

PRESENTATION DESIGN FOR THE COURSE TUNNEL ENGINEERING

Jianqin Ma

School of Highway, Chang'an University (China)

Abstract

To play an active role in this situation, high education would be in a transforming way to meet the diverse needs of the society. As a traditional course needs redesigning, well-designed presentations for the course are necessary. Here is the presentation design for the course Tunnel Engineering at Chang'an University in China, with the considerations of the practical situation, the contents and features of the subject knowledge, the styles of the information available, the focus for the course stages, the efficiency of the students' knowledge building and the evaluation of the course procedure. The design plan is executed in a dynamic way, in which the contents and styles of the presentation are tuned according to the evaluation results of the student's knowledge learning levels at a specified stage. The practice shows that: (1) students are skillful to find information, but they need instruction in information sampling and knowledge system building; (2) instructors should focus on the presentation of key concepts, the connections of the knowledge points, student's learning skill and capacity development; (3) adequate evaluation and active motivation are necessary and favorable to student knowledge building.

Keywords: *Design, knowledge presentation, course, tunnel engineering.*

1. Introduction

The world is increasingly changing, especially in the industrial fields. To play an active role in this situation, high education would be in a transforming way to meet the diverse needs of the society, as engineering education would play a fundamental, global, and leading strategic role in the social development (Li, 2020). Since the engineering profession need to embrace diversity and globalization in the engineering workforce and in the professional activities, the young engineers will be the well-rounded or more rounded (NAE, 2004, 2005). Therefore, engineering education is increasingly challengeable to face the practices (NASEM, 2018) and this trend will be increasingly significant in the future (OECD, 2015). On the other hand, the rapid evolution of digital technology is reshaping the educational landscape. As the Artificial Intelligence (AI)-driven technologies are reshaping both academic environments and human resource practices, the intersection of AI and education gives new ways to enhance learning experiences, personalize student engagement, and foster skills critical to the future workforce. We educators need not only to consider how to teach, learn, and adapt to the emerging trends in educational technology, but also to take advantage of the contemporary technologies. Some emerging engineering education models (Graham, 2018; Stanford2025) or New Engineering Education Plan (Li, 2020) have been in practice to meet the requirements. All of these well-accepted learning and teaching styles prefigure changing in the conventional course presentation. A traditional course needs redesigning and well-designed presentations for the course are necessary. Here is the presentation design for the course Tunnel Engineering at Chang'an University in China.

2. Background the course

In a traditional mode, engineering education contents include the fundamental scientific principles and discipline-specific knowledge, and design techniques in later years. Young engineer learns in practice, such as the on-the-job skills of teamwork, communications, ethics, etc. However, nowadays, there need a broadened engineering curriculum, with the features of diversity. Students could acquire a set of pluralistic skills and dispositions necessary for today's diverse workforce and society under an educational system, with across disciplinary contexts (Engberg, 2007). As the roles of heuristics, empiricism, rationalism, logic, ethics, and aesthetics are considered illustrating the relevance of philosophy to the practice of engineering, the modern engineering education should focus on the development of a range of attributes both from the

engineering pedagogy and liberal arts (NAE, 2004). As the reports (NAE, 2005) stated that “...engineering educators and curriculum developers must anticipate dramatic changes in engineering practice and adapt their programs accordingly” to prepare them for addressing the complex technical, social, and ethical questions raised by emerging technologies. Some of the skills identified include: good communications, high ethical standards, an ability to think critically and creatively and independently, the ability and self-confidence to be flexible, and an understanding of the importance of teamwork. The world needs well-rounded or more rounded engineers. The engineering education must adapt to this situation.

On the other hand, universities must continue to focus on the key skills, such as to teach 'core engineering' and not dilute course content with peripheral subject matter (RAE, 2007). As it is said that 'if everything on the Earth were rational, nothing would happen'. The practical situation is always not a standard or totally predefined procedure, such as to finish a civil engineering project. For example, a tunnel project is often unique indeed. This means an engineer must consider it in a logical way, with specified professional characteristics, such thinking and making decision with the help of engineering judgement. Against such a background it is proposed that a framework based on both philosophy and the history of engineering, science and technology constitutes a valid footing upon which engineers can be enabled to see and develop their profession in a suitably rounded manner (NAE, 2005).

In brief, we need a more adaptive, diverse and inclusive system of engineering education. There need changes in the curricula to broaden the context of engineering, enhance the status of the engineering profession and improve technology literacy and the public understanding of engineering. In terms of student-centered principle, the presentation style should accordingly be robust and more favorable to student knowledge acquisition.

3. Design of the course presentation

3.1. Design considerations

The considerations for the course presentation design include the followings: (1) the practical situation of the course, such as to cope with increasing knowledge points within decreasing course hours; (2) the contents and features of the course knowledge; (3) how to use the various styles of the course-related information available; (4) to design focus for each stage of the course procedure and to present them in a proper mode; (5) how to make the stage key points being connecting nodes in the students' course knowledge system; (6) how to dynamically evaluate the results of the presentations during the course procedure.

3.2. Social requirements and course focus

We are in an innovation-driven society, knowledge creates pathways to a sustainable future. For example, the social focus is shifting with a decreasing time interval, with the new technology taking the place of the old one. This situation requires students being robust and flexible. Education activity should skillfully manage both the general and professional knowledge. Engineers need not only fit to a specified engineering position but also create or lead a new engineering field. The basic attributes of an excellent engineer are of being professionally qualified and flexible to the changing world. Therefore, one of the education key features should be timely and effectively tuned, with the focus on students' knowledge building and capacity development.

3.3. Features of knowledge building

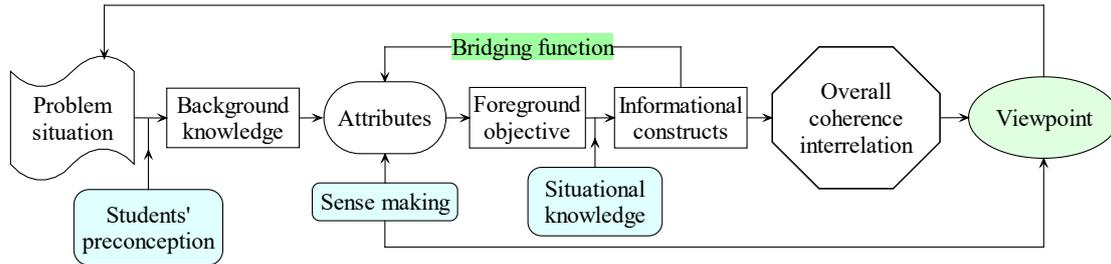
Effective learning is a knowledge building procedure. Data and information accumulation is the starting point of the process. The epistemological features of the process of intrapersonal knowledge building or creation (Labour, 2014) is sketched in Figure 1. Sense making and knowledge building require the personal ability of verbal formulations to capture the essence of various aspects of unformulated experience, such as in terms of a step towards theorizing key aspects of an informational process. It is situational interactions between a learner and the information in his or her sense-making process. This means a fusion of the perceived “external” object and learner’s “internal” interpretive process related to a person’s situational knowledge and expectations about an identified problem situation. This process is strengthened by the bridging function of informational constructs and bringing together attributes that deduce from learner’s sense-making process. On the contrary, without reflection, such as no interaction between the students’ set objective and situational knowledge, there is no viewpoint about the problem situation. The loosely built knowledge will eventually become meaningless or dissipated (Labour, 2014).

3.4. Techniques available

In terms of presentation styles, education is in a changing era. Various digital forms are emerging. It is challengeable to effectively use the techniques available in practice (Ma, 2023). As a traditional way,

such as speaking, writing on a blackboard and body language, is using, the digital mode of PPT, video, flash, online information, is increasing in presentation. The design would consider how to apply available technology at a specific learning and teaching issue or knowledge point.

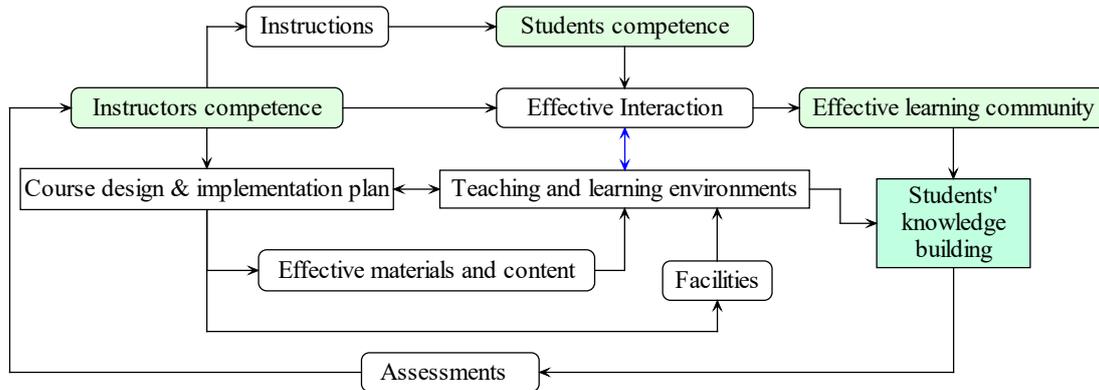
Figure 1. Sense making and knowledge building procedure (modified from Labour, 2014).



3.5. Presentation design

Teaching serves for learning, with special focus on the students’ knowledge building and capacity development (Figure 1). Well-designed presentation will help the interaction among the students, teachers and knowledge under certain context (Kozulin, Gindis & Ageyev, 2003), as shown in Figure 2. The results of a course teaching depend on various factors, such as the competence of the instructors and students, learning environment, facilities available in teaching and learning procedure, the features of the interaction between instructors and students. As the students’ learning capability is various and changing, the course presentation should be dynamically tuned under the above-mentioned considerations. A design would be in details, such as in terms of the learning objectives, presentation styles, instructional strategies and evaluation measures.

Figure 2. The key factors and their interaction in learning and teaching procedure.



3.6. Implementation and evaluation

Under a student-centered education situation, course presentation works for student’s capability development (Figure 2) and the presentation design would be executed in a dynamic mode. To meet the various social requirements, the course presentation will be with college characteristics, such as in terms of knowledge-level, personal abilities and objectives. There are well-accepted parameters of personal capacity in social evaluation field, such as the Bloom’s taxonomy (Anderson & Krathwohl, 2001) in thinking skills and cognitive domains. Creative thinking is in the top-level or higher-order. Therefore, the assessment should focus on the level of student achievement indicating the learners' knowledge building and capacity development, especially the potential progress in the future (Daneshfar & Moharami, 2018).

4. Presentation practice

The course presentation is dynamically designed and tuned in terms of content sampling, interaction between the learning and teaching, as well as results evaluation.

4.1. Content sampling

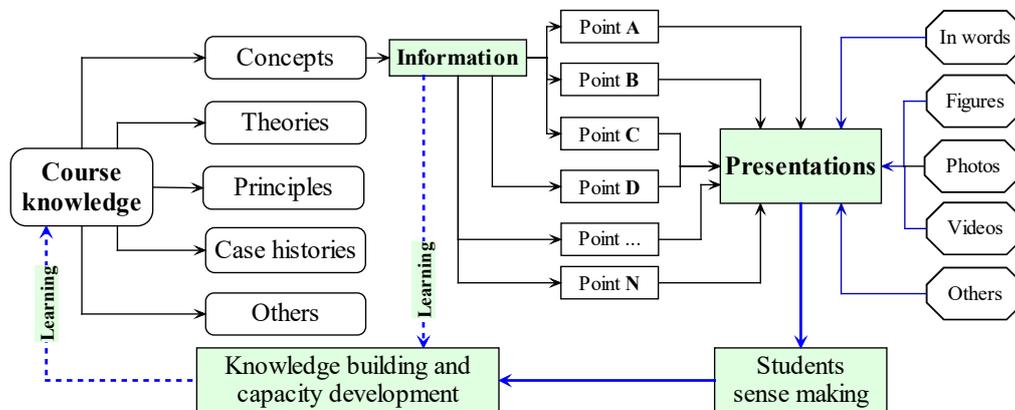
The presentation contents of the course Tunnel Engineering should include planning, design, construction, operation and management in a system mode (Ma, 2022). The subject contents related the course are increasing with time and the time assigned to the course is relatively short. For example, as tunnel and underground structures are well used in the field of transportation system, the knowledge of Tunnel Engineering is increasing with time, in terms of types, applications, building technology, the complexity of structures. From 1990 to 2024, the mileages of the tunnels in China increased 24 times and the mileages increased exceeds half of the world's total. At present, the total length of the railway and road tunnels is beyond 50000 kilometers. This situation gives China the leading position in terms of the number of tunnels, the construction market, high-speed railway and highway networks, and the development speed. Some new types are built, such as immersed tunnels, under sea TBM tunnels. There also need new tunnel and underground structures in the infrastructure system.

To be favorable to the students' knowledge building, the course information sampling is specified to each step and stage in the learning and teaching procedure, respectively. For example, considering the both features of the students' knowledge building procedure and the course contents in terms of the relationship between information, concept, structure and their components, activating points are designed to increase student engagement and systems thinking application (Ma, 2022), with evaluation measures and scales under consideration.

4.2. Presentation procedure

We need understanding of what data, information, knowledge, and wisdom mean to us and how their interrelating enables us to define and move along a knowledge building pathway (Kaipa, 2000). People learn in practice, such as through borrowing styles and ideas from diverse sources for whatever he or she is working on. For example, engineers take ideas, knowledge and techniques from wherever engineering project in pursuit of completing its goal. Date and information could indicate us hints to do things right, while knowledge means knowing how and why to do the right things. Presentation would be helpful to students making sense on what to do, how to do, why it should (or should not) be done for specified situational knowledge. Students would transform from information accepting into an information assimilating in terms of knowledge building and capacity developing. For example, presentation starts from information, concept, as presentation points with the designed ways, such as words, figures, photos, videos, etc. And then it helps students transferring specified information and concepts into subject principles, rules, theories, as well as sense making. It is a procedure of making the information separated to be assembled into a student's knowledge system, as shown in Figure 3. It is noted that the course presentation is not only in styles of class activities but also others modes, such as self-learning, test, assignments, project working. To meet the social requirements of comprehensive capacity and underline the knowledge building, the time period of design project account for one-third of the course time, since a project-based learning would be helpful for students' information distilling and sense making (Beneroso & Robinson, 2022; Guo, Saab, Post, 2022).

Figure 3. The presentation tactics with student's knowledge building under consideration.



4.3. Evaluation

Considering the course objectives, the more effective of the transferring process of the course knowledge into students' knowledge system, the more favorable to the course procedure. The presentation score evaluated will be high. The checking of the knowledge building results would use the indexes of the thinking skills following the Bloom's taxonomy system. Effective reflection to the goal achievement or the

students learning outcomes (Figure 2) is helpful to the next learning and teaching procedure. The experience shows that it is favorable to the student's capacity development that the students' performances are positively and timely evaluated with objective-specified modes (Ma, 2023).

5. Conclusions

Base on the practice of the course presentation design and implementation, conclusions are as followings. (1) Students are skillful to find information, but they need instruction in information sampling and knowledge system building. (2) Instructors should focus on the presentation of key concepts, the connections of the knowledge points, student's learning skill and capacity development. (3) Adequate evaluation and active motivation are necessary and favorable to student knowledge building.

Acknowledgments

The author acknowledges support from the textbook project at Chang'an University, China.

References

- Anderson, L. W., & Krathwohl, D. (2001). *A taxonomy for learning, teaching, and assessing: a revision of Bloom's taxonomy of educational objectives*. New York: Longman.
- Beneroso, D., & Robinson, J. (2022). Online project-based learning in engineering design: Supporting the acquisition of design skills. *Education for Chemical Engineers*, 38, 38-47. <https://doi.org/10.1016/j.ece.2021.09.002>
- Daneshfar, S., & Moharami, M. (2018). Dynamic assessment in Vygotsky's sociocultural theory: origins and main concepts. *Journal of Language Teaching and Research*, 9(3), 600-607.
- Engberg, M. E. (2007). Educating the workforce for the 21st century: a cross-disciplinary analysis of the impact of the undergraduate experience on students' development of a pluralistic orientation. *Research in Higher Education*, 48(3), 283-317.
- Guo, P., Saab, N., Post, L. S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures. *International Journal of Educational Research*, 102, 101586.
- Kaipa, P. (2000). Knowledge architecture for the twenty-first century. *Behaviour & Information Technology*, 19(3), 153-161.
- Kozulin, A., Gindis, B., Ageyev, V. S., & Miller, S. M. (2003). *Vygotsky's educational theory in cultural context*. New York: Cambridge University Press.
- Labour, M. (2014). Understanding users' informational constructs via a triadic method approach: a case study. In F. Ibekwe-SanJuan, & T. M. Dousa (Eds.), *Theories of Information, Communication and Knowledge, Studies in History and Philosophy of Science 34* (pp. 267-296). Dordrecht: Springer.
- Li, J. (2020). The "quality revolution" of high education led by emerging engineering education. *Research on Higher Engineering Education*, (2), 6-11+17.
- Ma, J.-Q. (2022). The application of systems thinking in tunnel engineering course. *Learning and Teaching Methodologies*, vol. 1(1-23). Infonomics Society.
- Ma, J.-Q. (2023). The online teaching practice of the tunnel engineering during the COVID-19 pandemic. *Science Journal of Education*, 11(3), 93-103.
- National Academies of Sciences, Engineering, and Medicine (NASEM). (2018). *The integration of the humanities and arts with sciences, engineering, and medicine in higher education: branches from the same tree*. Washington, DC: The National Academies Press.
- National Academy of Engineering (NAE) (2004). *The engineer of 2020: visions of engineering in the new century*. Washington, DC: The National Academies Press.
- National Academy of Engineering (NAE). (2005). *Educating the engineer of 2020: adapting engineering education to the new century*. Washington, DC: the National Academy Press.
- OECD. (2015). *Universal basic skills: What countries stand to gain*. OECD Publishing.
- Stanford2025. Open Loop University. <http://www.stanford2025.com/open-loop-university/>
- The Royal Academy of Engineering (RAE). (2007). *Educating Engineers for the 21st Century*. London: the Royal Academy of Engineering.