Invited Paper
Reflections on the Current State and Future of Information Systems Education

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ABSTRACT

This essay discusses the current state of and potential future directions for information systems education structured around several key themes that have emerged as central in several large-scale IS education initiatives over the past 15 years. The core idea that connects all of these themes is the centrality of IS as a transformative enabler for virtually all goal-directed human activities. The essay emphasizes the role of IS as the initial integrative discipline that for decades has prepared its students to identify opportunities to fundamentally change multiple target domains with computational capabilities. Furthermore, the discussion recognizes the distinctive focus of IS on bringing multiple technologies together into systems that serve organizational and societal goals and underscores the responsibility to carefully consider implications and potential consequences of technology-based solutions. The essay also acknowledges the essential roles of formal quality assurance mechanisms (such as accreditation) and education-focused research as essential resources for the future of the discipline.

Keywords: IS education, Competency, IS education research, Computing education, IS environment

1. INTRODUCTION

I am honored and humbled to have this opportunity to reflect on the state of information systems (IS) education and offer some thoughts about the future of our field. The most important role of the information systems community is to educate new generations of professionals whose work focuses on the use of information systems to transform the ways in which organizations and societies are structured and operate to achieve their goals. There is no better way for us to have an impact on the world in which we live than by being the best coach, mentor, and facilitator of learning for our students. For a variety of reasons, it is now more important than ever to ensure that we offer our students educational experiences that are both effective and comprehensive, reaching from technical expertise to new business models and values-based ethical analysis of impact.

Never in the history of civilization has a set of technologies had as profound a potential to change the world as systems based on information technologies have right now. Information systems have a truly fundamental role in the lives of all individuals, organizations, and societies, whether or not they recognize it. This is closely associated with the rapidly changing world of work, where artificial intelligence and IT-driven automation is changing job roles and relevancy of various professions at a pace that often exceeds the human capability to adapt. At the same time, physical and digital systems are increasingly fully integrated, and the actions of individuals in many contexts and even at the most minute level are captured and analyzed more closely than ever before. Information systems as a discipline might not be in the center of the development of technical component systems, but our core competency of bringing all these capabilities together in a way that serves individual, organizational, and societal goals is more critical than ever. At the same time, we have a significant responsibility to help our students understand the significant implications and potential consequences of their work.

In addition to the rapidly changing world of work and the foundational role of information systems in enabling that process, I will discuss in this essay the following themes:

- The role of information systems as a collaborating and contributing discipline under the umbrella of computing;
- Broadening our understanding of the information systems environment;
- Shaping curricula through understanding of graduate competencies and improving our understanding of information systems competencies;
- Opportunities for using accreditation as a mechanism for quality improvement in information systems;
- Improving the visibility and impact of information systems education research; and
- Understanding implications and potential consequences of specification and design decisions.

I have found these themes to stay consistently essential in the work I have done during the past 15 years or so in the field of information systems education as a member of the ACM Education Board, the AIS Education Committee and Council, and the CSAB Board; as an author of textbooks (Hoffer, Ramesh, and Topi, 2019; Hoffer, Topi, and Venkataraman, 2014) and edited volumes (Topi and Tucker, 2014; Brown and Topi, 2003) on information systems and information technology; and in leadership roles of information systems curriculum development in projects such as IS 2002 (Gorgone et al., 2003), CC 2005 (Shackelford et al., 2005), IS 2010 (Topi et al., 2010), MSIS 2016 (Topi et al., 2017), and CC 2020 (Clear et al., 2017). It is also equally important to realize that part of this history and source of ideas includes several projects that have not yet been able to achieve their expectations (such as the Partnership for Advancement of Computing Education and an effort to put together a large coalition of partners to develop a curriculum recommendation for Data Science).

2. INFORMATION SYSTEMS AND THE FUTURE OF WORK

I would like to set the stage for the discussion with two quotes – selected relatively quickly from among many similar ones from those presented by consulting firms that work with very large numbers of companies around the world helping them figure out their future – and an advertisement slogan (see Figure 1).

The next waves of disruptive technology – AI, robotics, virtual reality, IoT, and sharing economy platforms – will create an enormous degree of labor displacement. … Not all jobs will be affected, and not all affected jobs will be eliminated – as always, automation will both replace and supplement human labor – but jobs that are truly untouched will be the exception rather than the norm.
EY – Future of Work; www.ey.com/gl/en/issues/business-environment/ey-megatrends-future-of-work

So what should we tell our children? That to stay ahead, you need to focus on your ability to continuously adapt, engage with others in that process, and most importantly retain your core sense of identity and values. For students, it's not just about acquiring knowledge, but about how to learn.
Blair Sheppard, Global Leader, Strategy and Leadership Development, PwC; http://www.futureskills.blog/future-of-workforce/

Robots can't take your job if you are already retired.
Prudential billboard on I-90 in Boston

Figure 1. Industry Statements on the Impact of Modern Computing Capabilities

It would be easy to find dozens of other statements that are equally convincing and important from the perspective of the work we do as IS educators. Fundamentally, a key question is whether or not we as a discipline are prepared to provide our students with competencies that will enable them to be among those who are able to continuously adapt, learn, and acquire

knowledge so that they maintain their relevance in a world in which the role of work keeps changing very rapidly. I firmly believe we have an excellent opportunity to be among those disciplines that give their students long-lasting preparation as long as we focus on the core competency of our discipline: when faced with rapidly changing technologies, understanding which of them serve the needs of a particular organization, specifying requirements for integrated systems that serve those needs, and, finally, designing and implementing these systems. The main role of our graduates is not to develop the component technologies (although they might contribute to those processes, too); instead, their role will continue to be to contribute, better than anybody, in bringing business and computing-based solutions together in a way that allows organizations to achieve their goals.

One-off uses of technology offer, in practice, only short-term advantage; the long-term winners are those who can integrate various technology components into systems, preferably in a way that allows continuous improvement. Right now, this is, however, only possible if we as individual faculty members and as a community of computing educators know enough about artificial intelligence, machine learning, robotics (both physical and virtual), Internet of Things (IoT) and sensor systems, blockchain and related technologies, and data science and analytics (particularly from the machine learning perspective). Again, our discipline might not be involved in the development of the core technologies underlying any of these capabilities, but we have to be able to understand how to integrate them into organizational and societal systems in the context of specific industries, types of firms, and individual companies. This technology set will continuously change.

We as educators need to adapt quickly to organizational needs to be able to integrate these rapidly changing technologies. We have to be able and ready to prepare our students for a world in which winners effectively integrate machine learning and AI with human intelligence. Do we currently know what this means for some of the core learning experiences in our degree programs? Courses in systems analysis and design have a key role in teaching and learning about the integration processes. Understanding and structuring data has very quickly become a foundational competency for all knowledge professionals. For IS majors at various roles, it is essential that they are competent both in modeling core organizational information structures and applying the results of those modeling processes in a variety of technology contexts, from traditional relational databases to data warehouses, data lakes, and sophisticated analytics environments.

We often fail to recognize that even though the underlying technologies change very rapidly, the individual competencies required to integrate technologies into effective organizational systems are much more stable. Discovering, articulating, and specifying system requirements; designing approaches for humans to interact with system solutions; identifying what data sources and structures are needed to understand how an organization operates; etc. – these are all key competencies of IS professionals that will continue to stay relevant even when the component technologies change radically.

3. BROADENING OUR UNDERSTANDING OF THE INFORMATION SYSTEMS ENVIRONMENT

Even though many other disciplines find this difficult to admit, the discipline of information systems has an increasingly strong foundational role in understanding, explaining, and continuously improving how most organized human activities work and can be improved. It is particularly important to recognize that our field's expertise is not limited to business (e.g., Huh, Kim, and Law, 2009; Pai and Huang, 2011; Dimyadi et al., 2018), even though business in its different forms has been the most important domain of practice for IS from the beginning. The same competencies that make the IS discipline essential in the context of business allow IS to contribute to governmental units, not-for-profit organizations, scientific exploration, and any other form of goal-oriented human activity. The power of computing technology to enable individuals and organizations to better achieve their goals is only limited by our imagination and our ability to understand how to integrate technology capabilities so that they serve the human goals in a meaningful, productive way. Obviously, this requires that the IS community stays continuously connected with both the development of technology and the forefront of integrated solutions in industry practice in a variety of sectors.

The context in which information systems professionals perform their work is at times called an *information systems environment* (such as in the ABET IS accreditation criteria available at https://www.abet.org/accreditation/accreditation-criteria/cac-criteria/). Within these criteria, the IS environment is specified as

> an organized domain of activity within which information systems are used to support and enable the goals of the activity. Examples of information systems environments include (but are not limited to) business, health care, government, not-for-profit organizations, and scientific disciplines.

Another frequently used label for the same underlying concept is *domain of practice* or *domain of interest*. Regardless of the label, the idea is the same: the key competencies that we as a discipline prepare our students to have are ultimately meaningful and consequential only when they are applied to a goal-oriented activity that produces value for some group of individuals (or even a single person).

It is essential to recognize that the practice of bringing computing technology and the needs of a domain of practice together itself requires a highly demanding set of human competencies and that both individuals and organizations can over time and with practice become significantly more effective in integrating technology solutions and the needs of a specific domain of practice (Topi et al., 2017). For example, a professional working on health information systems in the context of a large hospital needs to be able to bring to the table technical competencies, an in-depth understanding of the healthcare environment, and specialized competencies in combining computing and healthcare. Even though these integration competencies are certainly partially transferable, that is not entirely the case: specialized expertise in applying computing-based technology to specific types of organizational contexts is an essential resource that evolves over time with education and with expertise.

Information systems was one of the first, if not the first, academic discipline that systematically brought together computing with a domain of practice, representing several decades of work in an area that had recently been described with names such as "computing in context, computing with a purpose, computing + X, computational X,…" (Beck et al., 2013). As such, IS has the potential to contribute significantly to the development of computing as a whole now when, in increasingly many fields of science and practice, the integration of computing and another discipline (or multiple disciplines) has become a major point of focus. Beck et al. (2013) state that "regardless of the descriptor, the goals for exploring the relationship remain the same: students need to understand how the power of computing informs and shapes ideas throughout the academy and society." The information systems discipline has been working from its early stages (Ashenhurst, 1972) on understanding how the power of computing informs and shapes ideas in business. Our expertise developed over time can contribute to a variety of fields for which the key question is how to most effectively apply computing to a specific context.

4. INFORMATION SYSTEMS AS A COLLABORATING AND CONTRIBUTING COMPUTING DISCIPLINE

Above, we established the significant contribution that IS can make to computing as a whole because of the expertise we have developed over time in integrating computing capabilities with the needs of various organizational fields. At the same time, we are, in practice, highly dependent on other computing disciplines for the development and understanding of the computing-based technology components. For example, IS 2010 explicitly recognizes that in terms of the computing knowledge areas, information systems can and should use the knowledge developed by computer science, software engineering, and computer engineering. At this point in time, almost a decade later, we would make the same observation regarding not only graduates' knowledge but also their competencies: IS is dependent on other computing disciplines in terms of providing some of the foundational material that we will expect our students to master by the time of graduation. Technical aspects of software development (including programming) are one good example, and various infrastructure technologies are another. We are, indeed, closely connected with other computing disciplines.

We do, of course, also develop and maintain specialized competencies on which other computing disciplines can rely. For example, IS has developed over time a strong, independent tradition of requirements analysis and specification for large-scale organizational systems. Similarly, we have unique expertise in conceptual modeling of domains of practice for the purposes of developing a foundation for data management solutions and for making sure that all relevant parties have the same conceptual understanding of the domain. The advances developed by the information systems community in terms of recommended practices and pedagogy in these areas have the potential for providing significant value to other computing disciplines.

During the past few years, the set of recognized computing disciplines (often specified as CE, CS, IS, IT, and SE) has been extended by two new areas of focus that are clearly multidisciplinary in nature: cybersecurity and data science. Cybersecurity has developed its own curriculum recommendations and accreditation criteria for the undergraduate level, and multiple groups are working on versions of data science criteria in parallel. In the context of cybersecurity, IS faculty members affiliated with AIS SIGSEC contributed to the curriculum recommendation in an important way, and IS experts on analytics have participated actively in discussions regarding data science education. These are also important examples of ways in which our discipline has contributed significantly to the core substance of computing.

Ultimately, the most important contribution of the information systems discipline to computing education is based on our focus on integration of computing with other academic disciplines and domains of practice. In many ways, information systems was the original "Computing + X" discipline, and in IS education, questions about application of computing technology to solve problems and benefit from opportunities of an application domain have always been central to our practice. We need to intensify our role as a brave, confident, and active partner in conversations among computing disciplines.

5. SHAPING CURRICULA THROUGH COMPETENCIES

In curriculum development in computing, one of the major shifts of the last few years is an increasing emphasis on the competencies that students of degree programs attain based on their work in the degree program. Earlier curriculum documents were based either on the specification of knowledge area/knowledge unit/topic structures or, more recently, an articulation of the curriculum as a set of courses (including, obviously, their topics). The newest computing curriculum recommendations, instead of specifying units of knowledge or details of courses, provide guidance to the programs that takes the form of integrated specifications of competencies, consisting of knowledge, skills, and fundamental human characteristics (often labeled as attitudes or dispositions). In a competency specification, we could state, for example, that a graduating student is expected to "develop a conceptual model that accurately reflects the essential concept structures within a domain of practice." This is done instead of simply specifying a topic of "conceptual data modeling."

Two concrete and completed examples of moving to the competency-based approach are MSIS 2016, the most recent ACM/AIS graduate curriculum guidance document for Information Systems, and IT 2017, a curriculum recommendation for undergraduate degree programs in Information Technology. Both specify outcome expectations as graduate competencies, which they consider as the most important contributions of the document. Obviously, competency specifications are not enough: degree programs also need guidance regarding the approaches for moving from graduate competencies to the design of a curriculum.

The benefits of the competency-based approach are numerous (Topi, 2018):

- A focus on competencies will move the emphasis away from what we, as educators, are teaching to what our students are expected to learn. This will highlight the two most important aspects of the learning process: students and learning.
- It is highly useful for a degree program to be able to effectively communicate the performance expectations of its graduates to its external stakeholders. Prospective employers are particularly interested in graduate competencies, but they are of interest also to parents, policy makers and others making funding decisions, and academic administrators. Competencies create a common language that facilitates communication between a program and its stakeholders and emphasize a program's interest in understanding what its partners (particularly employers) are expecting from its graduates.
- Competencies encourage us to reflect on student learning from a broader perspective, reminding us of the importance of general individual characteristics that are important as ingredients of professional success, such as commitment to quality, ability to consider organizational goals, ability to work effectively in diverse teams, and continuous focus on the implications and consequences of one's actions.
- Based on the work done by global task forces to develop curriculum recommendations, competencies are the best common currency for programs around the world. Educational systems and legal and regulatory requirements for degree programs vary widely in different parts of the world. These contextual factors dictate many aspects of degree programs in ways that make it very difficult to develop globally consistent guidance to them. Graduate competencies, however, can serve as shared goals that may be achieved through numerous means in a variety of contexts.
- Most accrediting agencies are using an outcomes-focused approach to evaluating programs. The competency-based approach is consistent with that.
- Competencies as outcome expectations can be used to strengthen the profile of an entire category of educational programs.

As with any program outcome specification, it is essential to articulate competencies at the right level of abstraction. On one hand, the competencies have to be concrete enough to describe the expectations in a way that allows effective communication with various stakeholders (particularly employers). On the other hand, the competencies cannot be so detailed and concrete that they change frequently or are relevant only for a narrow segment of the program population.

In MSIS 2016, this was addressed by specifying nine competency areas (see Figure 2), 88 competency categories, and 3-10 non-exhaustive examples of specific competencies per category. The MSIS 2016 task force believed that the competency categories present a good balance between stability and appropriate level of abstraction for effective communication. Note that in addition to the technical and integrative IS competencies, the MSIS 2016 model also includes domain of practice competencies and individual foundational competencies (see Figure 3).
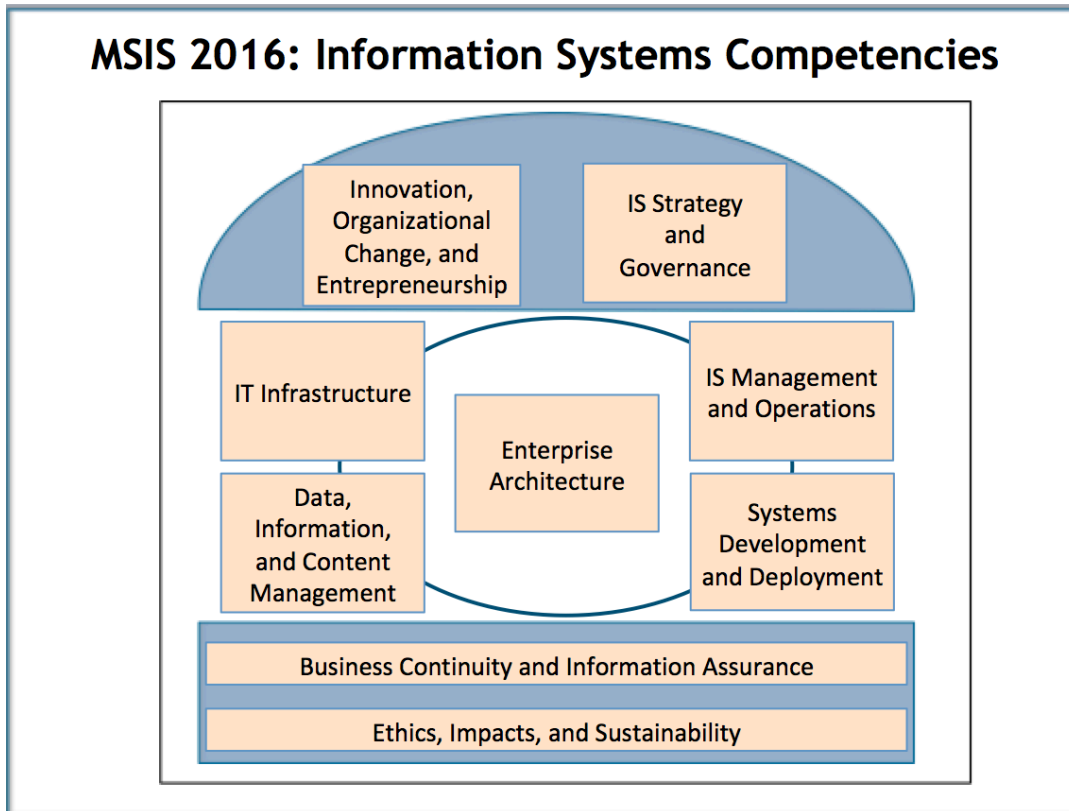
MSIS 2016: Information Systems Competencies

Innovation, Organizational Change, and Entrepreneurship

IS Strategy and Governance

IT Infrastructure

Enterprise Architecture

IS Management and Operations

Data, Information, and Content Management

Systems Development and Deployment

Business Continuity and Information Assurance

Ethics, Impacts, and Sustainability

Figure 2. Areas of IS Competencies (Topi et al., 2017)

OVERALL COMPETENCY ARCHITECTURE

Specialized Competencies

Additional information Systems competencies that build on the core competencies and allow the graduates to perform more sophisticated tasks and act in more specialized professional roles.

Core Competencies

Areas of Information Systems Competencies	Areas of Individual Foundational Competencies	Areas of Domain Competencies
• Business Continuity and Information Assurance • Data, Information and Content Management • Enterprise Architecture • Ethics, Impacts and Sustainability • Innovation, Organizational Change and Entrepreneurship • IS Management and Operations • IS Strategy and Governance • IT Infrastructure • Systems Development and Deployment	• Collaboration and Teamwork • Creativity • Critical Thinking • Ethical Analysis • Intercultural Competency • Leadership • Mathematical and Statistical Competencies • Negotiation • Oral Communication • Problem Solving • Written Communication	Core competencies in a domain of human activity such as business, government, health care, law, a field of scientific research, etc.

Areas of Information Systems Competencies with Pre-master´s Elements

- Data, Information and Content Management
- IS Management and Operations
- IT Infrastructure
- Systems Development and Deployment
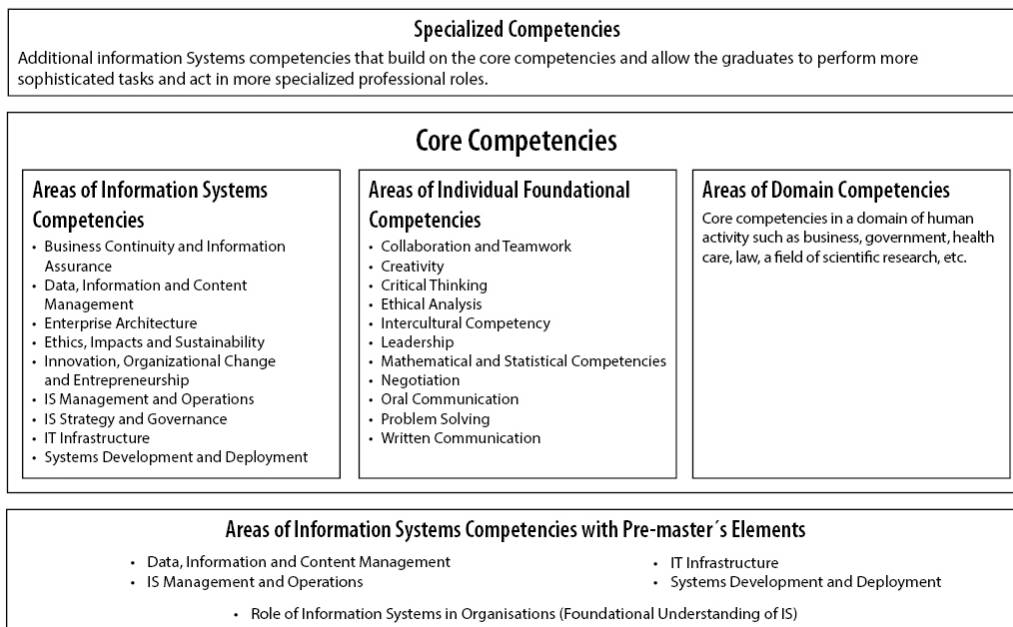- Role of Information Systems in Organisations (Foundational Understanding of IS)

Figure 3. MSIS competency architecture (Topi et al., 2017)

The computing education community is collaborating actively to bring the competency-based approach to all computing degree programs. This is happening through the Computing Curricula 2020 (CC2020) project (Clear et al., 2017; Topi, 2017), which strives to develop a forward-looking, integrative perspective on computing education, including all current documented disciplines, and providing space to incorporate new ones when they become relevant. A major part of the work in the CC2020 project consists of a) the specification of a competency meta-model that can be applied to all computing disciplines and b) the development of a harmonized set of competencies that can be used to compare computing disciplines.

6. QUALITY ASSURANCE THROUGH ACCREDITATION

Based on my own experience as a volunteer in computing accreditation in general and information systems accreditation in particular, I would highly recommend that all faculty members actively involved in managing and marketing degree programs in information systems become familiar with what IS accreditation can offer. In brief, choosing to have an IS program accredited by a reputable and approved accreditor can be an excellent tool for the program to develop a culture of continuous improvement and enhance its visibility and reputation. In addition, computing accreditation offers outstanding volunteer opportunities for those faculty members who do not currently serve in an administrative role. Volunteers in accreditation will learn a lot from the programs that they are evaluating, and they will also have a chance to work closely together with representatives of other computing disciplines. I have found these to be outstanding learning opportunities that have had an impact on my views regarding our own programs and the field as a whole.

Most degree programs in information systems are located in schools/colleges of business or management, and many of those are accredited at the *school level* by AACSB or EFMD (EQUIS). A school level accreditation by a reputable accreditor is an essential credential for any business school, but even for those IS programs that are located within schools accredited by AACSB or EQUIS, a *program level* accreditation in IS may be a good additional option. A program accreditation emphasizes a specific degree program with intensity and focus that is never achieved in school level processes. A combination of accreditations at both school and program levels is a powerful sign of the program's focus on quality.

One of the primary options for program level accreditation in computing is ABET, a U.S. based global accreditor of degree programs in engineering and computing. Currently, ABET has about 525 accredited computing programs. Most of them are in computer science, but about 60 of them are information systems programs (42 of which are in the U.S., and the rest around the world). The governance structure of ABET accreditation is somewhat complex, but, simplifying slightly, from the perspective of computing it is essential to know that ACM and IEEE-CS are the only members of (and providers of funding to) CSAB which, in turn, serves as the lead society for most of the computing programs within ABET. Unfortunately, there is currently no professional or academic society with a strong focus on IS education representing IS accreditation within ABET. With the current organizational structure, there are no guarantees that the computing criteria decisions (including IS specific ones) would have any input from the IS community. In practice, CSAB and ABET have so far made sure that IS expertise is well represented in the decision making processes, but the IS community needs to find a way to be part of the organized structures that are responsible for computing accreditation. The current void is not good for our discipline.

This is not only an issue associated with degree programs in information systems. Computing accreditation is relatively quickly moving towards accreditation of new multidisciplinary programs, such as cybersecurity and data science. Information systems as a discipline has a natural connection with both and should contribute significantly to the development of both disciplines, including the representations they get in the form of degree programs. This is only possible if IS finds a way back into the conversations regarding the future of computing accreditation, either through an informal advisory or a formal structural arrangement.

The new multidisciplinary programs are also excellent examples of the type of change that is continuously taking place in the environment in which traditional degree programs operate. For example, during the development of MSIS 2016, one of the major questions that emerged from the discussions was the choice between a general master's degree program in IS vs. specialized programs such as, again, cybersecurity and some form of analytics (business analytics, data analytics, data science, etc.). Specialized programs offer important opportunities in many contexts, but I believe core IS programs also continue to have an important role for professionals who understand digital transformation in organizations driven by computing technology and are able to integrate component technologies in a way that serves the organization in the best possible way.

7. INFORMATION SYSTEMS EDUCATION RESEARCH

The primary challenges associated with publishing papers that focus on information systems education are well known: papers on IS education are difficult to get accepted to the most highly respected journals and conferences of our field, and annual evaluation, promotion, and tenure processes don't often give enough weight to publishing in education-related outlets, even within our own departments. In many contexts, the same applies to editorial work for IS education journals and conferences. At the same time, it is essential for the education mission of our field that we work actively to maintain active and vibrant communities that focus on improving IS education.

Publications on IS education can be divided into at least five categories (partially based on the results of the PACE workshop described in Topi, 2014):

- Sharing of new pedagogical approaches and methods based on personal experience and anecdotal/informal evidence;

- Developing and evaluating curriculum guidance for the discipline through the formal professional and academic society processes;
- Creating teaching materials (cases as the primary example) for the use of other members of the community;
- Sharing new pedagogical approaches and methods based on systematic and structured data collection that allows scientifically solid comparisons; and
- Developing and testing pedagogical theories associated with key IS learning outcomes, and constructing and testing new learning experiences based on them.

High quality work in all of these categories is important and should be valued by the community through sufficient space in conference programs and recognition in various merit evaluation processes. It is, however, essential that in all of these categories we as a community maintain quality standards that stand up to scrutiny by those who evaluate our work from the outside.

It is unfortunate that the community of scholars who publish work related to IS education is somewhat fragmented, and at least personally I hope that we will be able to find ways to break boundaries between various subgroups within the community. This would not happen by merging any subgroups but, for example, by submitting papers to and attending conferences that might not be the most familiar for ourselves and by reading and considering journals that might not be our typical first choices.

I believe one of the best ways to improve the visibility and reputation of IS education research would be to support the development of a strong theory- and evidence-based foundation for IS education in collaboration with other scholars working on computing education. This effort might benefit significantly from learning from those who have been doing this work actively, for example, in computer science. Our research questions and focal learning objectives might be different, but we as an IS education research community could learn a lot from CS education researchers in terms of, for example, collaboration with education researchers, successful identification of sources of external funding, and efforts to build long-term research programs. There are, unfortunately, few venues that make it easy for IS and CS education scholars to share findings, but it would still be worth trying; for example, participation in the SIGCSE symposium is always an exciting opportunity, and IS education researchers could also consider ACM ICER as a possible option. Even closer to home, I would encourage those for whom AMCIS or AIS SIGED is the primary home to consider submitting their work to EDSIGCON, and those for whom EDSIGCON is the central community could think about exploring one of the AIS conferences. Some are already doing this, and I hope increasingly more will do so in the future.

8. NEW KEY COMPETENCY: UNDERSTANDING IMPLICATIONS AND POTENTIAL CONSEQUENCES OF TECHNOLOGY-BASED SOLUTIONS

There is an area of study and practice that is both a major opportunity and an important responsibility for us as experts on organizational transformation based on information technology: enabling our students to understand the implications and potential consequences of IT-enabled organizational transformation and specific IT solutions (Markus and Topi, 2015; Markus, 2017). Relatively soon after graduation, many of our students will be in positions of power and responsibility related to the requirements specification, design, and organizational deployment of very powerful systems with broad impacts on practice. There is an increased need for each information systems professional to consider carefully the implications and potential consequences of their specification and design decisions, regardless of their role in the organization.

Many of the questions driving this need are related to the increasing use of artificial intelligence and large quantities of heterogeneous data often reused for purposes for which they were not originally intended. The questions raised are non-trivial, and every organization should ask them. For example, given increased process automation, who is actually making the decisions and who is responsible for them? How are the values of the organization built into and reflected in its systems? Does the organization know and understand the ways in which its systems are affecting customers, employees, government units, and other stakeholders? Does the organization have processes in place to understand the unintended consequences of a proposed system?

As information systems educators we have a responsibility to ensure that the students graduating from our programs and completing our courses do not simply strive to develop the best possible technical solutions or systems that blindly advance narrowly defined goal sets. We are called to provide our students with conceptual frameworks and analytical tools to understand the broader impact of the systems they are involved in specifying, designing, implementing, and deploying, and with the courage to speak up when they discover potentially harmful or highly unpredictable consequences. Particularly with systems that have complex decision algorithms built deep into the internal structures, it is possible that only a small number of professionals truly understand what the impact of these systems is or could be. We have the responsibility to give our students a strong conceptual and practical foundation on ethics. Based on this foundation, they are able to:

- Recognize and address value conflicts and ethical dilemmas;
- Understand barriers to and enablers of data, algorithm, and decision quality; and
- Find the right balance between human expertise and computing-based automation, with a particular focus on designing systems that recognize the roles in which human decision makers naturally perform better than AI-based systems.

9. FINAL THOUGHTS

This is an excellent time to be an information systems educator. At the intersection of computing and various domains of practice, our discipline is serving a very important role that gives it an outstanding opportunity to thrive and a significant responsibility to help students become competent,

independent, and ethically grounded. This does, however, require that we continuously maintain the ability to bring together the technologies that at a particular time have the most to offer to the domain(s) of practice in which we specialize. This requires that we simultaneously continue to learn new technologies and maintain an in-depth understanding of at least one domain of practice so that each of us individually, and all of us together as a community, are able to identify and integrate new computing capabilities into organizational systems.

New specialties such as data science and analytics, cybersecurity, and IoT offer us as a field new, exciting opportunities, not only as experts in these focus areas and collaborators of other computing disciplines, but also and particularly as professionals who understand best how these capabilities are brought together into systems. This is our key value proposition, and we need to learn to articulate it better – we educate the graduates who are the strongest in enabling individuals, organizations, and societies to better achieve their goals. This requires a continuous focus on the quality of our programs and the work our graduates are able to do. Using graduate competencies as a way to specify expected outcomes gives us a powerful way to tell the story about the strengths of our graduates, continue to bolster our image, and increase our stakeholders' awareness of what we are able to offer (in addition to, of course, helping us continuously improve our programs).

It is essential that we continue systematic efforts to collaborate with other computing disciplines and that our societies work together with others whose focus is on advancing computing education. Together, the computing disciplines serve a critically important societal role and all of them, including information systems, are needed to help our stakeholders to understand the significance of our role in shaping the future.

Information systems educators and graduates of IS programs should have a particularly strong preparation to a) understand the implications and potential consequences of computing-based systems that transform organizations and b) act decidedly to avoid harmful consequences and strengthen benefits for broad groups of stakeholders. The IS community has always served the role of building bridges between domains of practice and pure technology specialists. In this role, we have an excellent opportunity to ensure that computing-based systems solutions are designed and deployed in a responsible way with a strong understanding of their potential consequences. This is a significant responsibility that we should take seriously.

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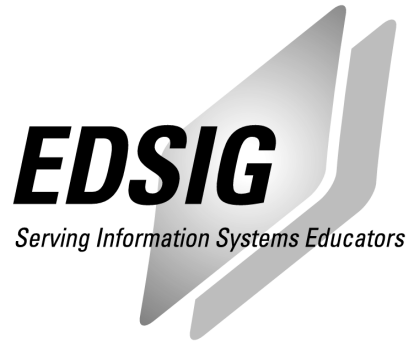
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