Instructional Design for Online Course Delivery in Engineering Management: Synthesizing Learning Styles, Pedagogical Perspectives and Contingency Factors

S. B. Kiridena1*, P. Samaranayake2, D. B. Hastie1
1School of MMM Engineering, University of Wollongong, Wollongong, Australia
2School of Business, University of Western Sydney, Penrith, Australia
e-mail: *s.kiriden@uow.edu.au; p.samaranayake@uws.edu.au; dhastie@uow.edu.au

Abstract – Online course delivery can not only help meet the increasing flexibility demanded by students, but also enhance collaborative learning. Moreover, online delivery allows access to students and markets that are not served through the traditional face-to-face delivery mode. Despite these potential benefits, and the opportunities created by the advancements in information and communications technologies, there are still many barriers to the market penetration of online education programs. This paper explores the implications of learning theories, pedagogical aspects and other contingency factors for instructional design in the context of online delivery of tertiary courses. A synthesis of extant knowledge pertaining to these perspectives is presented in the form of an integrated conceptual framework for guiding future work.

Keywords – Instructional design, online course delivery, project management

I. INTRODUCTION

Instructional design concerns with the development of strategies, procedures, processes, materials and tools of instruction for facilitating ‘learning’ or ‘the advancement of knowledge and understanding’ [1][2][3]. In the context of engineering education, learning also includes the development of skills and personal attributes that enable effective application of knowledge within specific areas of professional practice. ‘Facilitating’ learning, in turn, involves creating a positive environment to ensure an effective and efficient learning experience. As such, an understanding of ‘how people learn and adapt’ can inform the design and development of education programs. This notion can be explored from two primary perspectives. First, instructional strategies should be informed by alternative conceptualizations of how people learn or what is popularly known as ‘theories of learning’ [3][4][5][6]. The second aspect is the role played by the instructor or the facilitator of learning. The skills, knowledge, personal attributes and dispositions of the instructor are all said to influence one’s learning experience [7][8][9][10]. As such, pedagogical aspects relating to the practice of teaching also need to be considered in instructional design. Besides, there are a range of other factors that can enhance or inhibit learning and teaching; for example, learning propensities of students, their demographic profiles, their perceptions of teaching and learning and discipline-based pedagogical slants prevalent in certain professions [11][12][13][14][15]. Moreover, institutional factors such as the availability of suitable infrastructure and policy settings can also play a part in shaping one’s learning experience [10][16][17]. Therefore, it would be prudent that these perspectives, along with and other relevant exogenous factors, are appropriately considered in designing educational programs as they inform how alternative theories of learning and teaching apply to varying contexts. However, the extant literature seems to have dealt with these aspects selectively around the topics and circumstances pertaining to individual studies. We consider that there is value in synthesizing the fragmented knowledge pertaining to these perspectives into a holistic framework for guiding future work in this area.

This paper presents the insights drawn from a critical and extensive review of extant literature, undertaken to inform the design and development of an online course in engineering project management. The literature review covered the theoretical frameworks of learning, including learning styles, and pedagogical approaches, along with other ‘contingency’ factors identified as influencing one’s learning experience. The paper first presents a snapshot of the current discourse on these perspectives before exploring their implications for instructional design. It then identifies some specific challenges relating to the delivery of online courses. This is followed by a brief account of the key considerations in instructional design for online delivery of tertiary courses. Finally, the key perspectives examined in the review are integrated into a conceptual framework, prior to concluding the paper.

II. THEORETICAL FRAMEWORKS

With a view to providing an appropriate context for our discussion of instructional design, we first present a brief summary of the scholarly discourse on learning, pedagogy and the key factors in the broader environment.

A. Theories and Styles of Learning

The ‘theories of learning’ referred to in literature appear to be quite diverse in terms of: their scope, level of abstraction and the focus of attention; the underpinning epistemological foundations; and the contexts to which they apply [6][18][19][20]. Additionally, there is a substantial body of work that has examined individual cognitive styles, learning styles, personality types and learning strategies adopted by students, including the
association between alternative learning styles and teaching practices in certain disciplines or professions [4][21][22][23][24]. However, no literature was found to have distinguished between learning theories and learning styles per se. The major distinction between the two constructs gleaned from literature is that learning theories represent ‘how people learn and adapt’ at a more abstract level in terms of behavioral, cognitive, social and affective dimensions whereas learning styles deal with how students approach learning tasks, including the effects of personality traits, learning orientations and how they respond to external influences such as the way information is presented. Thus, it can be inferred that learning theories capture endogenous aspects of learning or learners personal-cognitive development. In contrast, learning styles relate to exogenous aspects of learning or learners’ preferences in the way they process information (for example, abstract vs., concrete) and interact with the learning environment (for example, through visual, auditory and kinesthetic means). In this paper we considered: four major theories of learning widely cited in literature, behaviorist, cognitive, constructivist and humanist [5][6][25]; and multiple dimensions of learning styles reported in empirical studies [4][23][24]; and their implications for instructional design. However, a detailed treatment of these learning theories and styles was not warranted in this paper due to space constraints.

B. Pedagogical Perspectives of Teaching

Pedagogy in its contemporary form largely concerns with the practice of teaching, as informed by theories of learning and facilitated by technology, including tools and techniques. Shulman [26] claimed that the practice of teaching should include “the management of students in classrooms and the management of ideas within classroom discourse” (p. 1). Alternative approaches to the ‘management of students and ideas’ should, in turn, be based on the nature of subject matter taught, the demographics of student cohorts and the physical environment in which learning takes place. The differences in pedagogical approaches that relate to the training of professionals (signature pedagogies), adult learning (andragogy) and online learning found in extant literature attempt to address these differences. Signature pedagogies highlight the unique characteristics of teaching and learning observed across multiple settings in relation to the way various professional groups are educated [26][27]. Andragogy, by comparison, attempts to account for the differences between adults and children (or older vs. younger learners) in terms of intelligence, learning, problem solving and cognitive development [28][29][30][32][32]. Online pedagogy concerns with the facilitation of learning in technology-enabled online and blended (online/face-to-face) environments, for example, scaffolding individual (personalized/self-directed), peer-to-peer (distributed/collaborative) and asynchronous (time-phased/interactive) learning [33][34][35].

C. Contingency Factors Affecting Learning

Numerous studies have examined the effects of a range of situational factors on learning. These factors are usually associated with the learner, the instructor or the environment in which learning and teaching takes place. The learner related factors include: demographic attributes and presage factors; individual preferences and their propensities for learning; and their perceptions and expectations of teaching and learning [11][12][13][14][15]. For instance, Cassidy [11] cited a number of studies in which factors such as self-discipline, personality traits and creativity have been rated as equal to intelligence and cognitive ability of learners in terms of their contribution to academic achievement. Other, more mundane, aspects related to learners that have been reported in literature include: students only interested in rewards, as opposed to learning; students’ lack of commitment to learning, as constrained by other difficulties; and students with practical experience are imbued with pre-disposed positions and their lack of flexibility to reshape their mental models. The instructor related aspects include: their ability to influence students’ learning orientations; their capacity to deal with the challenges like lack of motivation, incongruent goals or expectations and circumstantial impediments; lack of empathy; and their predispositions towards discipline-based pedagogies [7]. The widely cited institutional factors include: instructors’ workload issues; policy issues; professional development; resource constraints; and other doses of commercial reality [13]. However, these issues have mostly been discussed in the context of online delivery of courses.

III. INSTRUCTIONAL DESIGN: SYNTHESIZING MULTIPLE PERSPECTIVES

We reiterate that the holistic goal of instructional design is facilitating learning to achieve desired outcomes covering the cognitive, affective and behavioral aspects of development. Facilitating learning, therefore, involves creating a positive environment to ensure an effective and efficient learning experience, in addition to imparting knowledge, per se. Considering these aspects, we set the scope of instructional design to include: the development of course materials and assessment tasks; methods and procedures relating to course delivery; and processes and tools of instruction. Our approach to instructional design is, thus, informed by the epistemological, pedagogical and contingency perspectives of learning and teaching.

A. Implications of Epistemological, Pedagogical and Contingency Perspectives

Guided by their understanding and awareness of how people learn and adapt, instructors can aim to optimize the learning outcomes through adopting a range of measures. The generic learning outcomes may be interpreted in terms of the knowledge and understanding of subject matter, academic achievement and students’ overall satisfaction with a course [14]. If the preferred learning styles of students are known in advance or discovered during a course, instructors can endeavor to match their teaching style with students’ learning style, adopt appropriate pedagogical approaches in the design of a course and employ instructional methods that accommodate the needs of students. Alternatively, if the learning styles of students are not known or in cases where diverse learning styles were found to be present in a given cohort of students, then instructors can use a suit
of instructional methods with a view to accommodating the needs of as many students as possible. Some authors have also highlighted the importance of developing other skills and attributes such as communication, teamwork, self-efficacy and aptitude for self-directed learning [35]. More specifically, instructional design can be targeted to support students achieving desired learning outcomes through: the alignment of learning objectives, teaching methods and assessment; the design of in-class activities and assessment tasks that reinforce preferred approaches to learning; and creating appropriate learning environments that support different levels of cognitive engagement [7][11].

However, despite the substantial body of research that have examined cognitive and/or learning styles and the popularity of numerous measurement instruments, a significant number of authors have pointed out the lack of empirical evidence to support the existing theories and instruments [4][17][36][37][38]. These observations mean that although instructors can be selective to some extent in their choice of instructional strategies, they should use complementary methods to support multiple learning styles. Moreover, literature on pedagogy suggest that there are significant differences in: the way people are trained in different professions; how learners of different maturity levels assimilate knowledge, including how they make meaning of subject matter taught; and the influence of environmental factors on learning. Although there is no consensus on prescriptive approaches to deal with these variations or even concrete evidence to conclusively support these assertions, authors generally concur that approaches to pedagogy should recognize such differences and instructors should develop the capacity to adopt appropriate styles of instruction to facilitate learning within different groups under specific settings. Overall, these observations highlight the importance of a scholarly approach to teaching and reflective practice.

Our review of the impact of situational factors on learning further highlighted the relevance of the notion of equifinality and hence the need for an eclectic approach to instructional design. The extent of variations in terms of the presage, demographic and institutional factors experienced in real world educational settings may well mean that instructional design should not be driven by prescriptive rules. However, a greater awareness and understanding, developed through the participation in the current discourse, can indeed inform an instructor or educational designer in incorporating these multiple perspectives in a selective (e.g. to suit the context and learner characteristics or preferences) and complementary (e.g. to reinforce learning experience) way in instructional design. Coffield and colleagues [17], for instance, noted that “those who reject the idea of learning styles might, nevertheless, see value in creating a more precise vocabulary with which to talk about learning, motivation and the idea of metacognition… better self-awareness may lead to more organized and effective approaches to teaching and learning” (p. 4).

B. Challenges Associated with Online Delivery

The challenges associated with the online delivery of tertiary courses have been widely discussed in literature, and they primarily concern with: overcoming the negative effects of physical separation of learners and instructors and/or asynchronous learning; dealing with the difficulties associated with the use of technology; and managing the perceptions, anxiety and expectations of students, as well as instructors [9][39][40][41]. Apart from these challenges, which are directly related to instructional design, literature also deals with a range of institutional, policy and administrative issues that act as barriers or impediments to the successful delivery of online courses [41][42][43]. These issues include (lack of): learning support; staff development; infrastructure and resource allocation; technical and administrative support; and quality assurance and change management.

Physical separation of students and instructors in online learning environments could result in minimal face-to-face interaction among students, as well as between students and instructors, which could, arguably, limit collaborative learning. Other challenges associated with physical separation and asynchronous learning that have been cited in literature include: facilitating and moderating learning activities and/or assessment tasks; compensating for the absence of social presence; reinforcing discipline and self-motivation; and dealing with the sense of loneliness and social detachment [9][18][39]. Percel and colleagues [40] have argued that these issues are further exacerbated when courses are taught by instructors who have had no involvement in designing and developing those courses. As such, authors generally advocate the need for paying particular attention to these aspects in instructional design, to ensure adequate levels of interaction and presence (to create a sense of learning community), through such means as orientation sessions, personal biographies, online discussion forums, bulletin boards, quizzes, virtual teams, collaborative assessment tasks, instant messaging and instant self-check feedback mechanisms. Some authors argue that, if these features are incorporated, along with adequate technical support and instructor training, online delivery can even be more effective (vis-a-vis face-to-face delivery) in achieving desired learning outcomes. This is partly because technology allows students to actively engage with material at their own pace while refining their understanding and testing new knowledge [13][44].

Nonetheless, within online learning environments, students and instructors alike can easily be frustrated by the challenge of assimilating knowhow to effectively use technology. Difficulties with the use of learning technologies seem to be quite common among otherwise technology-savvy students of the present day, even in face-to-face teaching environments. Anecdotal evidence suggests that instructors often find themselves in the difficult situation of not being able to meet the expectations of students to fix such problems immediately, which in turn affect students’ overall experience. These challenges can only be more severe in online environments as communication and coordination between different parties involved in resolving such issues can be more difficult and time consuming [45]. Although there may not be many options available for the instructor in addressing technology related issues, the role of administrative and technical support, as well as the importance of training and continuing professional
development, has been cited as useful measures to deal with such issues [41][42].

Despite the continuing expansion of online learning, and the extensive body of literature available in this area, many are still not familiar with the particular challenges and opportunities presented by online environments. Students often expect the same level of interaction and response times they are accustomed to with face-to-face learning in online environments. Similarly, instructors expect the same level of discipline and self-motivation they experience in traditional class rooms from online/distance students. Although the fundamental learning concepts may equally be applicable to both traditional and online learning, literature suggest that there are non-trivial differences between traditional classroom and online learning environments in terms of: motivation, discipline and time commitments required of learners to successfully complete online activities; opportunities for collaborative learning; the role and dispositions of the instructor; and the challenges faced by instructors in facilitating learning, particularly, in the absence of visual cues [13][39][41][42]. Studies on students’ perceptions of online learning also reveal that students consistently rate their on line learning experience at a lower level than traditional class room experience on dimensions such as heavy workload, difficulties with the use of technology and tardiness in relation to feedback and resolving issues [14][39][44][45].

C. Key Considerations in Instructional Design for Online Delivery

A variety of guidelines and recommendations (in the form of best practices, critical success factors, lessons learnt and reflections) for enhancing the effectiveness of online learning can be found in literature [1][8][9][21][34][39][40][46][47][48][49][50]. This literature has addressed such aspects as: the design and delivery of programs, including structuring learning activities, assessment tasks, feedback, visual components and user interfaces; the development of course material and instructor resources; motivating and engaging learners; the changing role of, and demands on, the instructor; the choice of technology and the development of learning tools. The broad principles, which the design and delivery of online courses should be guided by, as elicited in this literature, can be summarized as follows:

- Putting students in charge of their own learning (self-directed learning) through such measures as student led discussions/projects and peer assistance/assessment;
- Providing support for learning through modelling, scaffolding and coaching, as well as setting explicit learning goals/outcomes, clear assessment criteria and timely feedback;
- Enhancing learner engagement and strengthening collaborative learning through the use of enhanced audio-visual material, interactive learning activities and group projects; and
- Building a sense of learning community (social presence) through shared responsibility, personal knowledge, communication and feedback.

These principles are predominantly driven by the constructivist and humanistic perspectives of learning and andragogy. They also account for the contingency factors discussed earlier, for instance, demographic aspects, presage factors and individual learning preferences. However, addressing the perceptions and expectations of learners, as well as the concerns of instructors, are to be dealt with separately – which also include measures to address wider institutional and administrative issues, for example, technical and administrative support, training and development, policy redirections, resources allocation and cultural adjustments.

Nonetheless, there is no consensus among authors on the empirical validity of the theoretical platforms used or the effectiveness of current approaches to instructional design. Given the wide variety of recommended practices and the diverse nature of epistemological and pedagogical foundations that inform such practices, authors often advocate the development of appropriate measures to suit specific settings based on the best judgment of the instructor involved. Apart from the above aspects of instructional design which have been discussed widely in the context of online delivery, there seem to be several other principles that are more broadly applicable to instructional design and those pertaining to the discipline-based practices, in particular. These include:

- Adopting a scholarly approach to teaching, including pedagogical approaches that bring inquiry into teaching (i.e. the teaching-research nexus);
- Aligning learning objectives, teaching approaches and assessment tasks;
- Using technology tools to facilitate collaborative learning that extends beyond the traditional didactic approaches; and
- Considering pedagogical approaches that have been proven particularly useful/effective in the area of management/project management.

Overall, our review of extant literature brought out a wide range of issues, challenges and opportunities pertaining to the instructional design for online courses. Although our main focus was on the development of an engineering management course, we purposely explored a broader spectrum of literature. We believe this approach allowed us to draw rich insights from the contributions of a range of scholars, and develop a holistic and more complete understanding of the multiple factors that influence learning and teaching. The diverse set of theoretical frameworks we examined also helped us to appreciate the complementarities, as well as the overlaps and tensions, between alternative schools of thoughts.

We close our review and discussion of this topic by presenting a conceptual framework (Figure 1) which, we believe, integrates the multiple perspectives, dimensions and factors explored. We contend that the synthesis of an otherwise fragmented body of knowledge this way makes a valuable contribution to both theory and practice. At the same time, we acknowledge that this framework may not be sufficiently scrupulous to serve as a robust theoretical construct. However, it may serve as an initial reference frame for guiding future empirical work in this area.
IV. CONCLUSIONS

We have discussed the insights drawn from extant literature concerning the three perspectives explored, along with the inferences drawn from those insights, in the previous section of this paper. We have also stated our position in regards to how they can inform instructional design within varying contexts.

Overall, our extensive review of literature brought out that instructional design should indeed be informed by epistemological and pedagogical perspectives. However, the most effective approaches to the design and development of a particular course may still be finally determined based on the best judgment of instructors, while considering an array of other factors applicable to the particular setting in which learning and teaching take place, as well. The eclectic nature of the best-practiced approaches found in literature also suggests that while instructors can be selective to a degree in their choice of instructional strategies they may also need to use complementary approaches, methods and tools to support multiple learning styles and to suit the diversity present in a given learning environment. These observations lead to the notion that instructors’ awareness and understanding of multiple perspectives, as discussed above, as well as their ongoing engagement in scholarly discourse on these topics, remain highly relevant and useful for ensuring the effectiveness of instructional design.

We believe that the integrated conceptual framework presented in this paper can serve as a useful reference frame for those who pursue such a holistic approach to instructional design. As this framework synthesized the existing body of knowledge pertaining to the three aspects of learning styles, pedagogical aspects and contingency factors it will provide instructional designers with a holistic view of their linkages to learning and teaching. In future research, we aim to evaluate the efficacy of the proposed framework using empirical evidence.

REFERENCES
