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Management Information Systems Education: A Systematic Review

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ABSTRACT

Management information systems (MIS) programs were developed to prepare graduates to create innovative solutions to problems where business and technology intersect. As such, the curricula must change rapidly to stay current with industry standards, an accelerating moving target. This research presents the findings of a systematic literature review to identify and present trends in the scholarly literature on MIS education. The purpose of this approach was to understand how academia ensures students are prepared for industry and keeps pace with changing industry needs. Key findings from the literature are presented, as well as a compilation of areas for future research. Overwhelmingly, a lack of international perspective was identified as the vast majority of articles collected data in the US. Further, the direction of future research and exploration revolved around five themes of innovative pedagogical approaches, industry partnerships, subtopics of MIS education, new methods and metrics for measuring success in MIS education, and cross-disciplinary opportunities in fields such as mathematics, traditional business disciplines, and the hard sciences.

Keywords: Management information systems (MIS), Higher education, Student preparedness, Curriculum design & development, Literature review, Pedagogy

1. INTRODUCTION

College students have been defined as consumers of higher education and, as such, they derive value from the increased marketability they possess as a result of their college experience as well as the knowledge gained in classes (Levin, 2005; Woodall et al., 2014). Further, it can be easily argued that hiring organizations are also a key customer of higher education as they expect graduates to be prepared for the workforce based on their college education. Despite this, research suggests that management information systems (MIS) curricula is not always aligned with industry needs. According to Downey et al. (2008, p. 361), an MIS degree is a "highly technical major that incorporates business fundamentals and prepares graduates for the key roles of managing people and technology in business organizations." However, Lee et al. (1995) found that educators and business executives alike have raised key concerns over the future of Information Technology (IT) education as the needs

of the Information Systems (IS) profession evolve. Further, Hunt et al. (2010) stated that organizations recruit MIS students that can adapt to changing technologies and business structures while contributing their technical expertise to improve the organization. According to Beitelspacher et al. (2018), while business students often have high aspirations with respect to their career goals, potential employees tend to view them as not prepared for the real world. Students must be prepared in the fundamentals of business, but they also need to be competent professionals. Likewise, business intelligence (BI) is increasingly being used by companies to aid in a variety of decisions. However, according to Olsen and Bryant (2012), many university business courses are not keeping pace with industry with regard to teaching BI applications. More recently, Zadeh et al. (2018) noted the need for data-literate graduates in the MIS profession is increasing as the quantity of data that businesses consume and produce increases. A graduate's ability to adapt to changing technologies and business needs, therefore, is a direct reflection of the knowledge gained through the MIS curricula at their universities. Many within the MIS education community note an education gap exists between what MIS curriculums are teaching and what employers require of their employees. Therefore, in order to improve the value that students receive in classes, faculty should rethink how they package and deliver business technology programs (Lee et al., 1995), particularly since the MIS field continues to grow. Educators need to recognize that keeping pace with industry standards is a challenge many universities are not equipped to meet due to the lack of agility and the traditionally bureaucratic nature of the institutions (McCully & McDaniel, 2007).

According to the U.S. Bureau of Labor Statistics (2020), MIS jobs are expected to continue to increase by 11% between 2018 and 2028. The top 10 emerging global roles with an anticipated 133 million new jobs by 2022 include data analyst and scientist, artificial intelligence (AI) and machine learning specialist, general and operations manager, software and application developers and analyst, sales and marketing professional, big data specialist, digital transformation specialist, new technology specialist, organizational development specialist, and information technology service (Leopold et al., 2018). However, the top declining roles by 2022 related to MIS include data entry clerk, accounting clerk, client information and customer service, and business services and administration manager (Leopold et al., 2018). The question then becomes if MIS programs are staying on pace with future industry needs and careers.

To prepare students for industry, career readiness must be considered in addition to the soft and hard skills. The National Association of Colleges and Employers (NACE) developed a road map of eight core career readiness competencies, which include oral and written communications, critical thinking and problem solving, leadership, teamwork and collaboration, digital technology, career management, professional and work ethic, and global/intercultural fluency (Beitelspacher et al., 2018). According to Pate (2020), there are five key soft skills companies need: creativity, persuasion, collaboration, adaptability, and emotional intelligence. Pate (2020) further defined the top hard skills as blockchain, cloud computing, analytical reasoning, artificial intelligence, user experience (UX) design, business analysis, affiliate marketing, sales, scientific computing, and video production. MIS curricula often focus on honing programming, project management, critical thinking, and problem-solving skills. MIS programs typically include concentration areas such as economics, finance, human resources, organizational leadership, and project management. In addition, MIS curricula focus on using current techniques and models for a variety of scenarios and industries to further prepare students for industry. With a rise in the diversity of IS career paths, education must change to integrate various skills and competencies for graduates to succeed in the field. Several researchers suggest that having different tracks within MIS programs at the university-level are necessary to prepare students for their intended career paths (Lee et al., 1995). As noted by educators, however, many constraints including fiscal, personnel, and time contribute to the impracticality of such a tailored degree. Therefore, schools should become more interdisciplinary in course offerings and provide more breadth than depth.

Since technology and industry needs rapidly change, the focus of this research was to address the following research question. What trends have occurred in MIS education? By addressing this key question, recommendations can be made to improve MIS education in order to better prepare students for their careers and satisfy employer needs for graduates in the area of MIS.

In order to address the research question, a systematic literature review of MIS education research was conducted. The review enabled a detailed analysis of the current literature to identify trends over time and identify gaps. Based on these gaps, potential paths to expand the current subject knowledge and improve MIS education are recommended for future research.

2. RESEARCH METHODS

In order to effectively identify the educational trends in MIS education, a systematic literature review was conducted. A systematic literature review was selected due to the methods transparency and repeatability (Materla et al., 2017). Further, this methodology reduces research bias conducting a review and provides a traceable research path (Subhash & Cudney, 2018). The structured approach recommended by Tranfield et al. (2003) includes planning the review, conducting the review, and reporting and dissemination as shown in Figure 1.

2.1 Planning the Review

Based on the research question, the intent of the systematic literature review was to locate, organize, and report on the existing academic research encompassing the trends in MIS education. Online journal databases, including ABI/Inform, Business Source Premier, and Scopus were searched to identify the journal articles related to MIS trends in education. These databases were selected based on their research domains.

To identify relevant research in this area, key search words were selected based on the main objective of the research. These search terms included MIS education, fintech, trends, artificial intelligence, data science, business intelligence, enterprise resource planning, market analytics, customer research management, and digital supply chain, as these are key education content areas within MIS programs. The purpose of selecting as many key search terms as possible was to provide an exhaustive search within the research domain.

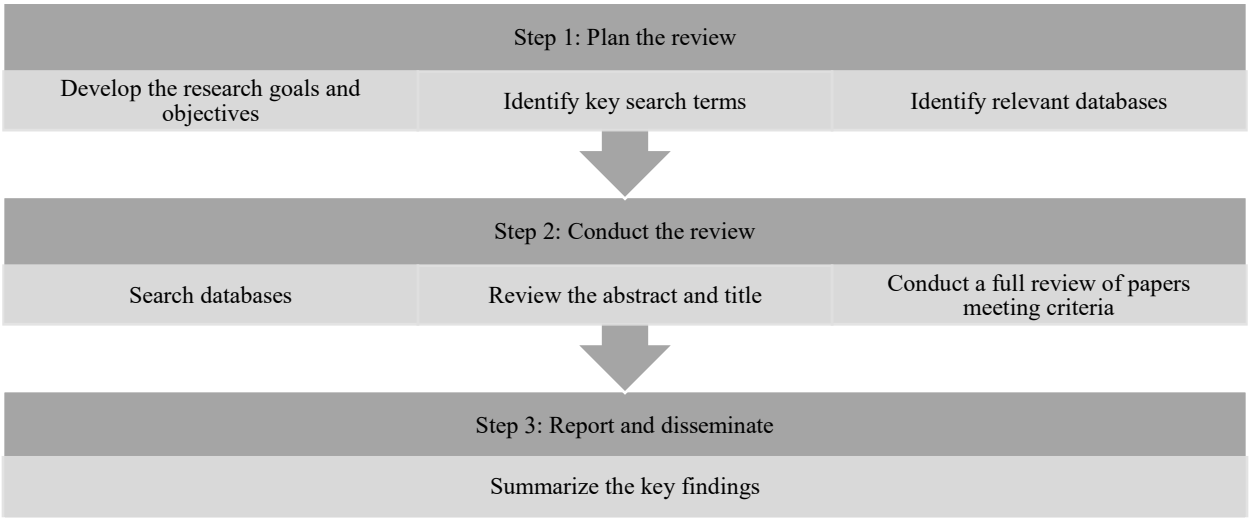

Figure 1. Research Methodology

2.2 Conducting the Review

The databases were searched using the identified keywords and selecting 'all text' in order to not limit the search to the abstracts or titles. This enabled the identification of any paper that mentioned the search terms in the body of the paper as well, which resulted in a more comprehensive list. All of the possible combinations of the nine search terms were used in the query using the connector 'AND' to combine the search terms. Therefore, 27 total queries were performed. Limiting search terms to these nine is consistent with previous literature that states it is appropriate to limit search terms while researching specific phenomenon (Diegmann et al., 2018; Dressen & Diegmann, 2017; Gregory et al., 2015).

During the search, two constraints were placed on the queries. The first restriction was that the paper must be peer-reviewed. Second, U.S. News and World Report began ranking MIS programs in 1989; therefore, only articles published since 1989 were included in the literature review. The searches were conducted using the key search words and criteria of peer reviewed journals, full text, scholarly journals, and English. Duplicate papers were removed. The aforementioned period of time was adhered to, assuring that the research analyzed was germane and current. We did not utilize trade journals, google scholar, or grey literature in accordance with previous research (Higgins et al., 2022; Hoehle et al., 2012).

The search process produced 227 search results. For specificity, the titles and abstracts of the papers were read and evaluated to ensure they conformed to the search criteria. Additionally, only full text papers, printed in English, which were relevant to MIS and education, in peer-reviewed journal articles were considered for inclusion. Therefore, the final papers included in this systematic review related to MIS and education based on the search terms. After review of the titles and abstracts using the inclusion and exclusion criteria, 22 journal articles remained in the comprehensive review. A similar paper published in the Journal of Information Systems Education conducted a similar review of fewer than 30 papers (Sharp et al., 2020).

3. LITERATURE REVIEW

The 22 papers that remained were initially reviewed for common themes based on the research conducted within each study. After review, two clear themes emerged: student preparedness and MIS curricula. The papers relating to student preparedness mainly focused on how to measure and ensure students were ready for careers in industry. Several papers also focused on working with industry to ensure their needs were met. The papers related to MIS curricula varied from individual course improvement to curricula redesign. The subsequent subsections discuss each paper in detail by theme and are presented in chronological order to further highlight trends over time.

3.1 MIS Student Preparedness

Education often focuses on fundamental technology skills and knowledge to ensure students are prepared for industry. A study by Arnett and Litecky (1994) used a systematic survey approach to examine employment advertisements in 10 major U.S. cities to determine the skills for MIS professionals. The results found that PC/LANs, relational databases, UNIX, and C were the most demanded job skills. In a similar study by Lee et al. (1995), a survey was conducted that consisted of five research questions targeted at industry partners: 1) What are the expected future changes in various types of IS jobs? 2) What are the expected changes in the portfolio of critical activities performed by IS professionals? 3) What are the expected changes in the critical skills and knowledge required by IS professionals? 4) Do perspectives on the human resource needs of the IS professional differ among the various stakeholders? 5) What are the implications of these expected changes on IS curriculum design? The study concluded that annual growth rates were 5% for central IS professionals, 24% for functional/business area professionals, 6% for IS consultants, and 7% for all respondents. As early as 1995, it was reported that the number of data entry and low-level IT positions would decrease due to technological innovation. As a direct result, survey respondents anticipated employment needs for higher-

level IT positions, such as programmers and technical specialists, would be in high demand. Further, the paper asserted industry leaders "will demand a cadre of IS professionals with knowledge and skills in technology, management, and interpersonal skills to effectively lead organizational integration and process reengineering activities" (Lee et al., 1995, p. 313). The results also indicated an industry shift from centralized IS services within a business to a decentralized, end-user-focused organization. This was expected to cause an increase in the technical services of centralized IS as they become more focused on the development, management, and support of the IT infrastructure for the entire organization, as opposed to a specific business unit. Thus, increased knowledge of business processes was cited as critical for future IT professionals.

Curriculum issues, as well as imperative skills expected of recent MIS graduates, were the focus of a study by Downey et al. (2008). Personal attributes (e.g., soft skills), database skills, computer languages, and web design proficiency were determined to be the most critical skills that IT professionals expect of new graduates. By translating these identified skills into curriculum components, a redesigned curriculum model was proposed that provided a technically robust major with a strong core foundation in both business and IT. The new curriculum not only focused on skills to prepare the IT graduate for their first job but also technical and reasoning capabilities to prepare them for continued learning throughout their career. The study also concluded that concentrations involving sequences of courses are necessary.

The Office of Systems Research Association published the Model Curriculum in Organizational End-User Information Systems (OEIS) in 2004 that serves as a "guide for undergraduate curriculum design in the area of IT, developed by IT educators and business professionals…" (Hunt et al., 2010, p. 13). Hunt et al. (2010) surveyed MIS faculty on their perceptions of the OEIS curriculum model. The researchers concluded the OEIS model still had relevance and value, considered strictly from an objectives and outcomes perspective. Therefore, universities should make considerable efforts to implement this curriculum model into their MIS degree programs, specifically the highest-rated objectives of the model, such as experiential learning and core courses in web technologies, network administration, and operating systems, among others.

The research by Olsen and Bryant (2012) outlined an innovative teaching model for incorporating BI principles into the MIS curriculum. The proposed model can be implemented into any database course as a specific module that can be taught during one or two 75-minute class periods. The BI module utilizes Gagne's Nine Events of Instruction as its framework; which includes "gain attention, inform learner of objectives, stimulate recall of prior learning, present stimulus material, provide learner guidance, elicit performance, provide feedback, assess performance, and enhance retention and transfer" (Olsen & Bryant, 2012, p. 4). Beginning with relational databases, Microsoft Visual Studio, the Analysis and Reporting Services framework, and the AdventureWorks sample database, students are instructed on how to build, deploy, and glean data from a data cube. After class discussions on aspects relating to BI design and implementation, students are quizzed to determine their understanding. The module culminates in students developing their own questions based on the sample database content and then quizzing their peers.

In a study by Zadeh et al. (2018), a proprietary program called *SAS Enterprise Miner* is used in a first-year MIS course to expose students to the notions of data analytics and how to sift through vast amounts of data, much of which is extraneous. The study infers that the shortage of qualified business analytics practitioners is perhaps due to a lack of practical and in-depth training, particularly in the areas of managing data sources and analyzing large datasets. Students may also be reluctant to engage with data analytics concepts because of anxiety with the math level required. By introducing data analytics concepts in a first-year MIS course without including higher-level technical details, students can ease their way into learning technology without being overwhelmed or failing to grasp the practical applications. Using *SAS Enterprise Miner*, students are first exposed to database patterns revolving around customer behavior and learn how to query, transform, analyze, score, and visualize the data. By applying this case study, some pedagogical observations were made. First, students do not learn best from the bottom-up approach, where foundational knowledge is obtained through lecture or textbook reading before practical hands-on experience is gained through lab simulation. Second, business cases should come before mathematical and statistical definitions and theories. Third, changes should be made one at a time and results examined independently. This allows students to see how each separate variable that goes into business insights affects the grand model. Finally, business analytics is an emerging field and institutions across the U.S. and around the world adopt curriculum changes and models at different speeds. To support these claims, the researchers outlined three learning objectives: "(1) improve student comprehension of business analytics and its practical application, 2) introduce students to a new data analytics tool and have them perform data analysis without burdening them with unnecessary technical details, and 3) encourage students to explore business analytics as it relates to their future courses" (Zadeh et al., 2018, p. 135). A survey of 278 students that participated in the case study reported an average of 83.88% of them strongly agreed that the case study had a positive impact on their understanding of data analytics and their outlook on future courses of the same nature.

3.2 MIS Curricula

3.2.1 Undergraduate MIS Programs & Courses. In the world of e-commerce, Moshkovich et al. (2006) examined factors pertaining to e-commerce education in business school curricula. The factors included in the study were to what extent undergraduate MIS curricula incorporate e-commerce concepts, how the extent of e-commerce knowledge is commensurate with the collection of course offerings in the MIS degree program, whether or not the topic coverage correlates to current market requirements, and potential ways to resolve issues that come from limitations on the quantity of courses in the MIS major. Data from 266 AACSB-accredited schools were used in this study, and the researchers concluded that 62% of surveyed schools cover basic e-commerce concepts, such as web development, in their MIS curricula. The study found that the theoretical foundations of application development and deployment relating to e-commerce technology were important in curricula. Recent college graduates working in IS were also presumed to retain

substantial expertise related to client-side web development strategies, as reported by IT specialists. Finally, it was concluded that the choice of general support technology, as well as specific server-side technology, should be decided based on regional needs, available resources, and expertise.

Many business students and faculty are frustrated with the traditional model of teaching introductory computer application courses because of the redundancy of information that most students already possess and the seemingly pointless end-of-chapter assignments, according to Mykytyn et al. (2008). As a more engaging alternative to traditional instruction methods, problem-based learning (PBL) has become a powerful pedagogical tool that could result in more impressive outcomes for students and faculty. Mykytyn et al. (2008) designed a study that examined 186 business students taking a computer applications concept course and focused on "student motivation, computer self-efficacy, knowledge, and satisfaction" (Mykytyn et al., 2008, p. 89). Students self-reported their inherent opinion on computer self-efficacy through a 10-item scale focusing on Excel and Access, with most students reporting they felt their present knowledge of computing was sufficient for the course. Student motivation was studied as a culmination of self-reported attention, relevance, and confidence. The study concluded that students who expressed a higher degree of knowledge, motivation, and satisfaction were in the PBL group, as opposed to those who were not in the PBL group. Therefore, the study concluded that PBL is a preferred teaching method over traditional methods.

Student enrollment in MIS and computer science (CS) departments has declined in the U.S., according to Downey et al. (2009), which is concerning because of the increased demand for IT skills. To counteract this trend, the motivations behind students' choice of major must be determined and analyzed. Further, the information could be used to target interested and undeclared students who may find a good fit within the MIS/CS career field. The research involved a survey that was conducted with participants from 205 MIS or CS majors at four different universities. The survey results concluded the six factors in order of importance for deciding on an MIS major for students were "interest in IT, monetary influence, business influence, nature of IT work, college influence, and high school influence" (Downey et al., 2009, p. 362). Interestingly, business majors reported that interest in the field was more important than monetary compensation and job opportunity when deciding on their major. The study also concluded that MIS departments must expand their high school presence, faculty need to increase student interactions, and MIS professionals should be involved in the educational process.

Keeping pace with advancements in technology is a challenge for IS educators. Abrahams and Singh (2013) proposed expeditionary learning as a good method to combat the obsoletion of curriculum content. The research hypothesis for this study was to determine whether learning by the expedition was helpful in improving student satisfaction, strengthening community engagement, and improving the skills and confidence of both the expedition participants and external leaders who were educated from the expedition catalog. The study concluded that students who participated in the expeditionary learning model did not result in higher course evaluations. However, the study did find that the self-discovery component did increase the learners' perceived self-knowledge of the subject area. Further, self-discovery increased learners' intentions to pursue the subject area. The study also concluded that the system expedition exposed students to more areas of technology than a more conventional, hands-on experience where students only work with a single firm as part of a course. Finally, the research did not have enough evidence to determine whether or not students who participated in expeditionary learning achieved comparable "personal, academic, and civic improvement" (Abrahams & Singh, 2013, p. 62) as opposed to those that experienced more traditional class pedagogy.

Between 2004 and 2010, IT graduates from U.S. universities decreased by 33.4%. To address this decline, Downey et al. (2016) established a four-day summer camp for high-achieving high school students to expose them to hands-on technology applications, technology companies, IT professionals, and different career fields within the IT field. The primary goal of this summer camp was to increase the number of IT majors. Secondary goals included attracting more female majors, making the camp a fun learning experience, and promoting the University of Central Arkansas and TechCompany. The researchers did not have contact with the students after the conclusion of the camp; therefore, tracking the camp's success was difficult. Instead, changes that occurred over the course of individual camps were examined to determine what caused students to choose a technology major. This was accomplished through the proctoring of a pre- and post-camp survey that gauged students' perceptions on various facets within the IT field (e.g., starting salary, job security, math/science skills). At the end of the camp, a 20 percent increase in students wanting to attend the parent university was noted. Limitations observed included mandatory employer buy-in, faculty participation, and female participation. Overall, the camp served to increase participants' perception of the parent university as well as dispel some myths surrounding the IT industry. It did not increase female sentiment toward the industry, nor did the study empirically analyze the long-term impact of the camp after the participants graduated high school.

According to Akpan (2016), some institutions utilize consulting practicums to adopt the highly regarded experiential learning component of an IS curriculum. The goal of these practicums is for students to gain "the essential practical skills and experience to enhance career readiness and ensure a smooth transition from college to employment…" (Akpan, 2016, p. 412). The goal of the study was to fill the gap between consulting practicums and the career readiness of students. Career readiness was defined as the possession of the academic knowledge and skills required to be successful in post-secondary employment. To measure the efficacy of the consulting practicum in the IS curriculum, the researchers found clients that were implementing IS and students self-organized into teams that then worked with each client. The overarching project plan for each client included deliverables that allowed the course instructor to gauge the performance of the project team. The industry mentors could also complete a performance review of the team members. Through this appraisal, the study concluded that 82% of students were gauged as above average or excellent in overall performance and related skills. Chi-squared results from the survey also revealed that students had a high degree of behavioral and technical skills, with the strongest being the quality of the written report (deliverable). Having a pedagogical strategy such as a consulting practicum is a reasonable action for encouraging students to improve their technical abilities within an actual

work environment, hone their professional and interpersonal skills, and limit the focus on theoretical knowledge that is taught in the classroom.

Blended learning in computer education was the focus of research by Monk et al. (2019). In this study, one-third of the coursework was replaced with online activities, keeping course material and instructor constant. The basis for this research was constructivist learning theory, and for the purpose of study, the Business Information Systems class was chosen. The study used a mixed methodology that followed the critical realism approach. Multiple regression analysis found that the change in the delivery modality did not have a notable effect on the student's final grades, nor did international students earn better grades than domestic students. Qualitative analysis conducted over a series of three interviews found that at the start of the semester, students said self-discipline was needed to succeed in the course. However, at the end of semester many other challenges were revealed. Students felt a disconnect between face-to-face and online material and preferred asking questions in face-to-face classes. Additionally, online courses caused an increase in distractions. Upper-class students benefited more from the blended mode, which made them more self-disciplined; however, this was not the case with lower-class students. Some felt the online content was helpful but only if the quality of the course content was sound and relevant. A limitation of this study was the exclusion of international students as they were not willing to participate in interviews and the study was designed around a single course and professor. In conclusion, the study revealed the limitations and challenges in blended mode keeping course content and professor constant. It was also suggested that future curriculum utilizing blended learning should keep the percentage of online classes to one-third and ensure the online material is well-organized and relevant.

3.2.2 Graduate Education in MIS. Curricula must constantly evolve to meet the changing needs of industry. Further, most accrediting bodies, such as the American Assembly of Collegiate Schools of Business (AACSB) and the Accreditation Council for Business Schools and Programs (ACBSP), provide flexibility in curriculum matters. The research by Quarstein et al. (1994) addressed the content and structure of IT courses in Master of Business Administration (MBA) programs. The study found that only one MIS course did not adequately prepare MBA students for industry; rather these skills need to be integrated across the entire MBA curriculum.

Traditionally, MBA degree core courses consisted of a single MIS course (Shore & Briggs, 2007). However, AACSB-accredited schools have trended away from this approach due to the change in the length of MBA degree programs, MIS topics included in other core required courses, and a reduction in the number of required core courses. The purpose of this study by Shore and Briggs (2007) was to determine the best path for MBA programs to incorporate MIS into the core by examining the curriculum of the top twenty AACSB-accredited MBA programs in the nation. Each MBA program was put into one of the categories; no stand-alone course, no formal coverage, stand-alone course, or integration of MIS in the core. None of the top 20 MBA programs had a stand-alone MIS course in its curriculum. Thus, they either included MIS concepts in other courses or did not include it at all. The implications of these results for MIS faculty are far-reaching, and the data produced was insufficient at the time of the study to make any concrete claims.

Due to the rapid growth of IS programs during the dot-com burst, academic administrators have been reactive in faculty planning, curriculum design and implementation, and program development plans (Thouin et al., 2018). Economic cycles are uncontrollable, but academic program design should take a proactive approach in meeting the needs of "various stakeholders such as employers, faculty, students, accrediting bodies, and society" (Thouin et al., 2018, p. 25). Most research surrounding IS curriculum design focuses substantially on the needs presented by employers. This research, however, focuses on student needs and expectations, specifically on the attitude of graduate MIS students. Such information can provide valuable information to administrators on how to improve existing curriculums and refine the development of future curricula. Their survey of 184 graduate MIS students concluded that a graduate program with an equal mix of business and technical coursework that is just under two years in length is optimum. Additionally, students expressed a desire for flexible programs that emphasize IT management and provide guest lectures by industry professionals regularly. Specific courses that students felt were necessary for the program included quantitative business analysis, operations management, strategy, leadership, business intelligence, data warehousing, MIS fundamentals, and IT project management. The researchers determined the most important factor impacting students' decisions as they selected an MIS program was program ranking.

3.2.3 Subspecialties of MIS (ERP, HCI, Big Data). Human-computer interaction (HCI) was noted as a sub-discipline of MIS that focuses on the way humans interact with technology, specifically in the business context (Zhang & Li, 2005). This study was designed to synthesize existing research in the field of HCI to provide a more holistic picture of who is publishing in the field, which topics of research interest are being studied, and what methods are being used. The study concluded that HCI research is conducted primarily at the consumer level and in the workplace and organizational context. Researchers are interested in a wide variety of HCI applications, but three topics dominate: cognitive beliefs and behavior, attitude, and performance. Such research is primarily performed empirically through lab experimentation, surveying, and field studies. As IT becomes increasingly complex, the study concluded the HCI sub-discipline is in an evolving state. Future HCI studies should focus on how to "make human experiences with technologies more pleasant, interesting, rewarding, and fulfilling, thus generating more human value for the users, more business value for organizations, and more social value for societies" (Zhang and Li, 2005, p. 279).

While data analysis has been around for centuries, big data is a relatively new concept that came into creation with the advancement of technology (Mills et al., 2016). As a result of the advent of this new field, data scientists are rapidly becoming in demand for companies that wish to remain competitive. Mills et al. (2016) claim that the growth of data science within the past decade has largely been due to improvements in technology infrastructure, data storage, transformation, manipulation tools, and interdisciplinary analytical tools. Data science tools include data mining, predictive analytics, visualization, and text analytics. The International Conference

on Information Systems (ICIS) reported in 2011 that there is a great "disconnect between what academia teaches and what industry needs" (Mills et al., 2016, p. 132). The panel called for IS schools to increase focus on business analytics, data mining, SQL, and big data. Five main research questions pertaining to the ICIS findings were presented in this study: "1) What percentage of programs have added big data/analytics courses? 2) What are the most common analytics offerings? 3)What impact does offering an advanced database course in 2011 have on the analytics course offered in 2016? 4) What impact does adherence to the 2010 model curriculum recommendations have on analytics courses offered in 2016? 5) What impact does tuition costs have on analytics courses offered in 2016?" (Mills et al., 2016, p. 135-137). The researchers concluded through a survey of 118 AACSB-accredited schools that 60% added at least one new big data/analytics course between 2011 and 2016. The four most popular added courses in order were big data/analytics, visualization, business data analysis, and business intelligence. Introductory courses are becoming broader in their scope by including content related to SQL programming, entity relationship diagramming, normalization, and relational modeling. Additionally, advanced courses in database integration are increasing in availability. It was determined through a chi-square test that 33 of the 118 surveyed schools adhered to 40% of the 2010 model, 36 schools adhered to 50%, and all other institutions adhered to more or less than a normal distribution pattern. A chi-square test was also performed to determine the impact of tuition costs on analytics courses. It was concluded that the correlation between tuition fees and an added analytics class was not significant.

The subjects of enterprise resource planning (ERP) implementation and business process reengineering (BPR) are usually taught hand-in-hand within the standard MIS curriculum model (Pellerin & Hadaya, 2008). The study made a distinction between the ERP solution and business process redesign in relation to the organization transformation process, focusing on the latter as the basis of its proposed ERP implementation and business reengineering course design. The main goal of business process reengineering is to reduce non-value-added activities and the main goal of ERP implementation projects is to "streamline an organization's processes by integrating the information flow into a single system" (Pellerin & Hadaya, 2008, p. 65). Since both activities seek to improve efficiency and cut costs, they are generally carried out together or in close succession within an organization. Because ERP implementation projects involve the analysis of business processes, the researchers assert that the focus of ERP implementation courses should be on the business process rather than the ERP function. The challenge with simultaneously teaching ERP implementation and BPR concepts is that it requires a multitude of technical IT and business functional knowledge. The AcceleratedSAP® methodology was utilized as the basis for the proposed framework, which provided a series of stages that represented an entire cycle of product implementation and business process redesign. The stages are as follows: project preparation (initial planning, project procedure, training planning, and project kickoff), business blueprint (business process definition, organizational structure definition, and change management planning), realization (configuration, training development, and report development), final preparation (tests, end-user training, and cut-over preparation), and go live and support (production support, ongoing key performance indicator management, and project close-out). To test the framework, the ERP implementation class partnered with a firm that manufactures residential furniture on a multinational stage. All stages of the AcceleratedSAP® methodology were carried out except the continuous process improvement stage due to time constraints. To quantify the outcomes of this initiative, a recapitulative exam was administered at the end of the project and the results showed that students "learned and remembered a lot more of the managerial and technical concepts taught than in more traditional IS courses" (Pellerin & Hadaya, 2008, p. 70). Overall, it was concluded that the students learned more by doing rather than seeing.

Faced with budget cuts and increasing software costs, universities often must prove the value of the education provided (Hepner & Dickson, 2013). ERP software is a significant investment of money, time to implement, and knowledge to teach. This research examined the costs and benefits associated with adopting an ERP curriculum. To conduct the cost-benefit analysis, specific quantifiable factors were studied, such as "increased business knowledge and understanding, increased student placement, [and] an increase in graduates' salaries…" (Hepner & Dickson, 2013, p. 309). The researchers also studied associated benefits to the university, such as increased credibility and evidence that a more realistic learning environment was produced. The study was unable to determine whether ERP system experience leads to higher starting salaries; however, it was noted that SAP experience leads to higher starting salaries.

ERP concepts and software in education have been researched more recently, with three of five papers covered here occurring since 2018. For example, Zadeh et al. (2020) specifically investigated how to tie Microsoft Dynamics ERP into an MIS class, recognizing that incorporating these software programs may be cost-prohibitive for some universities. Zadeh et al. (2020) assert that the free software for ERP does not allow for in-depth technical know-how and can only provide basic functional and conceptual lessons. Thus, experiential learning was utilized in conjunction with Microsoft Dynamics AX in an undergraduate course to ensure students were technically proficient and better equipped to perform well in a live ERP environment in their future employment. Specifically, experimental design consisted of two sections of the same undergraduate course, with one providing the technical proficiencies through the use of the ERP platform and frequent lab practice. The second covered ERP use and processes without the software and lab work. After the completion of both classes, students in the more experiential course enjoyed the course more and felt they had gained knowledge and valuable exposure to the program.

Since there has been a recent uptick in ERP education literature, Zhao et al. (2020) studied the perceived learning outcomes of students, their satisfaction in ERP-specific courses, and the predictors of whether they intended to utilize an ERP system in their future careers. The course utilized SAP software. This research was theoretically grounded in the IS Success Model and several constructive learning theories. Data was generated using questionnaires with five-point Likert-type scale questions. The overall system quality of SAP ERP was suggested as the most vital predictor for satisfaction, continued use intention, and learning outcomes in students. This finding was consistent with results from previous studies. Other

findings included perceived instructor support had a direct impact on student satisfaction, yet only a small effect on students' learning outcomes. Finally, the study indicated no effect on students' intention for continued SAP ERP use. Another indication of students' intention to continue using SAP ERP was found to be student motivation. It also was found to increase student satisfaction and students' perceived learning outcomes. The research concluded that individual instructors did not have a significant impact on if a student had intentions to use the ERP system in the future. Instead, a better indicator was based on the quality of the system and the self-motivation of students. The limitation of the study is the lack of generalization as the study was focused on a single software program.

A summary of the research contributions is provided in Table 1. The summaries are organized by the MIS trends subgroups identified and presented in chronological order.

Theme	Authors	Year	Contribution
MIS Student Preparedness	Arnett & Litecky	1994	Conducted a survey to examine employment advertisements to determine job skills for MIS professionals.
	Lee, Trauth, & Farwell	1995	Conducted a survey targeted at industry partners and found that respondents anticipated employment for higher-level IT positions would be in high demand. Results also pointed to an industry shift from centralized IS services within businesses to a decentralized, end-user focused organization.
	Downey, McMurtrey, & Zeltmann	2008	Focused on curriculum issues and imperative skills expected of recent MIS graduates and determined that translating employer skill expectations could be translated into curriculum via a redesigned curriculum model.
	Hunt, Kelley, Green, & Smith	2010	Conducted a survey of MIS faculty on perceptions of the "Model Curriculum in Organizational End-User Information Systems" and determined that the model still had relevance and value and that universities should make efforts to implement this curriculum model into their MIS degree programs.
	Olsen & Bryant	2012	Outlined an innovative teaching model for incorporating Business Intelligence principles into MIS curriculum by utilizing Gabne's Nine Events of Instruction in its framework.
	Zadeh, Schiller, Duffy, & Williams	2018	Introduced a proprietary program called "SAS Enterprise Miner" in a first-year MIS course to introduce students to data analytics. The study concluded that students in a first-year MIS course could be eased into learning technology without being overwhelmed or failing to grasp the practical applications.
MIS Curricula			
Undergraduate MIS Programs & Courses	Moshkovich, Mechitov, & Olson	2006	Concluded that the theoretical foundations of application development and deployment relating to e-commerce technology was important to cover in curricula.
	Mykytyn, Pearson, Paul, & Mykytyn	2008	Discovered that problem-based learning was an effective way to combat frustration in teaching introductory computer applications courses due to the redundancy of concepts that students already know.
	Downey, McGaughey, & Roach	2009	Concluded that student enrollment in MIS and computer science departments had declined in the US and noted that this is concerning due to the increase in demand for IT skills.
	Abrahams & Singh	2013	Proposed that expeditionary learning might be an effective way for faculty to combat obsoletion of current curriculum content even considering the challenge in keeping pace with advancements in technology.
	Downey, Young, Bartczak, & England	2016	Implemented a four-day summer camp for high-achieving high school students to expose them to different aspects of IT applications, companies, professionals, and careers.
	Akpan	2016	Concluded that institutions utilize consulting practicums in an effort to adopt the highly regarded experiential learning components of an IS curriculum.
	Monk, Guidry, Pusecker, & Ilvento	2019	Examined blended learning in computer education and concluded that it should keep the number of online classes to one-third and also ensure that the online material is well-organized and relevant.
Graduate Education in MIS	Quarstein, Ramakrishna, & Vijayaraman	1994	Studied the content and structure of IT courses in MBA curriculum and concluded that MIS skills should be integrated across the entire MBA curriculum rather than being isolated to one course.

	Shore & Briggs	2007	Examined the nation's top twenty AACSB-accredited MBA programs' curriculua to determine the best path to incorporate MIS into the core curriculum and found that none of the top twenty programs had a stand-alone MIS course.
	Thouin, Hefley, & Raghunathan	2018	Determined that academic program design should take a proactive approach in meeting the needs of various stakeholders, including employers, faculty, students, accrediting bodies, and society.
Subspecialties of MIS (ERP, HCI, Big Data)	Zhang & Li	2005	Synthesized existing research in HCI to provide a holistic picture as to who is publishing in the field; concluded that HCI research is primarily at the consumer level and in the workplace and organizational context.
	Mills, Chudoba, & Olsen	2016	Concluded that 60% of 118 AACSB accredited schools added at least one new big data/analytics course between 2011 and 2016 - including big data/analytics, visualization, business data analysis, and business intelligence.
	Pellerin & Hadaya	2008	Distinguished between ERP solution and business process redesign in relation to the organizational transformation process and used the AcceleratedSAP methodology to present an entire cycle of product implementation and business process redesign to students.
	Hepner & Dickson	2013	Analyzed the use of ERP in the classroom, explicity comparing the university investment in ERP tools against the student benefit of having ERP integrated into the curriculum.
	Zadeh, Zolbanin, Sengupta, & Schultz	2020	Examined the use of Microsoft Dynamics AX in ERP courses and determined its effectiveness in facilitating hands-on learning.
	Zhao, Bandyopadhyay, & Barnes	2020	Studied students' perceived learning outcomes, their satisfaction in ERP-specific courses, and predictors of if students planned to use ERP systems in their future careers.

Table 1. Summary of Research Contributions

4. RESULTS

Most of the journal articles were found in the *Journal of Information Systems Education*; however, 11 journals were found to have contributed to the systematic literature review. Table 2 presents the publications by journal.

Overwhelmingly, the U.S. is publishing the most journal articles regarding MIS in education. Twenty-one of the papers were published in the U.S., while only one paper was published outside of the U.S. in Australia. One interesting finding was that all of the included articles, with the exception of two, had a dataset entirely from the U.S. The two exceptions to this utilized a dataset from Canada (Pellerin & Hadaya, 2008) and an international sample where only 7.3% of those surveyed were outside the US (Hunt et al., 2010).

Figure 2 shows the number of publications per year. Overall, the most interest in MIS education took place from 2005-2010 and then again in the last five years of 2016 - 2020.

Journal Title	Number of Papers
Journal of Information Systems Education	9
Decision Sciences Journal of Innovative Education	3
Review of Business Information Systems	2
Communications of the Association for Information Systems	1
Education and Information Technologies	1
e-Journal of Business Education and Scholarship of Teaching	1
International Journal of Enterprise Information Systems	1
Journal of Education for Business	1
Journal of Systems Management	1
Journal of the Association for Information Systems	1
MIS Quarterly	1

Table 2. Publications by Journal

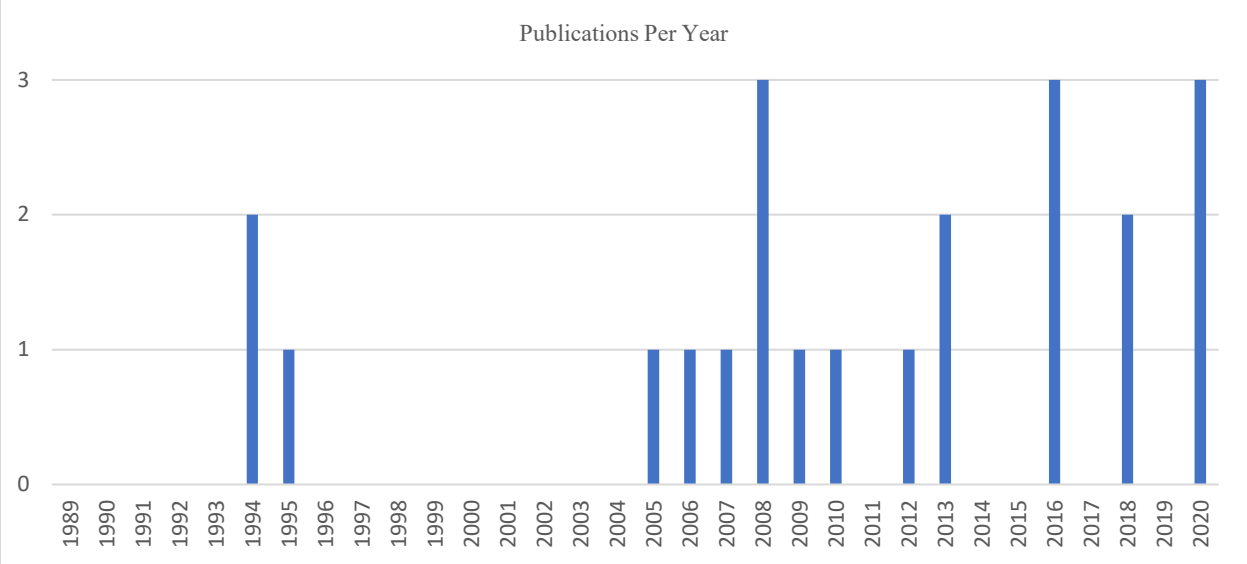

Figure 2. Publications Per Year

The academic literature examining MIS education is broad and has considered everything from the recruiting and retention of students, to classroom experience, and culminating with internships and job placement. As universities deliver this service to MIS students, academics seek to improve the quality of that education, and their work has taken many approaches.

To further analyze the literature, Table 3 presents the research papers examined in chronological order and the specific future research recommended. In analyzing and proposing future research, there are some general themes in the future work suggested.

Authors	Date	Suggested Future Research
Lee, Trauth, & Farwell	1995	This study does not specifically address future research studies but does argue the most critical issue facing MIS education is the need for collaboration between industry and academia; therefore, growing those partnerships is key to meaningful educational programs.
Zhang & Li	2005	As a literature review of HCI, this study gave several potential broad directions for future research without explicitly stating any research questions or topics. The broad directions include categories such as ad hoc opportunist research versus long-term theoretically oriented research or pluralistic methods, dominating methods or multi-methods.
Moshkovich, Mechitov, & Olson	2006	Future studies were recommended to examine how e-commerce is incorporated into MIS curriculum, for instance, is it a stand-alone course or added as topics in pre-existing courses? In addition, how in-depth is the topic covered as compared to more traditional topics in MIS?
Shore & Briggs	2007	This study recommended identifying how a more diverse sample of AACSB schools (below the nation's top 20 schools and international programs) addresses MIS in their MBA curricula, as a stand-alone core course or through integration throughout traditional courses. This includes discovering how MIS faculty are incorporated into the MBA programs, what MIS topics are included in the core MBA curricula and which are excluded, and what pedagogical approaches are best suited for MBA students learning MIS topics.
Downey, McMurtrey, & Zeltmann	2008	While no specific directions for future research were identified, the research did break down the lessons learned from studying the impact of IT career camps, including that employer buy-in is necessary, faculty participation is critical, it is difficult to engage female students, and inviting campers for a second, more in-depth experience, is successful. Thus, papers with a specific focus on these areas would build on their work.
Mykytyn, Pearson, Paul, & Mykytyn.	2008	Future research included replicating this study utilizing PBL and potentially expanding it to other software programs beyond Excel and Access, such as statistical software tools, HTML and/or Java.
Pellerin & Hadaya	2008	This paper did not explicitly suggest future research, but it did encourage other academic institutions to attempt to combine the concepts of ERP and BPR through the use of the AcceleratedSAP® methodology they piloted. They suggest that if a school is not already

		using a nine-month class block that they split such a project over two terms so that the project can be nearly experienced in its entirety by the students.
Downey, McGaughey, & Roach	2009	In furthering this work, researchers should focus on the factors influencing an undecided student's choice of major not just between CS and MIS, but other related fields such as math, engineering, business, and science. Additionally, data should be considered from a broader geographical sample beyond the mid-south and lower midwest, including an expanded US sample and international schools.
Hunt, Kelley, Green, & Smith	2010	Further studies should expand on this research by exploring the model curriculum in organizational end-user information systems with additional stakeholders beyond the faculty and measure success against a wider range of metrics. In addition, academics should work to uncover trends in end-user IS, with a focus on the gaps between industry and educational output, considering both educational offerings and IT professionals' hiring needs.
Olsen & Bryant	2012	Future research suggested investigating what pedagogical methods are most likely to result in a student's ability to decipher vast amounts of data and derive insights so that they are more prepared to work in the field of business intelligence.
Abrahams & Singh	2013	Future studies should identify if expeditionary learning is related to student enrollment or retention in higher education. Moreover, case studies looking at hands-on learning in specific subtopics of MIS are needed, as is a complete survey instrument designed to measure the effectiveness of such teaching tools. In addition, experimental design studies that look at the difference between expeditionary learning and traditional textbook teaching tools should be conducted.
Hepner & Dickson	2013	Future research should seek to quantify the benefit of ERP-integrated curriculum (ERP-IC) to students trying to understand the cross-functional business processes, including controlling for or comparing against other contributors such as internship experience, and prior student experience, among others; and understanding what level of integration is necessary to be beneficial for students (potentially a cost-benefit analysis of the investment into ERP integration).
Akpan	2016	In addition to the use of an MIS consulting practicum, faculty would work on developing a way to more significantly increase students' creative skills. Moreover, the use of consulting practicums may be beneficial in other academic disciplines.
Downey, Young, Bartczak, & England	2016	A longitudinal study tracking the students who attend MIS recruiting camps to understand their effectiveness should be conducted as follow-on research. A more thorough understanding of the meaningful touchpoints for parents at these camps should be studied, and the word-of-mouth marketing that may or may not be spread by the participants to their high schools before and after attending such a camp.
Mills, Chudoba, & Olsen	2016	A comprehensive study of industry's MIS needs could be conducted and then mapped to current topics in education, whether that be MIS, statistics, or CS.
Thouin, Hefley, & Raghunathan	2018	The preferences of graduate MIS students with regard to curricula should be examined in additional university contexts (as this sample was from a single US university), over a longer period of time (a longitudinal study), or with a wider array of constituents (industry professionals, campus administrators, and/or faculty).
Zadeh, Schiller, Duffy, & Williams	2018	Building on this work, the authors suggest including a hands-on analytics exercise into an introduction to business class as beneficial, by increasing the measures of effectiveness considered in the research.
Monk, Guidry, Pusecker, & Ilvento	2020	Further studies should expand on this research by similarly studying blended learning and incorporating more success measures (besides the single measure of student grades), improving sample size, and include other subject matters to improve robustness.
Zadeh, Zolbanin, Sengupta, & Schultz	2020	This paper does not include any explicit or implicit suggestions for future research.
Zhao, Bandyopadhyay, & Barnes	2020	The authors suggest that future research focus more narrowly on the specific model constructs and incorporate additional variables, such as course duration, course delivery method, course content, and course level [undergraduate or graduate]. Moreover, their exact study could be replicated with additional software programs such as Oracle Financials and NetSuite to increase the generalizability of their results. Lastly, using additional research methods to explore this topic, such as a case study approach, could add meaningful value to these results.

Table 3. Suggested Areas of Future Research

Of the 22 papers that were examined, eight suggested future research that involved investigating innovative pedagogical approaches in MIS (Abrahams & Singh, 2013; Akpan, 2016; Hepner & Dickson, 2013; Mykytyn et al., 2008; Olsen & Bryant, 2012; Pellerin & Hadaya, 2008; Shore & Briggs, 2007; Zhao et al., 2020). A few papers proposed additional research on theoretical pedagogical solutions, such as PBL, expeditionary learning, and process reengineering (Abrahams & Singh, 2013; Mykytyn et al., 2008; Pellerin & Hadaya, 2008). In contrast, others focused on more specific curriculum innovations, such as software integration or consulting practicums (Akpan, 2016; Hepner & Dickson, 2013; Pellerin & Hadaya, 2008; Zhao et al., 2020). Another study advocated for a more general look at innovative pedagogical methods that would be most effective in teaching data analysis (Olsen & Bryant, 2012).

A second theme that emerged from the literature is a need for future research in the area of industry partnerships in MIS education (Akpan, 2016; Downey et al., 2008; Hepner & Dickson, 2013; Hunt et al., 2010; Lee et al., 1995; Mills et al., 2016; Thouin et al., 2018). Several of these studies advocated for more industry feedback on MIS curriculum and suggested mapping current industry needs to topics in education (Hepner & Dickson, 2013; Hunt et al., 2010; Mills et al., 2016; Thouin et al., 2018). Yet others wanted more direct involvement between students and industry professionals through experiences such as IT camps and guest speakers, the provision of internship experiences, and consulting practicums (Akpan, 2013; Downey et al., 2008; Hepner & Dickson, 2013). One study was much broader and theorized that the constantly changing landscape of MIS required current professionals to be involved in the education of students but did not go so far as to recommend a specific outlet for such interaction (Lee et al., 1995).

Of the papers considered for this project, six articles advocated for more work into the subtopics of MIS education (Abrahams & Singh, 2013; Hepner & Dickson, 2013; Moshkovich et al., 2006; Olsen & Bryant, 2012; Pellerin & Hadaya, 2008; Shore & Briggs, 2007). Most of them were concerned with the educational value of teaching MIS more broadly or focusing on specific sub-disciplines. Specifically, subtopics considered were ERP (Hepner & Dickson, 2013; Pellerin & Hadaya, 2008), business intelligence (Olsen & Bryant, 2012), and E-commerce (Moshkovich et al., 2006). One study asked that researchers consider how subtopics of MIS might integrate hands-on learning as a pedagogical approach (Abrahams & Singh, 2013) and the last one speculated on how MBA students learn MIS, whether as a stand-alone course or integrated throughout the graduate curriculum (Shore & Briggs, 2007).

Another theme that emerged in the review was the need for new methods and metrics for measuring success in MIS education (Abrahams & Singh, 2013; Downey et al., 2009; Downey et al., 2016; Hunt et al., 2010; Monk et al., 2020; Zhao et al., 2020). This theme seems to be more recent as five of the six articles mentioned are within the last ten years. A few of these articles specified research methodology, such as broader samples (Downey et al., 2009), more complete survey tools (Abrahams & Singh, 2013), and additional variables (Hunt et al., 2010; Monk et al., 2020; Zhao et al., 2020). More qualitative research methods were also proposed to add additional clarity and depth to the current understanding of the issues in MIS education (Downey et al., 2016; Zhao et al., 2020).

The last theme is the cross-discipline opportunities in MIS education (Akpan, 2016; Downey et al., 2009; Downey et al., 2016; Mills et al., 2016), specifically in subjects such as math and statistics for work in data analytics and related fields (Downey et al., 2009; Mills et al., 2016). Education crossover opportunities also exist in technology fields such as CS and computer engineering (Downey et al., 2009; Mills et al., 2016). MIS education can also overlap with traditional business areas to create sub-disciplines such as FinTech, marketing analytics, and UX. Lastly, the line between the hard sciences and MIS education blur in fields such as biotech and environmental technology. While there has not been considerable research specifically in these areas with regard to education, several universities have created interdisciplinary programs that prepare students for such career paths.

5. CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

The overarching contribution of this systematic literature review was to identify and present the existing literature on the trends of MIS in education. Overall, 27 queries returned 227 papers, of which 22 were directly related to the search terms and intention of this systematic review.

The findings indicated that the research in MIS education needs to focus efforts on expanding data sets to include more international samples. Currently, 21 of 22 journal articles in this systematic review focused their data collection on datasets derived primarily from the US. This may be, in part, due to the search criteria only considering publications in English but more investigation into international work is still warranted. Further, the future research ideas proposed by the articles examined fell into five overarching categories. These five categories are 1) industry partnerships in MIS education, 2) the need for innovative pedagogy in MIS, 3) the opportunities to work with complementary disciplines, 4) the extent to which education should focus on the broad field of MIS or one of its subtopics, and 5) the need for new measures in evaluating MIS education.

Future research endeavors should be focused on one of these themes of work in order to add the most value to the body of knowledge. In doing so, educators can better serve both their students and MIS employers, build a stronger bridge between academia and industry, and improve satisfaction with their educational offerings.

Many of the papers found through this process were geared directly towards a specific subspecialty of MIS, such as big data, HCI, or ERP. In this analysis, ERP has the most longevity with papers spanning from 2008 – 2020. Still, it is important to know that keeping up with industry standards is difficult as they are ever-changing and research into some specialties becomes obsolete quickly. In fact, there has been quite a bit of research into the area of professional obsolescence as industry insiders also consider it a challenge to keep up with the moving targets within MIS (Joseph et al., 2011). What follows are the papers that, included in our analysis, were specifically related to curriculum development in a more specific discipline of MIS.

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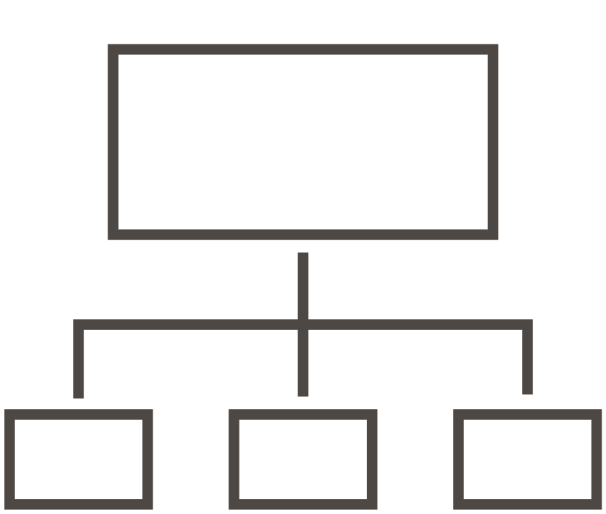

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