a core course in the Master of Aeronautical Science program. Case-based teaching is used as the online portion of the Blended delivery modality. The goal of this paper is to provide a discussion on the implementation of inquiry-based learning in a multimodal delivery system and to gather students' perspectives thereof. This manuscript describes the (1) fundamentals of inquiry-based learning, (2) fundamentals of case-based teaching, and (3) strategies for integration of case-based teaching into the Blended delivery modality.

Introduction

Inquiry-based learning. Inductive based teaching is the overarching methodology of student-centered learning under which inquiry-based learning (IBL); discovery learning; problem-based learning; project-based learning; hybrid (problem/project-based) methods; and case-based teaching reside. It "is an instructional (and curricular) learner-centered approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem" (Savery, 2006, p. 9). *The emphasis is placed on constructivist education; whereby questions, data collection, and learning are student centric. Instructors guide and facilitate the learning process. Experimental and analytical skills are assessed rather than quantity of knowledge accumulated.* Inductive based teaching, as opposed to the more traditional and widely used deductive based teaching, places the means of discovery on the student. The instructor becomes a facilitator of the learning process, guiding students in their quest for knowledge rather than an Oracle of indisputable truths.

Inquiry-based learning; a derivation of inductive based teaching, is based upon the philosophy of John Dewey "IBL is a student-centered, active learning approach focused on questioning, critical thinking, and problem solving" (Savery, 2006, p. 16). *Inquiry based learning is an instructional method and form of active learning developed during the discovery learning movement of the 1960s ("Community Center," 2013, para. 1).* Any learning activity that: (a) begins with a question; is followed by investigative solutions; (b) creates knowledge through data gathering and analysis; (c) elicits discussion on discoveries and experiences; and (d) reflects on new-found knowledge is IBL (Savery, 2006, p. 16).

Case-based teaching. Instruction beginning with a challenge, when the required knowledge has not been previously provided, is inquiry-based learning. The scope of inquiry

may vary from a portion of a single lecture to a major term project. “In case-based teaching, students study historical or hypothetical cases involving scenarios likely to be encountered in professional practice” (Prince & Felder, 2007, p. 16). One way to motivate students is to provide them with a case analysis based upon a contemporary, real-world, and subject-matter-related problem to solve. Permeating a case analysis with the tenets of IBL presents students with a challenge in which they are responsible for readings as assigned; identifying, isolating, and defining a relevant problem or issue; establishing significance of the problem, and creating a well-developed and substantiated solution to the problem.

The case analysis methodology that is the centerpiece of this research has undergone modification, adaptation, and continuous revision since it was first applied by one of the researchers in 1996. At that time the case analysis process was brought into the classroom to augment a textbook that was more than 10 years old. The initial case analysis process was loosely structured and casual. Although the case analysis methodology did have merit; a more structured format to conduct the analysis was needed.

Significance of the study. “I read – I forget; I see – I remember; I do – I understand” this Chinese proverb sets the stage for IBL as applied by the researchers of this study. As we move farther and faster into the 21st century our means and methods of instruction must advance to properly prepare future generations of aviation and aerospace leaders. Embry-Riddle Aeronautical University (ERAU) Worldwide campus delivers undergraduate and graduate course work in a number of modalities that are designed to serve a widely diverse and dispersed student population. This accredited multimodal delivery system has proven to be successful and it has been sustained with an intense continuous improvement process. Instructors must be qualified

and re-qualified; courses are continuously reviewed, added, or deleted based upon needs; and the delivery technology is continuously updated.

"It has been widely recommended that the learning approach should be changed from teacher-centered to student-centered with a balance of knowledge, skills, and attitudes" (Ketpichainarong, Panijpan, & Ruenwongsa, 2010, p. 169). Distance learning and online modalities are particularly open to the implementation of student-centered learning. In either distributed learning mode, interfacing with instructors is at a moderate level at best. Students are, for the most part, on their own path of discovery. In the purely online courses there is even less opportunity for instructor to student and student to student face time as compared to the traditional classroom. Regardless of the modality, the inductive teaching method has merit.

> A better way to motivate students is *inductive teaching*, in which the instructor begins by presenting students with a specific challenge, such as experimental data to interpret, a case study to analyze, or a complex real-world problem to solve. Students grappling with these challenges quickly recognize the need for facts, skills, and conceptual understanding, at which point the teacher provides instruction or helps students learn on their own. (Prince & Felder, 2007, p. 14)

The researchers of this study have implemented the case analysis methodology as the Blended component when teaching a core course in the Master of Aeronautical Science (MAS) program. This was done for the first time in the August term of 2010. Initial results were encouraging. In-class discussion increased, student to instructor discussion increased, student to student interaction increased, and students became more cognizant and conversant on specific components of the assigned readings. Research skills, writing, critical thinking, and problem solving improved as well. This research study originated when the second researcher adopted the

case analysis methodology in the Air Transportation Systems course and experienced many of the same results. It then became apparent that this phenomenon warranted further research.

Literature Review

Inquiry-based learning. "Inquiry based learning is a learning environment focused on a process in which asking questions, thinking critically, and solving problems are encouraged" (Friedman et al., 2010, p. 766). Not all course work lends itself to the time and effort required of IBL. "If instructional objectives are at a low cognitive level, requiring almost exclusively rote memorization of facts or mechanical substitution into formulas, there is no reason to use an inductive method" (Prince & Felder, 2007, p. 18). However, for coursework that requires higher levels of cognition IBL is an ideal, albeit time and labor intensive methodology. It would appear that IBL would be an ideal method for non-traditional students, those with "day jobs," taking courses in an environment outside of the traditional classroom environment.

> In inquiry based lessons, students develop, carry out, and reflect on their own multiple solution strategies to arrive at a correct answer that makes sense to them, rather than following the teacher's prescribed series of steps to arrive at the correct answer. (Inoue & Buczynski, 2011, p. 10)

However, each of the delivery modalities at ERAU-Worldwide is highly structured. They have to be in consideration of the numbers of different faculty that teach a wide range of courses, with thousands of registrations, and coursework delivered in all modalities. Consistency is understandably a required quality, and yet, research has shown the need for more inductive versus deductive teaching. "While studies supporting the different inductive methods vary in both quantity and persuasiveness, the collective evidence favoring inductive teaching over traditional deductive pedagogy is unequivocal. Induction is supported by widely accepted

educational theories, cognitive science, and empirical research" (Prince & Felder, 2007, p. 18). Striking a balance among quality and consistency, and the traditional deductive approach and the progress inductive approach is challenging.

As indicative of IBL's flexibility and adaptability, consider that IBL lessons may be "guided" with more direction from the instructor and somewhat less independence on the part of the student. Students are provided with a problem and the resources to solve it and they are expected to devise their own procedure to solve the problem ("Just Science," 2013). Open inquiry on the other hand places sole responsibility for the learning process upon the student (Inoue & Buczynski, 2011, p. 10). Students identify and isolate a problem and develop their own solutions (Inoue & Buczynski, 2011, p. 10). The IBL teaching process does not ignore the need for structure. Using structured inquiry provides students with basics of investigating as well as techniques for using various equipment and procedures. Structured inquiry provides common learning experiences that can be used in guided or open inquiry.

Case analysis. According to Towl (as cited in Lutte & Bowen, 1995), case analysis can be documented as early as 1915 at Harvard. Case analysis has continued to find application in a wide variety of subjects and delivery modalities over the years. Definitions for case analysis range from the basic by Taylor "a description of an organization or organizational situation" (as cited in Lutte, 1996); the more complex by Jain, Gooch, & Grantham as an opportunity to generate knowledge (as cited in Lutte, 1996), and the pragmatic as useful in keeping students attention and applying previously learned skills to real world situations (Lutte & Bowen, 1995). Other research parallels and supports Lutte & Bowen findings. For example, well-constructed case analysis enables the learner to grasp significant facets of the problem/situation. Conducting case analyses develops critical thinking skills and to identifying logic flaws or false assumptions.

Using the case analysis methodology as a group project enables students to develop improved communication and collaboration skills (Savery, 2006, p. 15). The key to case-based instruction is having cases that are clear and realistic and encompass all of the teaching points the instructor wishes to convey (Prince & Felder, 2007, p. 17).

Case analysis has been identified as a school-based teaching/learning strategy that assists students in understanding the relevance of learning. Lundeberg and Yadav (2006) carried out a meta-analysis and concluded that cases have a positive impact on faculty and student attitudes, class attendance, and faculty perceptions of learning outcomes. Case analysis can enable the learning environment by providing the link between knowing and doing and thereby capture and maintain the attention of the student (Finch, Frantz, Mooney, & Aneke, 1997). Compared to typical problems used in problem-based learning, case analyses tend to be relatively well structured and rich in contextual details, with students applying material that is already somewhat familiar (Lohman, 2002).

The impact case analysis has on communication cannot be overlooked. Conducting a case analysis can help students develop all aspects of communication that is required in the workplace: reading, writing, speaking, and listening. Case analysis significantly improves the quality of education, provides a variety of workplace scenarios, and exposes students to all facets of workplace communication (Graves, 1999). The degree to which a student masters the skills of communication will directly and proportionately determine their probability of thriving in the real world.

Student's perspective. So far responses to Case Analysis as a tool for IBL have come from the perspective of the practitioner. Initial reaction from instructors has been positive with the overall process. However, the literature indicates that some students do not express the same

broad acceptance as do instructors. It appears that some students are more dependent or expectant of the traditional deductive learning process. According to Madden (2010), student comments varied from "interpretative questions are useless in the readings without something to guide you through them (p. 235);'' IBL "did not effectively provide what the economist was thinking. It made really ha[r]d readings even harder (p. 235);'' "felt more confused coming out of class than ... when I came in (p. 236);'' and lastly from a student with underdeveloped reading skills:

> I am not a strong reader and my reading comprehension lacks as well, so when I have to read difficult material and analyse [sic] it I lose motivation and tend to get confused. I don't feel I learned anything on my own using this technique. (add en, 2010, p. 236)

Expect the unexpected. Inquiry based learning poses a challenge to instructors who may not be prepared for the answers, or questions, that result from their IBL lesson plan. This challenge originates from the inability to anticipate diverse responses to an open ended question and/or an unanticipated follow up question to the initial open ended question. Inoue and Buczynski (2011, p. 20), found that "failure to anticipate students' diverse responses" was one of the reasons that an inquiry lesson was ineffective and deviated from the initially planned instructional goal.

Methodology

The researchers determined that a common course would be best for the study, this led to the selection of a core-course in the MAS program. Selection of a core-course would ensure the greatest number of student participants. The course chosen is a core course that both researchers teach on a regular basis. The Air Transportation System is the core course in the MAS program that meets these criterion.

Course-work delivery at ERAU-Worldwide are delivered in any one, or combination of modalities: traditional classroom; EagleVision classroom, EagleVision home, Online, and Blended.

Classroom. The classroom modality is representative of the tradition means of course delivery. The distinction for ERAU-Worldwide classroom delivery is that the classrooms are not located on campus. The vast majority of courses are taught in the evening or on weekends.

EagleVision. EagleVision is ERAU-Worldwide's version of synchronous distance learning. There are two versions of EagleVision delivery.

EagleVision classroom. Instructor and students are located together in a classroom connected in real time with up to three additional classrooms at remote locations, and combine into a single classroom environment.

EagleVision home. Instructor and students are not collocated. The instructor and students are at different locations; either one may be at home, at an office, or deployed to any number of locations worldwide.

Online. Online programs support and connect students in an asynchronous virtual learning community through Web-based support groups, e-mail discussions, and other online forums.

Blended. A blend of classroom (generally 70%) and online (generally 30%) course delivery. The majority of the instruction occurs in the classroom, a portion of the course takes place online through activities such as guided discussion, group projects, and online assignments.

For the purposes of this study, the researchers chose a core course in the MAS program using the Blended modality. This course, ASCI 602 The Air Transportation System is taught by

both researchers. The online component of the Blended modality is facilitated with case analysis methodology.

Case Analysis Methodology

At the outset of the course students are introduced to the case analysis methodology that will be used throughout the course. A thorough description of the process is provided, this includes exemplars, and workflow expectations.

The case analysis (CA) is comprised of summary, problem statement, significance of the problem, alternatives, and recommendation and it is required to be directly related to course material; learning outcomes, assigned readings, etc. Initially, the CA horizontal and vertical structure is relatively rigid. However, as students demonstrate ability, the structure becomes less rigid allowing students to take a much broader approach to the requirements. The analysis is limited to four pages: title page, analysis (two pages maximum), and references. Adherence to the guidelines and application of the applicable components of the most current edition of the Publication Manual of the American Psychological Association (APA) is emphasized.

Summary. The purpose here is to provide a brief and comprehensive summary of the analysis. Students are encouraged to establish the nature or the background from which the issue/problem/situation emerged. The summary must be accurate, non-evaluative, coherent and readable, and concise (APA, 2010b, p. 24).

Problem. This section begins with a clear problem statement "The problem is…." Students are required to elaborate on what caused the problem. Nothing but the problem statement and its contributing factors should appear in this section. The problem statement must include only one problem. The problem should be specific and action oriented. The problem statement should reflect a situation that must be addressed. Students are cautioned not to confuse

symptoms or results of the problem with the problem itself. This is the centerpiece of the analysis. From this point forward the problem statement must establish a thread of commonality that is woven throughout the remainder of the analysis; everything that follows must be linked back to the problem statement.

Significance of the problem. What is important about this problem? Students are required to identify what is significant about the problem they have identified. At this point the analysis is not concerned with what caused the problem; that should have been illustrated in the previous section. Students are encouraged to consider what will happen if the problem is not corrected. Will there be a decline in one segment of the industry, a weak financial report/reduced revenue, or an impact on safety? The significance of the problem may be multi-faceted, however students are cautioned to not lose their focus on the problem that was identified previously.

Another aspect of significance of the problem is to validate the problem and help to determine what priority should be assigned to its resolution. The significance of the problem and the priority assigned to it is determined by what will happen if the problem is not resolved.

The significance of the problem is a pivotal point in the analysis. When it is done correctly one of two things should happen (a) the problem is validated and the student moves onto to the next step having identified and isolated one problem or (b) the problem is not valid, it does not justify the expenditure of time and effort to resolve it. Although disappointing, this is an essential component of the analysis. If the problem is valid the student moves on to alternative actions. If not, a new problem statement must be developed.

Development of alternative actions. Alternatives (two each) provide a feasible, realistic approach to resolving the problem. Students must justify their alternative actions with rationale: why is the alternative an appropriate approach to resolving the problem at hand? Students must

then state what they believe the advantages and the disadvantages of each alternative action are. There must be two advantages and two disadvantages for alternative action. Advantages and disadvantages may not be duplicated. Once again it is essential that each alternative action be directly related to resolving the problem at hand.

Alternatives must be derived directly from the source of the issue/problem/situation and/or the assigned chapter(s)/learning outcome(s). Students are directed to focus on the problem at hand and to consider the significance of the problem as well. They are required to use the information they have: current and related trade magazine or research journal and the assigned chapter(s) from the textbook or assigned reading material to resolve the situation.

Students are given the option to complete this section in one of two formats. The first of which is to write it out in paragraph form; being sure to address each required component: two alternatives, with rationale, and with two advantages and two disadvantages. The second approach is the "matrix" format.

In the matrix format students use a table formatted in accordance with APA (2010a) requirements (see Table 1). Consistency takes precedence over typical punctuation and grammar.

Recommendation. This part of the analysis requires students to provide a recommendation that is separate and distinctly different that either alternative action. Rationale for the recommendation is required and one advantage and one disadvantage are required. Students are encouraged to get outside of what was identified in the source document and/or the assigned chapter(s) or reading material to solve the problem they have discovered. Students are encouraged to (a) explain why their recommendation is superior and why the advantage outweighs the disadvantage; (b) discuss how the disadvantage might be overcome or minimized;

(c) discuss what is involved in implementing their recommendation, how long it will take, how much it will cost, and anticipated results.

This is an opportunity for students to take a chance and risk putting forth an idea or thought of their own device; it is a simulation of sorts. Creativity and innovation are highly desirable. And, once more, theoretical resolution of the original problem must be evident.

Table 1

Alternative Actions

Alternative	Rationale	Advantages	Disadvantages
1. Clearly state what the alternative action[a]	Provide the reason for this action	a. [b]first advantage b. second advantage	a. first disadvantage b. second disadvantage
2. Clearly state what the alternative action	Provide the reason for this action	a. first advantage b. second advantage	a. first disadvantage b. second disadvantage

Note. Use the appropriate table note to indicate any special instruction/comment and to properly cite sourced material. [a]punctuation is not required, consistency is. [b]capitalization is not required, consistency is.

Results

At this point in the study results are preliminary and subjective at best. However, both researchers have seen positive results overall. Student comments (post-course) also suggest high levels of learning occurred and students confirming applicability to their professional lives. As previously discussed, in-class discussion has improved, not only in quantity but quality as well. Students are more engaged and animated in expressing what they have discovered. Student to student interaction through the online component has been an interesting development. Comments on one another student's discussion board posts frequently goes beyond the tertiary levels. It appears, initially, that students are less inhibited to make comments in the online environment than they are in the traditional face to face classroom environment. In regard to threats to the process, some students have a tendency toward confirmation bias. Both researchers

have noted that some students find, identify, and isolate a problem and then they cannot substantiate it. Rather than revising to find another problem they attempt to "make it fit" their analysis. Another interesting finding is that students are initially resistant to IBL; frequently asking for specific examples and resist taking action on their own initiative. At times, students have misinterpreted the connection to the subject matter of a specific week's assignment and stray away from the requisite area of research.

Discussion

The case analysis process was in progress with the researchers collaboratively since 2010. As the University progressed through the Southern Association of Colleges and Schools (SACS) accreditation process, it became more evident as the university's Quality Enhancement Program (QEP) was developed and with the initiation of *Ignite*, that there was a significant connection between the case analysis process and the tenets of *Ignite*. Inquiry-based learning approaches are trending upward for the Worldwide campus, and the case analysis process is complimentary to that movement. An unintended benefit is that the researchers case analysis process is symbiotic with both *Ignite* goals and several of the operational strategies, specifically:

Ignite goals.

- Faculty and staff will engage students in scholarly activities and facilitate research through curricular or co-curricular opportunities.

- Students will obtain the skills to investigate hypotheses, solve problems, and/or advance knowledge utilizing methods valued in the various disciplines.

Ignite operational strategies.

- Enhanced curriculum
- Enhanced faculty development program

- Enrichment for creation of co-curricular learning opportunities in academic support

Faculty mentorship. This is another area that the researchers have experienced similar findings. Although specific numbers cannot be substantiated at this time it is hoped the results of the study will provide some quantitative data for analysis. Faculty and student collaboration in the development of a case analysis has resulted in significant improvement of a student's ability to conduct a meaningful case analysis and/or significant research, analysis, and findings have resulted in a heightened awareness of the subject matter of the course. This "faculty mentoring," was found to be similar to that experienced in each researcher's respective graduate post-graduate academic careers.

Flexibility. The flexibility of the case analysis methodology is another benefit to IBL as discussed. The researchers are keen to explore the influence, viability, applicability, and performance of case analysis during the longitudinal study. Their analysis may provide exceptional results to the theory that case analysis is an exceptional method to impart IBL. Student responses, from those who have already experienced this technique, are supportive of the theory. One student expressed in class that this process was applied frequently to his mid-level management job in manufacturing at Bell Helicopter in Fort Worth, TX. The case analysis and IBL clearly support the first statement in the Ignite executive summary, "Our mission is to teach the science, practice and business of aviation and aerospace, preparing students for productive careers and leadership roles in service around the world."

Conclusions

There is a documented justification for a transition from purely deductive teaching methodologies to inductive based methodologies. Bringing the case analysis methodology, as

described in this research, into the Blended delivery modality is a natural application inductive based teaching. The case analysis methodology is a means by which students are challenged to identify and isolate a problem and then develop substantiated solutions for the problem discovered.

Recommendations

The researchers believe that the application of case analysis as a means to integrate IBL into graduate level courses delivered in the Blended modality warrants an intensive, longitudinal study to determine student perceptions of IBL. It is believed that this study will provide quantitative data that supports this hypothesis. If so, this study could be continued and expanded to include other courses, both graduate and undergraduate, as well as other modalities.

References

American Psychological Association. (2010a). Displaying results. In *The publication manual of the American Psychological Association* (6th ed., pp. 125-168). Washington, DC: Author.

American Psychological Association. (2010b). Manuscript structure and content. In *The publication manual of the American Psychological Association* (6th ed., pp. 21-60). Washington, DC: Author.

Community Center for Teaching Excellence. (2013). *Inquiry-based learning and guided inquiry.* Retrieved from the Monroe Community College website: http://www.communitycenterforteachingexcellence.org/inquiry-based-learning/

Finch, C. R., Frantz, N. R., Mooney, M., & Aneke, N. O. (1997, November). *Designing the thematic curriculum: An all aspects approach. Linking curriculum with instruction* (MDS-956. Section 7). Retrieved from the National Center for Research in Vocational Education website: http://ncrve.berkeley.edu/Summaries/956sum.html

Friedman, D. B., Crews, T. B., Caicedo, J. M., Besley, J. C., Weinberg, J., & Freeman, M. L. (2010). An exploration into inquiry-based learning by a multidisciplinary group of higher education faculty. *Higher Education, 59*(6), 765-783. doi: 10.1007/s10734-009-9279-9

Graves, H. B. (1999, December). Using cases in graduate-level professional writing classes. *Business Communication Quarterly, 62,* 89-92. doi: 10.1177/108056999906200413

Inoue, N., & Buczynski, S. (2011). You asked open-ended questions, now what? Understanding the nature of stumbling blocks in teaching inquiry lessons. *Mathematics Educator, 20*(2), 10-23. Retrieved from ERIC database (EJ923721).

Just Science Now. (2013). *What is inquiry?* Retrieved from http://www.justsciencenow.com/inquiry/index.htm

Ketpichainarong, W., Panijpan, B., & Ruenwongsa, P. (2010). Enhanced learning of biotechnology students by an inquiry-based cellulose laboratory. *International Journal of Environmental & Science Education, 5*(2), 169-187. Retrieved from ERIC database (EJ884417).

Lohman, M. (2002). Cultivating problem-solving skills through problem-based approaches to professional development. *Human Resource Development Quarterly, 13*(3), 243.

Lundeberg, M. A., & Yadav, A. (2006). Assessment of case study teaching: Where do we go from here? *Journal of College Science Teaching, 35*(5), 10–13.

Lutte, R. (1996). How to use case analysis as an entire semester course in aviation. *Journal of Air Transportation World Wide, 1*. Retrieved from the University of Nebraska-Omaha website: http://cid.unomaha.edu/~jatww/vol1/964.html

Lutte, R., & Bowen, B. (1995). Analysis of the case writing method for college teaching. *The Journal of Aviation/Aerospace Education & Research, 5*(3), 16-22.

Madden, K. K. (2010). Engaged learning with the inquiry-based question cluster discussion technique: student outcomes in a history of economic thought course. *Southern Economics Journal, 77*, 224-239. doi: http://dx.doi.org/10.4284/sej.2010.77.1.224

Prince, M., & Felder, R. (2007). The many faces of inductive teaching and learning. *Journal of College Science Teaching, 36*(5), 14-20. Retrieved from http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/Inductive%28JCST%29.pdf

Savery, J. R. (2006). Overview of problem-based learning: Definitions and distinctions. *The Interdisciplinary Journal of Problem-based Learning, 1*(1), 9-20. Retrieved from http://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=1002&context=ijpbl