Teaching with Enterprise Systems: A Three Phased Roadmap

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Abstract. Educators still face challenges using enterprise systems as a teaching tool despite many universities having approached vendors for resources to enrich their curriculum. Previously, there is relatively little guidance given to educators on how to incorporate enterprise systems into the curriculum. This article describes a three phased – negotiation, knowledge and evaluation – roadmap for teaching with enterprise systems. A roadmap is important to guide educators in addressing the issues associated with the using of enterprise systems in curriculum. Furthermore, the roadmap describes a learn-by-doing approach, to provide a balance of business process and enterprise systems software specific knowledge for students; that the majority of firms seek. Following the roadmap creates the potential for joint creation of teaching and learning value between constituents in a wider eco-system, comprising of educators, vendors, faculties and students.

Keywords: Enterprise systems · Education · Roadmap

1 Introduction

Since the 1990s, many universities and their faculties have endeavoured to incorporate Enterprise Systems (ES) into their curriculum. For more than a decade, ES vendor outreach programs (such as the SAP University Alliance and Microsoft Dynamics Academic Alliance) have sought to provide a platform for universities, professors, software experts and hundreds of thousands of students to share, combine and renew each other's resources to create value in education through new forms of interaction and learning mechanisms [1, 2]. However, educators have been recommended to exercise caution as some universities still struggle not only to realize the potential of ES software as a teaching tool [3] but also to leverage it to teach ES in a meaningful way [4]. As educators in IS technology and management, we continue to be queried frequently about the role of ES and vendor outreach programs, what to teach and how to teach ES in business courses.

Because ES have been able to maintain widespread demand and proliferation in the business landscape over the years, the development of a roadmap to guide educators to enrich their curriculum with vendor resources and to address the industry deficit in skilled

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graduates is particularly relevant. It has been reported that graduates who pursue ES-intensive coursework command higher starting salaries than those who do not [1, 5]. Given the specific demands for graduates today (and for the foreseeable future), continual adjustments need to be made to ES curricula in order to accommodate relevant courses in a vendor ↔ university ↔ faculty arrangement. The challenge for an ES course is to support the courses that preceded it and vice versa, so that students entering advanced ES courses have adequate knowledge of the content in preceding courses. Incidentally, scholars [6] cautioned educators about the "perennial challenges" (p288) of (and the dangers of not) updating and maintaining the relevance of curricula. She warns of the need for new approaches to developing educational innovations to accelerate the pace of teaching material and curriculum innovation. The literature suggests that the methods of delivery favor certain modular functions of the software [e.g. 7] or favor certain business processes [e.g. 8, 9]. The challenges in delivering a comprehensive and broad education in relevant ES topics include, but are not limited to, student traits (including rote-learning, passive natures and poor self-directed e-learning) [10], pedagogy (or a lack thereof), academic partnerships, and instructional material issues [4].

In this article, we present a step-wise guide to aid new faculties in developing curricula and to encourage discourse among existing faculties on addressing the challenges in using ES in curricula. Our article summarizes how educators work alongside the vendor, other educators and students (who, we propose, are constituents of an ES education eco-system) to create joint value in ES teaching and learning. Building on the work of [4] and [2] we discuss how industry trends influence curriculum redesign, such that academics must not only recognize the wealth of ES capabilities, but also acknowledge the challenges institutions face in mining them. Our guide incorporates software vendor-assisted academic alliances, cloud and open source platforms, and e-learning teaching delivery methods that have been developed in recent times. This article builds on and draws on the authors' experience in the past decade with ES curriculum roll-out across three universities in two states in Australia and therefore we do not claim our conceptualizations are the only pedagogical approach. All the universities participating in this research taught the same ES software (i.e. SAP) and were degree-awarding universities at both undergraduate and postgraduate levels.

While an unspoken divide often exists between research and teaching at universities, we believe that it is timely and necessary to combine current curriculum focusing on ES concepts with new research concepts and teaching tools. The authors have researched and experimented with a variety of pedagogical teaching and learning modes for the purpose of developing appropriate ES curriculum. To this end, we conceptualize three phases – negotiation, knowledge and evaluation – and propose that each phase must sustain a particular set of activities to develop an ES curriculum. The roadmap is meant to be a tentative prescription for educators relating to their own adoption, development, co-creation and quality assessment of ES for teaching. The roadmap can form a concrete checklist and guide that informs educators of opportunities when teaching ES.

2 The State of Enterprise Systems Teaching

In the early 1990s, the emphasis in course development was on theoretical ES-related knowledge including the inherent characteristics of the ES software, such that the contact with ES software in classrooms was minimal. During this time, educators consulted published work in the area and drew on their own or other educators' experiences for teaching materials. In this early stage of ES curriculum deployment, the success of the course depended largely on the altruism of the faculty, its members and the subsequent buy-in of other courses. The demand for institutional resources was higher at the outset, while the educators' ownership of teaching content was low. In this mode, universities and faculties tended to commit considerable time and resources to modifying their undergraduate business and IS curriculum to incorporate ES and attempted to build on these foundations. At the California State University, for example, the success of the ES course relied heavily on the degree of altruism of the faculty as there was no particular incentive for faculty members to emphasize skills training, hence reverting to more orthodox academic elements such as frameworks, analogies, conceptual models, and theories. It was reported in [2] that the general strategy at the California State University was for one faculty member (or sometimes a pair) to develop a course idea and initially offer it as a special topics course. If there was sufficient demand generated for the new course, it would ultimately be added to the official college catalog. This bootstrapping approach thus prescribed starting small and building upon prior achievements. Similarly, at Louisiana State University, it was reported that the success of its ES course was largely due to a combination of an established business curriculum and practitioner interest [2].

Over the next two decades, the proliferation of ES across the business landscape prompted the widespread demand for ES-related skills. Even with belt-tightening by employers, the demand for ES graduates subsequently pushed Louisiana State University to develop a competency center to significantly bring down the costs of curriculum development. Courses included hands-on business process integration and management, strategic ES applications, process planning and control, and business intelligence. Today, the SAP University Alliance, Microsoft Dynamics Academic Alliance and Oracle Academic Initiative are examples of outreach programs that provide university faculty members access to a suite of solutions that can illustrate to students how ES can facilitate the integration of business processes. However, despite the existence of such outreach programs and strong demand from the industry, studies including [11] and [12] have revealed that most IS graduates still do not possess the necessary business process and architectural knowledge of ES packages. Reference [13] identified that ES adopting organizations continue to seek graduates who possess core ES technical knowledge, technology management knowledge and business functional knowledge.

3 The Enterprise Systems Education Roadmap

Figure 1 presents the proposed roadmap for teaching with ES, showing the three phases of negotiation, knowledge and evaluation. Within each phase is the set of activities that must be sustained in order to develop an ES curriculum. Each of the activities is discussed in this section.

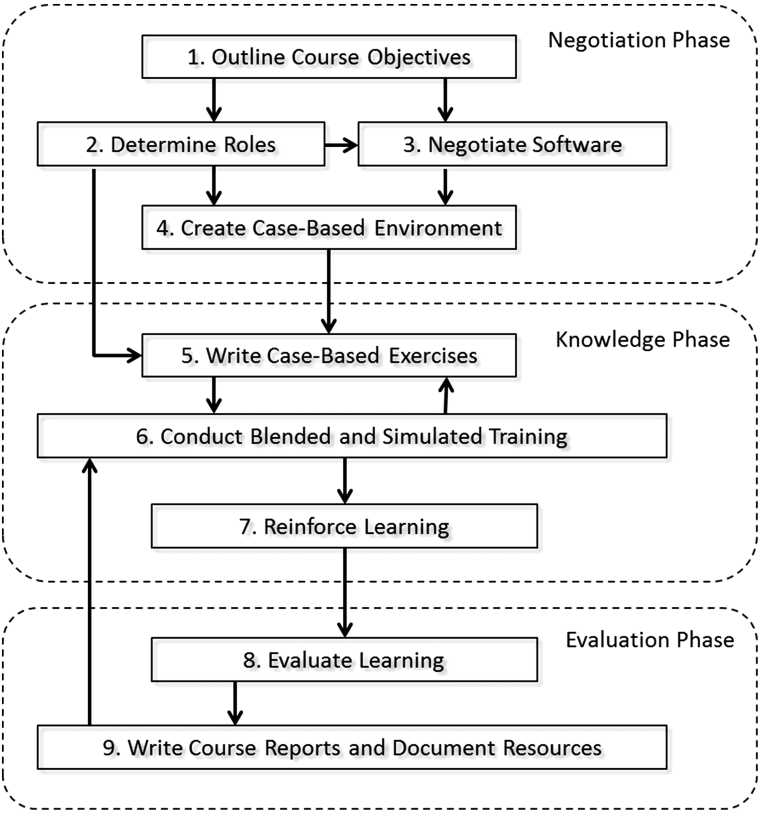

Fig. 1. A roadmap for teaching with ES

3.1 Outline Course Objectives

In the initial phase of negotiating the introduction of an ES course, educators must first outline the specific learning objectives and student learning outcomes, and the relationship of the course to the overall program learning goals and outcomes for all coursework. For example, it might be identified that the aims of the course are to instil an understanding of various ES modules and how they are able to be applied in a business context. For many faculties at a prescribed stage of curriculum development, hands-on experiences with software are often minimal and ES software when implemented may not contain all the information required for all teaching and assessment scenarios; hence, some curricula thrive in the form of spreadsheets or applications. In practice, individual spreadsheets end up acting as central repositories for critical corporate information and are widely regarded as "feral" information systems [14] compared to ES. ES have become the backbone systems for many organizations to integrate back-office applications in goods purchasing, inventory management, finance, and human resource operations; however, ES were not designed for data analysis and decision

support [15]. By nature, ES were not originally designed to provide real-time reports to massive numbers of users and these systems possess reporting limitations and involve manual processes [16]. Incidentally, this poses an issue for the often large introductory IS courses in Pacific and Australasian universities in terms of student support and generating reports for assessment purposes. Similarly in the real world, while ES applications are good at capturing and storing data for the day-to-day operations, spreadsheets thrive when dealing with disparate data sources. Regarding curricula content, we found that most foundation courses begin with anecdotal content of how ES have become the critical backbone for many companies' business processes, whereby management and IT organizations alike have become convinced that packaged software (rather than a best-of-breed approach) is a more effective way to satisfy the growing necessities of an increasingly competitive business environment. Subsequently, educators consult the popular work of [17] and [18] to describe how the automation of routine processes in an integrated fashion in the various functional areas such as accounting, inventory control and procurement has become the hallmark of such systems.

3.2 Determine Roles

Merely adopting a notable vendor brand or comprehensive instructional materials is not effective: the course must be enhanced with an experiential learning environment. In ES syllabi, the students should expect to assume an active real-world role in a described case and subsequently be able to work with the ES tools required of that role. For example, students may assume the employee roles in a large manufacturing organization where each student deals with day-to-day procurement and order fulfillment business transactions. Table 1 outlines some examples of roles in a supply chain. To be able to fulfill their roles, students would have to cultivate competence in the role and in the use

Table 1. Examples of roles, titles and related ES utilities in a supply chain [adapted from [19]]

Roles in…	Job Title	Related ES Modules, Functions and Utilities
Financial Management	Finance Manager	General ledger
		Accounts receivables & payables
	Accounts Officer	Consolidation
Sales and Distribution	Sales Manager	Order processing
		Pricing for sales & purchasing
	Inventory Manager	Inventory costing
		Shipment & delivery
Manufacturing	Production Officer	Production orders
		Bill of materials

of the ES tools, through both traditional instructional-centered material and active learning through role-play. This blended learning environment not only provides basic orientation to the ES tools and business roles, it further creates cooperative learning and collaborative work interactions between the students in the later learning phase.

3.3 Negotiate Software

Educators and vendors must work towards an agreement to provide students the opportunity to engage in practical learning experiences that powerfully affirm and complement the member institution's business course curriculum. As the emphasis on the interplay between ES ↔ workplace knowledge emerged, attention on the adoption of ES software for situated hands-on practice in classrooms grew. Vendors began to make their products available for classroom use. Subsequently, firms like SAP (SAP Education®) now offer 'readymade' software for a variety of ES-related courses that a faculty can implement. Similarly, educators can choose to join an academic alliance offering content and software support from a specific vendor. The impact on institutional resources is high due to the agreement with the software vendor, whilst the educators' ownership of teaching content is high by design. According to recent Gartner research, vendors such as Microsoft, Oracle, SAS, SAP and IBM are leaders – based on the completeness of their vision and ability to execute – in building enterprise-wide platforms on existing applications [in 20]. These leading software vendors distinguish themselves from niche players and challengers in the market by the breadth and depth of their capabilities to support the broad strategies of organizations. That is why the focus of many universities has been on the alignment of ES with strategic organizational frameworks, resulting in internally-funded projects and curricula improvements around ES design and use. The objective has been to motivate students, using a 'recognised vendor brand' ideology. The California State University, Louisiana State University, Worcester Polytechnic Institute and Bentley College (now Bentley University) in the US and Queensland University of Technology in Australia are examples of early alliance members receiving ES support in their curricula design from SAP [2, 6]. US colleges were part of the early SAP University Academic Alliance program which started during the 1996/1997 academic year. In 1997, Louisiana State University became a member of the US program and Queensland University of Technology joined the Australian program. Bentley joined the SAP academic alliance in 1998, and Worcester Polytechnic joined the Oracle program in 2000.

3.4 Create a Support Network

Generally, the members of vendor outreach programs like the SAP and Microsoft academic alliances receive donated software for the classroom, technical support, and access to online training. There has been much enthusiasm for the integration of ICT into higher education and the realization of virtual and electronic learning and teaching environments in recent times [21, 22]. Similarly, we favor an e-learning environment to help students organize their learning and to expose students to pre-determined knowledge and case-oriented problems. Moreover, to create a successful e-learning platform, we rely heavily on back-office administrators and faculty technical helpdesks, to ensure

direct and prompt system-related help throughout the sequence of the exercises. In addition, partnerships with vendors introduce business mentors to the programs. Reference [23] highlighted the advantages of having these business support advisors from business incubators, enterprise start-ups and consultancies to enhance the effectiveness of the e-learning tools and the training resource skills required of educators. Through the alliances, ES program coordinators are able to experience first-hand the teaching skills and abilities of real work business advisors to facilitate changes for their small business clients. Furthermore, business mentors act in an advisory capacity during the development of the case-based exercises to supplement the program. These materials are typically designed by faculty with support from alliance mentors and trainers. We suggest that the use of supplementary material and advice generated from academic alliances can enable institutions to be competitive in their educational offerings.

3.5 Write Case-Based Exercises

For the last six years, we have co-developed a number of instructional and learning materials with SAP and Microsoft to immerse students and generate situational awareness of their own 'adopted' roles. Although the teaching case approach has been employed in academic curricula for a long time, a teaching case designed to provide a technical viewpoint using organizational, functional and process viewpoints is atypical in SME and ES curricula. The situated instructional material contains: (1) the steps to complete the procurement and order-fulfillment activities in Microsoft Dynamics but more importantly to extend the current ES syllabi; and (2) the steps to create useful reports for management to add value to the sales process. The philosophy of the instructional material developed is that explanations to the students should be straightforward (less vendor-specific) while emphasizing the learning that can be gained through their analysis of the core sales processes they are completing. The hands-on material provides a worked example [24, 25] to give a systematic demonstration or impart knowledge of how ES are used to solve multiple examples [24] of complex organizational problems including procurement, production planning and order fulfilment (p206). Students also play an important role in co-creating a case-based ES hands-on training schedule. On one hand, a case-based approach is an effective means for higher education to move from more traditional academic to learner-centric pedagogical approaches [26, 27]. However, when set in a more practical context, the challenge (for educators) is to create a business case that: (1) is stimulating enough to invoke discussion and subsequent learning [28]; (2) can demonstrate the practicality of the theoretical teachings; and (3) allows the students to assume a particular role that mimics the real world. Hence, when designing a worked example [24, 25] exercise, the example must allow students to assume role(s) in a case organization, initiate business transactions and experience the business relationships between vendors, clients and customers – given that the educators assume such roles. For this reason, we believe that students play a particularly important role in co-creating a worked example that addresses the identified gaps. In the ES syllabi context, the students are expected to assume an active real-world role in a described case and subsequently are expected to be able to work with the ES tools required of that role. Furthermore, students should perform that role for the duration of the practical program in which they engage in a modular ES (e.g. Microsoft Dynamics NAV).

3.6 Conduct Blended and Simulated Training

In this section, we discuss a blended approach to in-class training that reinforces the textbook theory and principles with ES technical knowledge. Given the proliferation of ES in the current market, it is likely that students and staff are aware of ES concepts. Thus, positioned appropriately within a subject area, ES subjects have shown substantial attraction. Currently, on mature topics of ES, there are trustworthy web and textbook resources in abundance. However, we recommend that a starting university commences with an 'ES lifecycle-wide management' focus and uses an ES to demonstrate fundamental characteristics such as process standardization, best practices, real-time information, multiple-user groups, business processes and complexities in configuration. From a social constructivist viewpoint, and given that students by now are likely to have an understanding of how ES work for specified purposes in an organization, the educator and the learners are equally involved in learning from each other. This interplay, we think, is crucial for constructing a well-structured learning environment (for both the educator and the student), which [29] suggests provides the scaffolding for problem-solving. We think that the benefits are not just for the intended learners. Specifically, through our culture, values and background (as researchers) and including both the subjective and objective learning outcomes as an essential part [30], the interplay between educators, students and tasks shapes the overall learning experience. We have first-hand experience of instances of the benefits provided by such an environment, namely, new publications and repositories, new concepts previously overlooked in the literature, and the potential for new research and analysis of ES topics.

Hence, the emphasis for the faculty becomes building on the adoption of ES software for situated hands-on experiences, in extended and/or simulated environments. For this purpose, educators must actively seek to collaborate through extended activities that promote active teaching and learning. The impact on institutional resources is low, whilst the educators' ownership of the teaching content is high. The running of simulation games is one way to examine the application of practical concepts of ERP in extended activities that promote active teaching and learning. The use of simulation games to enrich ERP programs is gaining popularity, with examples including the so-called muesli supply chain game [9], MURSH-Bikes game [31] and pre/post ERP simulation model game [32]. We comment here on the development of one of these games in the region [see also 33].

The muesli supply chain game (also called ERPsim), designed by HEC Montreal and described in [34, 35], is now used in more than 150 universities worldwide and many Fortune 1000 organizations. Interested universities collaborate and send teams (including a team from the authors' university) to compete with other teams for market share and sales, while at the same time managing the procurement, production, sales and marketing, using SAP. The game involves changing various values and sales parameters within SAP, such as the sale price, in response to the information gleaned from reports such as inventories, market conditions and financials. Each team has an industry mentor from a large logistics firm acting as the supply chain advisor. The game allows students to interact with suppliers, customers and all elements in the supply chain, and teams compete to win the biggest market share by buying raw materials, managing budgets, developing production

and distribution schedules, and selling products. They are required to respond to changing variables such as an increase in grain price or a decrease in the foreign exchange rate, with every 25 minutes in the game simulating 30 days in the real world. From our experiences, we find this simulated and collaborative approach to ES education that incorporates a situational case study, business process and software to be useful. Collaborating on a topic of mutual interest with the industry and other academics is also plausible as an extension of the game.

3.7 Reinforce Learning

Typically in our courses, we use a second assignment – and usually a case study assignment – to reinforce the problem-based learning approach (fundamentally between membership and collaborative modes). In this assignment, the students examine a chosen case organization, namely, a real-world organization that has implemented ES, to submit a business report that summarizes the system strategy, implementation sins, critical success factors, business-to-ES fit and extended ES used in the case organization. To complete their assignment, students are encouraged to use a range of resources including published case studies and secondary data such as online articles and other printed media. Often, and with guidance from experienced researchers and educators who implement the case study assignment, the students will develop an understanding of rudimentary theories, their interpretations and the presentation of the case study content [36]. Although studies suggest that using worked examples is an effective instructional strategy to impart the required steps of a complex solution for beginners, [25] suggested that worked examples must be "faded over time" (p203) and replaced with problems for practice. Based on this premise, we use and therefore recommend an assignment to reinforce the students' learning from the laboratory activities. The assignment environment typically describes a problem-based learning approach that originated in the medical field [See 37] where students will adopt the ES to negotiate a series of real-world issues faced by a specified client organization, including inventory, purchasing, logistics and accounting problems. Herein, realistic examples [See 38, p11], feedback and reflection on previous worked example learning processes, and group dynamics are the essential components of problem-solving. During this transition (from worked example to problem-based learning), the educator adapts from the role of instructor to facilitator. As a facilitator, the educator helps students to recognize their role as the vendor, client, inventory manager or account clerk rather than taking the more didactic approach of asking them to solve a complex problem using the ES (e.g. creating a firm planned production order from a sales order). Students, who have by now developed some expertise [25, p.247] with the system, must be and are encouraged to play an active part in generating their own understanding of their role and the problem scenario, and to arrive at their own conclusions. From a constructivist learning perspective [38], this approach encourages students to be active learners, promotes educator-student interchange and is therefore more likely to promote social knowledge construction. Similar to the propositions by Kukla [39] and Savery and Duffy (2001), we believe that through the capture and assessment of deliverables (e.g. the creation of purchase order, goods receipt, picking list) generated from the

system, students can compare their version of the truth with that of the educator and fellow learners to get to a new, socially tested version of truth.

3.8 Evaluate Learning

Not surprisingly, feedback should be sought from students and other stakeholders, and continual improvements should be made based on this feedback. However, we do not find a consensual approach to the gathering of student evaluative feedback. According to [40], little research had been conducted on methods to measure the effect of course

Table 2. Selected dimensions and measures for gauging student satisfaction

Measure	Indicators	Sources
System Quality		
Features and functions (SQ5)	SAP ERP includes necessary features and functions	Adapted from [41]
Level of integration (SQ9)	All data within SAP ERP are fully integrated and consistent	Adapted from [41]
Information Quality		
Formatting (IQ4)	Order fulfillment outputs generated from SAP ERP appear readable, clear and well formatted	Adapted from [41]
Conciseness (IQ5)	Order fulfillment outputs generated from SAP ERP are concise (to the point)	Adapted from [41]
Individual Impact		
Learning (II1)	I have learnt much about order fulfillment through SAP	Adapted from [41]
Awareness (II2)	What I completed in SAP ERP has increased my awareness of order fulfillment	Adapted from [41]
System Use		
Frequency (F1)	I spend X number of hours per week on the system completing my tasks	[42]
Exploration level (DP5)	I have explored additional system features in SAP ERP beyond the given specifications	New scale

material on student understanding or students' broader knowledge of business issues. The use of surveys can be considered to: (1) track the students' reactions to the system, tasks and instructions; and (2) evaluate the learning outcomes, at either an early stage or latter stage of the system interaction or both. Toward this end, we recommend a set of measures including ease of use of the system, ease of learning with the system, understandability of reports generated from the system, un-expectancies encountered, adequacy of instructions and so on to canvass the students' reactions to the curricula. Table 2 presents a set of four dimensions and measures that is proposed to represent an overarching measure of student satisfaction.

3.9 Write Course Reports and Document Resources

Individual experiences can be shared by constituents in an ES education eco-system. In the present mode, institutions sign an agreement with an alliance that, in turn, provides content and software. Despite the growth in support structures especially through vendors, current academic institutions and new universities in the SAP academic alliance that are considering teaching ES still face resource constraints. For example, SAP University Competence Centers (UCC) provide access to software through a not-for-profit model. Universities could benefit from UCC curricula by sharing web portals and gaining access to well-tested curricula that is tailor-made for the software access provided by the UCC. Toward this end, faculties can encourage bricolage: by reapplying combinations of existing resources, educators can transform modest resources into contributions that are accessible by the academic community.

This is typical of a bricolage strategy which prescribes a combination and reuse of resources for different applications than those for which they were originally intended or used [43]. Educators in the SAP University Alliance, for instance, share their experiences (through university alliances, competency centers and community sites) to reinforce their own syllabus. For example, several versions of instructional material building on the Global Bikes Inc®, Fitter Snacker® and Fly-a-Kite® datasets have been created, characterizing the re-invention, implementation and testing conducted by the faculties. Encouraging other educators, vendors and students to collaborate via established networks and groups for learning can further establish their curriculum. In order to enhance the co-creation [44, 45] of ES education value, the strategy of developing a relationship with an academic alliance must start with the recognition of the university's infrastructure capabilities and the centrality of processes. Whilst the benefits of joining an academic alliance are evident, the management of the relationship is not so straightforward. The potential for co-creation is evident, given the present state of ES availability and adoption in classrooms. Faculties must understand that co-creation is about the joint creation of value by the vendor and the faculty, not the vendor trying to please the faculty: when managing the co-creation of value, educators highlight the importance of investing in new infrastructure capabilities that are centered on creating markets as a space for potential co-creation experiences. Today, universities have a unique opportunity to develop materials to fit their own contexts and based on the localized scenario. For example, if a particular industry is dominating employment in the location (e.g. mining, automobile, health), universities could develop ES teaching around those industries.

4 Conclusion

This article presents a roadmap for developing a relevant ES course. The roadmap, consisting of ten steps in three overarching phases – negotiation, knowledge and evaluation – offers a more focused effort to curricula design and assessment that reflects current practices in ES education. Our paper provides a checklist and a tentative prescription for educators relating to their own adoption of ES for teaching purposes. More and more faculties are looking to vendor outreach programs to provide access to software and to address the industry deficit for skilled graduates created by the widespread use of ES. However, the successful incorporation of vendor ES and associated materials for classroom use is not straightforward. Our roadmap introduces actionable guidelines to take advantage of hosting services, curriculum support, faculty training and collaboration. We add to the ES education literature on how educators co-create or intend to co-create value within the new ES education eco-system of which they have ultimately become a member (or a constituent). Furthermore, we encourage discussion about our roadmap, particularly in relation to the co-creation of value not only between new faculties and vendors but also between groups of currently participating faculties, and between educators and students through a wider digital network.

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