

Practice of Knowledge Presentation in Tunnel Engineering Teaching

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Abstract

High education situation is increasingly challengeable. The courses in traditional fields would suffer more squeeze from the changing environment. The teaching style should accordingly be robust and more favorable to student knowledge acquisition. Here is the practice of knowledge presentation in Tunnel Engineering teaching at Chang'an University in China. The presentation style is part of the course design, with the considerations of the features of the course content and experiences. The contents consist of the knowledge sections related to both the foundations to Tunnel Engineering and major professional knowledge, including the planning, design, construction, operation and management of tunnels and underground structures, respectively. To be favorable to the student-centered procedure, the course presentation is systematically designed in terms of specified knowledge points, such as, concept, information or facts, experiences, theory and principle. Each of the knowledge points is presented in a progressive and flexible mode in terms of learning content and complexity. The efficiency and robust of the knowledge presentation are checked by student learning result evaluation, with the indexes of the student's knowledge learning levels. The practice results indicate that: (1) students are skillful to obtain course information, but most of them are frequently confused in information sampling, concept and knowledge system developments; (2) course 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 self-enhancement and knowledge building metacognitively.

Keywords: Knowledge Presentation, Teaching, Learning Evaluation, Tunnel Engineering

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Introduction

Education quality is vital to a nation and society in this new era. As information is accumulating in an unprecedented manner, we are in a changing world. Information, especially digital issues, plays an increasing role in personal lives and social activities. At the same time, education is highly challenged. High education would play an active role (Ma, 2023). The results of learning and teaching is always one of the key points in education. As a teacher, one of the tasks is to make a teaching effective in terms of knowledge presentation.

In modern society, to make a nation truly dynamic, engineering education should play a fundamental, global, and leading strategic role in social development (Li, 2020). This means that engineering education needs to face the social developing challenges (NASSEM, 2018). Educators need knowing how to take advantage of the development and application of contemporary technology in the social development. This trend will be increasingly significant in the future (OECD, 2015). Some emerging engineering education models (Graham, 2018; Stanford2025) or New Engineering Education Plan (Li, 2020) have been in practice to meet the requirements. The well-recognized innovations, in terms of learning and teaching styles, include Massive Open Online Course (MOOC), Small Private Online Course (SPOC), Flipped Classroom, as well as the innovation program in new engineering education, such as the Open-loop University in the Stanford2025, the education styles at the Olin College of Engineering. All of these well-accepted learning and teaching styles prefigure changing in the conventional course presentation.

To adapt to the explosive growth of the knowledge, there are new courses being added to meet the requirements of the new industries and some courses are even cancelled in the curriculum at a university. As a result, a course for a specialty in civil engineering, such as Tunnel Engineering will share less time period. On the other hand, the contents of the existing course are also increasing with time. Therefore, the presentation of a traditional course is challengeable in this changing situation. In terms of student-centered principle, the teaching style should accordingly be robust and more favorable to student knowledge acquisition. Here is the practice of knowledge presentation in Tunnel Engineering teaching at Chang'an University in China.

Situation of the Course

The new information presentation and communication modes are generally beneficial to our living, studying and working. However, it is challengeable for an individual to take advantage of the information available. In brief, we seem enjoy an informational society, however, it is increasingly challengeable for a learner or presenter to cope effectively with the information around us. Course presentation would be helpful to the students' incorporating the sampled information into their knowledge system. The situation of an engineering professional course is of the following features. (1) The information related to a traditional professional course is easily available to students. The quantity of the information is increasingly accumulated with time. This means the information presentation of a teacher should shift from conventional mode to a new style to adapt to the new situation of course information. (2) The modes and forms of the course information are increasing with time. (3) It is challengeable to present the information with conventional way. (4) What is important to students is of personal features. (5) A proper quantity and style (way) to present a specified content is of dynamic feature.

1. Society Requirements

Social hot points or the requirements for a specified knowledge is generally shifting with a time interval. For students being adaptable, education activity should skillfully manage the focus on general knowledge and specified one, respectively. A professional engineer is generally much fit to a specified engineering position. However, a prospective institution needs not only adaptable personnel, but also creating or leading a new engineering field. Practice has given well indications that a super large company would have a super-conventional development stage, which has been founded on the innovation or creation of a new field. Therefore education should be timely tuned, with the knowledge building and capacity development of the students underlined and keeping her key features.

The social requirements are met in fulfilling personal needs. Student-centered course design and plan implementation would focus on student's capability development. Course presentation would contribute to the education objectives. Although various factors will have influence on the results of the learning and teaching achievements, it is one of the key points of course presentation to help students' knowledge building and capacity development. In practice, 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 (Figure 1). Of the parameters, creative thinking is the in the top-level or higher-order.

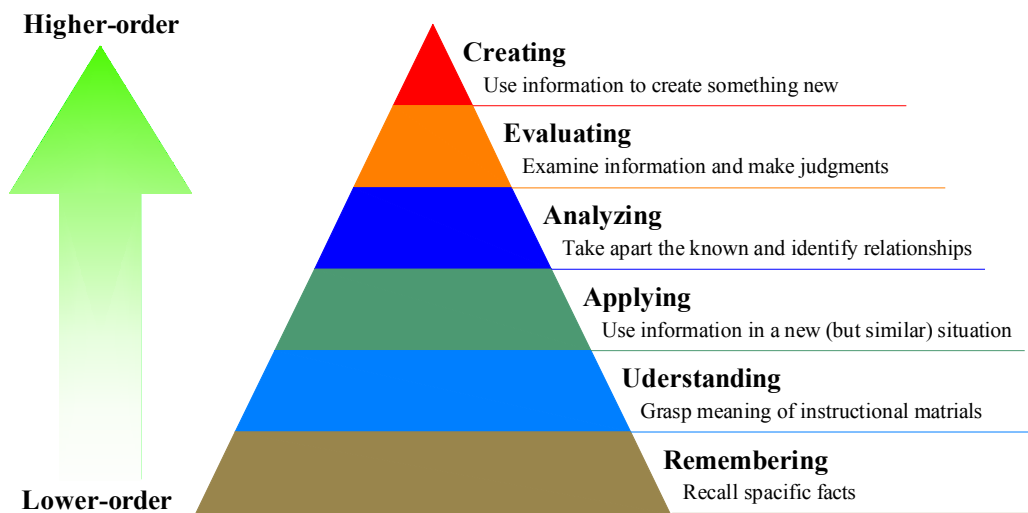


Figure 1: Sketch showing Bloom's taxonomy (2001) in thinking skills and cognitive domains

2. Techniques Applied in Learning and Teaching

Many information presentation styles are emerging in digital forms. Education is in a constantly changing era. Course would be presented in a traditional way, such as speaking, writing on a blackboard, body language, projector showing, as well as in a digital mode of PPT, video, flash, etc. On the other hand, knowledge presentation could be face to screen through online. It is not an easy job to effectively use the techniques available in practice (Ma, 2023). Teachers should skillfully manage the techniques, especially how to effectively to apply available technology at a specific learning and teaching issue or knowledge point.

This also include guiding professional information sampling, such as through database available.

3. Design of Course Presentation

Learning is a process of the interaction among the students, teachers and knowledge and would take place under certain context (Kozulin et al., 2003). As shown in Figure 2, the results of a course teaching depends on various factors, such as the competence of the instructors and students, learning environment, facilities available in teaching and learning procedure, features of the interaction between instructors and students. The course presentation should be well designed in terms of improving teaching quality and the students' knowledge building and capacity development.

In practice, course presentation is performed in a dynamic situation. The content and difficulty of the course points is changing. The students' learning capability is various and changing. The design of the course presentation should be dynamically tuned, in terms of course content choosing, presentation styles, interaction between students and staffs, as well as effect evaluation. For each presentation, the design should consider the learning objectives, instructional strategies and assessments, such as in terms of the content to be taught, the intentions and performances of both the students and staffs involved, evaluation measures. In the design, learning objectives, teaching strategies and assessments should be closely aligned so that they reinforce one another. 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).

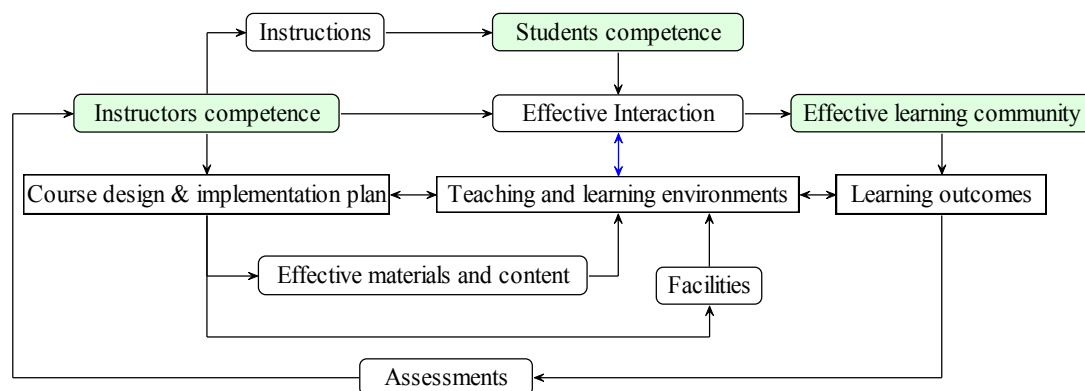


Figure 2: Sketch showing the factors relating to learning results

4. Implementation in a Dynamic Mode

A well-designed course presentation should include content choosing, implementation and delivery plan in details. To be favorable to the student's knowledge building and capacity development, the implementation would be actionable, such as with specific content and presentation styles (Ma, 2023). The learning outcomes should be timely assessed with the assumed criteria. Based on the feedback and evaluation results, the course design and implementation plan will be tuned in a dynamic way (Ma, 2022, 2023). The evaluation results of the students' learning outcomes are reference level of the presentation adjustment.

Practice of the Course Presentation

To be favorable to the students' knowledge building and capacity development, the presentation of the course Tunnel Engineering at Chang'an University is designed and tuned accordingly, in terms of content choosing, interaction between students and staffs, as well as effect evaluation.

1. Course Features and Content Sampling

The Tunnel Engineering should include planning and design, construction, operation and management in a system mode (Ma, 2022). In the course information sampling and presentation design, the content should be specified to each step and stage in the learning and teaching procedure, respectively. For example, considering the students' knowledge building procedure and the course features 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. Considering the development and usage of underground space are increasing, such as in terms of types and complexity, the information and knowledge system related to the subject Tunnel Engineering are accordingly accumulated with time. To make the course teaching in the pace of the engineering practice, there are new points in course presentation.

In the learning and teaching procedure, we start from concept, which is presented in terms of information. With more information and concepts are learned, students would develop professional knowledge to think in terms of engineering issues. In this process, personal capacity development is vital to the learning and teaching results. It is noted that we can only partially present the complex concept or meaning at a time or stage. How to make the related information being effectively presented and also to be favorable to students accepting, a proper presentation style and implementation plan would be well designed, as well as checking measures, such as testing with informative and summative modes, respectively.

Although we start presenting a course from simple concept with specified information, we need design the presentation in a system mode. The meaning of a concept should be presented with comprehensive considerations. For example, the concept tunnel structure is first presented in a narrow meaning, which means that tunnel structure is same as lining-style supporting system, applied around the tunnel excavation profiles. However, the supporting systems in tunnel engineering have developed into multiple-style modes. A primary supporting system applied in a modern mined tunnel could be partially installed into surrounding rocks, such as rockbolts or dowels, while other items, such as steel sets and shotcrete lining, are built inside of the excavation profile. On the other hand, the structures of a mined/bored tunnel should include both supporting system and surrounding rocks in terms of general meaning. The features of the tunnel structures would strongly depend on the nature of the interaction between the tunnel supporting system and the surrounding rocks. It is important understanding the dynamic feature of tunneling in terms of the tunnel surrounding rock properties and the interaction between the tunnel supporting system and the surrounding rocks. This is mainly because the properties of involved factors, such as the supporting system and surrounding rocks, vary during the tunneling process and after the supporting system being built. The key points of a presentation would be changing and a proper presenting mode should be well designed and prepared in the content sampling, with the subject features under consideration.

2. Modes of Presentation

Teaching is to help students realize the transform from information accepting, such as a receiver, into an information assimilating one in terms of knowledge building and capacity developing. As we present a course starting from information, concept, we need to help students transferring specified information, concepts into subject principles, rules, theories, as well as thinking ability. It is vital to make the information separated being assembled into a student's knowledge system. The results of this dynamic process would depend upon the followings: (a) features of personal capacity building in a professional field; (b) nature of the knowledge as a subject, such as the empirical or custom features, analogical method and working way in the professional field.

We divided the subject into learning and teaching points, as shown in Figure 3. Each point is presented with specified information and the presentation styles or modes would be specified in terms of words, figures, photos, videos, etc. With the presented information, we can demonstrate the meaning of a concept. Both information and concepts are components of personal knowledge. So, it is vital to make use of the accumulated information and concepts to build personal knowledge. The more effective of the transferring process of assembling the information and concepts into one's knowledge system, the more favorable of the course presentation to students' learning process. The checking of the knowledge building and capacity building results would use the indexes of the thinking skills, as shown in Figure 1. For example, assigning a task to analysis a case with the learnt theory and principles, and to make a decision on the specified problem. There are analogical methods to follow, such as through learning on case histories, rules from design codes, guidelines.

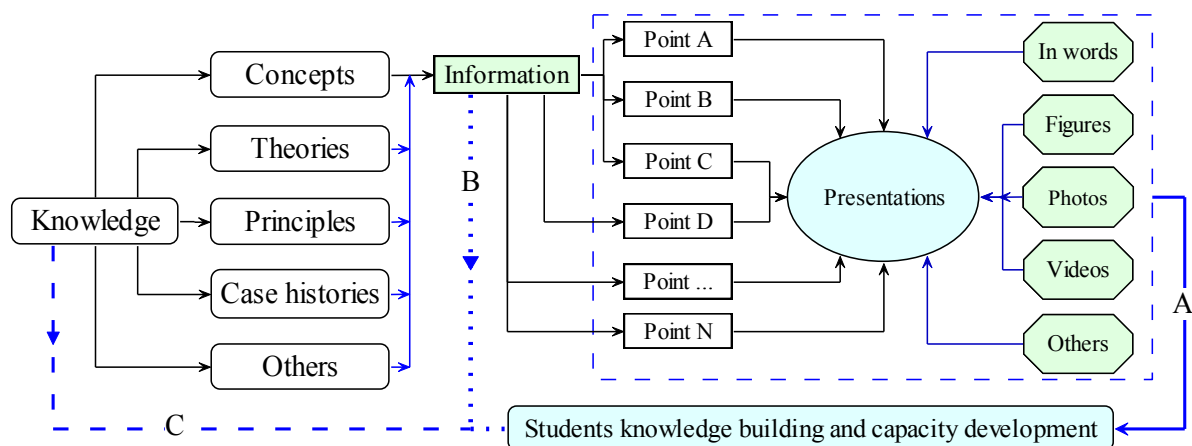


Figure 3: Sketch showing the course presentation tactics with student's knowledge building and capacity development under consideration

It should be noted that teaching is not just to present information, concept, theory, principle, and experience from case histories. It is important to help students to realize transferring the information into thinking skills, esp., critical thinking to use the knowledge to analysis, as following the route A in Figure 3.

3. Post Evaluation

In practice, the presentation types could include measures in class and out of class, being related to where and how to teach and learn. The results of the learning and teaching procedure should be timely checked through both informative and summative modes. There

are a variety of evaluation methods, including process evaluation, diagnostic evaluation and summative evaluation. A well-designed mode is in corresponding to the specified learning and teaching points. Effective reflection to the goal achievement or the students learning outcomes (Figure 2) is helpful to the next learning and teaching procedure, especially for the improvement of the presentation design and its implementation plan.

In general, the results should be positively evaluated in time, such as to meet the student's various intentions of capacity development. The applied approach should be supported by the viability of the specified goals, the enthusiasm of the participants, the applicability and timeliness of the course information and resources. As students' learning outcomes are evaluated, the presentation design and its practical effects are therefore checked in time, such as through discussion with students in a partnership way, quiz, test and assignment on the related learning contents. The experience shows that it is favorable to the student's capacity development that the students' performances are evaluated in an excitation (Ma, 2023).

Discussion

As the above-mentioned that the time for a course is limited. To do right things is vital to make the learning and teaching procedure effective. However, what is favorable measures at a specified time or stage, is a problem in course presentation design and plan execution.

1. Course Presentation Situation

We are in a digital age. Most of the information related to a course could be presented in a digital mode and is readily available to a learner. However, most of the students are not skillful enough in information sampling, especially in taking advantages of the database in digital literary at university. There needs additional information to guide students how to skillfully use the database, with special reference to a professional course learning.

Traditional mode is necessary but not total. Online learning or face to screen mode is of high flexibility and there are less restriction in students learning modality via the Web (Paul & Jefferson 2019). Online technologies would be favorable to students' creative thinking development provided there is a useful interactive e-learning strategies and techniques, tools and activities for developing teaching methods (Wen, 2023), but there is a huge gap between information available and personal knowledge building and capacity developing. A qualified college student would be of skillfully thinking, since modern intelligent would be able to solve problem, such as taking responsibility and making decision in practical situations.

Digital information should be skillfully managed. Online interaction is favorable to guiding, discussion, question and responding, but is would be not as effective as traditional face to face mode, esp., for new knowledge teaching and learning. In presentation design and plan execution, there are underling key points at a specified learning and teaching phase, with students capacity development checking and evaluation under consideration. The evaluation parameters would not only follow a textbook, but also be of college features, as well as with additional skills, such as information sampling in this digital situation.

In the recent years, it is often said that novice graduated from a college could not work with their knowledge in practice. Students know enough but not well qualified. We need consider the features of information and knowledge accumulated in the course learning procedure. If there is no effective connection between the information in brain and the practical problems,

there are not enough skills and capacity to present the practical problem with their own knowledge system in a logical mode. For example, of the factors related, which will determine the features of the procedure? What are the influence factors in the process? How will the results be developed? These information related to a practical problem could not effectively presented and analyzed in corresponding to personal knowledge system.

In a system mode, we need focus not only theories and principles, but also the skills or levels of thinking. Theory is not the full of a practical professional work. There need personal thinking to cope with a practical problem. For example, where we make use of theories and principles in practical problem, we need consider the specified pre-conditions, practical parameters of the project, which are often not fully available or limited. This means we need consider a practical problem in terms of a professional thinking or in the application of an analogical method. In this procedure, personal engineering judgement or empirical method would play a key role in a decision making. All of these require professional thinking or capacity development. It is favorable and also college characteristics to train students professional thinking in the course procedure, such as in face to face lecturing.

On the other hand, what are students believe in are more important than the others. If students have an active starting and believe in themselves, they would have a good chance of being well and effectively involved in the learning and teaching procedure, such as in terms of deep thinking and learning, with critical thinking in learning, reflection involvement. Positive emotion would contribute to learning outcomes (Goetz et al., 2014). In general, what is important to the course presentation is not equally considered by the learners and teachers, esp., at the beginning of the course procedure. There are choices for personal interests or capacity development, considering the difference in learner's competence. Ability, interest and personality are important factors in shaping success (McCabe et al., 2020).

Course presentation design and plan execution should be a dynamic procedure, with interactions among students, teachers, environments and facilities etc. Considering students' performances are more decisive to the level of the learning outcomes, course presentation should be well-designed and the implementation plan be well-known, especially making it known to students before course presentation time. And then students would actively engage in learning and teaching procedure. It is also vital to activate students' subjective initiative, such as through process based assessment. There are always adaptation and adjusting in the learning and teaching procedure, with the learners' situation under consideration.

2. Validity of the Presentation Modes

No presentation manner or style will be always effective for all course points. For example, to present the structure of a tunnel, we need consider it in terms of design, construction, operation and management. It is favorable to present the general features of a tunnel with a video. However, the structure of a planned tunnel will be more vivid with a 3D form. A tunnel building procedure in BIM or practical case recording video would be helpful to student's concept building, since their cognitive processes are inherently visual, and they often interact with knowledge primarily through images.

It is noted that an effective mode is not absolute in terms of knowledge presentation and students' learning procedure. For example, as a phenomena, we can present rockburst a dynamic breaking or failing process, in companion with noise and fragment shooting. In this term, video or a practical case recording is effective way to illustrate a rockburst procedure.

However, the reason and conditions of the rockburst could be complex. Additional information, as well as theory and principle are need to know the mechanism of a practical case. This means knowledge building and capacity development are required in a real and deep learning. And therefore, a concept is often be presented with terms in simple or brief mode at starting. Later, it will be presented with comprehensive terms. Under this situation, it is difficult to present the full meaning with simple words, single picture or photo, even a video of phenomena or procedure recording. There need logical process or thinking in understanding, which is indeed knowledge building and capacity developing. Similarly, same cases, such as tunnel portal structures, it is a description in terms of shapes. Sketch and pictures are more effective than totally in words. However, why different types portal structures are in practical application, we need consider other factors, such as building, operation conditions, regional custom.

In terms of knowledge building, presentation is only the starting point. Teacher could make a high starting level or the knowledge building smooth, but the presentation would not take the place of student's knowledge building by themselves. An effective or favorable situation would be that there are additional routes, such as the routes B and C, as shown in Figure 3, in student's knowledge building and capacity developing. This means student's competence is well qualified or in a higher level in terms of thinking skills and cognitive domains (Figure 1). The more competent of the student's thinking skills, the more effective of the capacity developing in a professional course learning (Figure 2) will be.

It is favorable to apply modern techniques in course presentation. However, we need recognize that new technology could not fully take the place of the traditional form or style of knowledge presentation and knowledge transmission in learning and teaching procedure. Practice in the course presentation indicates the following features.

- (1) There is enough information available for course learning at university. However, more than half the students are not skillful in information sampling, especially at the course starting stage. The presentation design would consider this situation.
- (2) Of the effectiveness of the various presentation modes, a description concept could be well presented in words plus picture, sketches or videos, such as structure shape or feature showing. A video, such as a case history recording is favorable to show a tunnel building procedure, process phenomena. Where there are various information and learner's thinking involved, such as principles and theories presentation, we need dividing the whole or comprehensive points into a few sub-points to present. In this procedure, it is difficult to present the total meaning with a step. This need students being involved, such as in terms of learners' knowledge building and logical thinking. Under this situation, traditional face to face mode, such as lecturing with the help of blackboard usage, PPT, video showing, as well teacher's body language, would be much effective in the course point presentation and favorable to student's logical thinking being involved.

Conclusion

Conclusions drawn from this study are: (1) students are skillful to obtain course information, but most of them are frequently confused in information sampling, concept and knowledge system developments; (2) course 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 self-enhancement and knowledge building metacognitively.

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