Critique – Achieving Mastery through Teaching and Assessment

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This critique focuses on the theories on achieving mastery and expertise presented in the chapter four of the book *How learning works: Seven research-based principles for smart teaching* (Ambrose, Bridges, & DiPietro, 2010) and chapter 3 of the book *Knowing what students know: The science and design of educational assessment* (Pellegrino, Chudowsky, & Glaser, 2001). Similar perspectives of the theories presented in these books are related to potential improvements on the level of programme or course assessment. However, the true potential of this information can be only obtained through integration of information from both books.

Theories on Expert Knowledge

Throughout the history, there were many theories developed related to the topic of human development and learning. Although all the theories throughout time were providing different perspectives, recent publications in this area are concluding that these theories are complementary and should comprehensively lead to a creation of a holistic theory on human development and learning (Crain, 2005; Jarvis, 2006). However, we have to make a distinction between development and learning. Development is usually considered as related to general "normal" knowledge that is acquired through simple and predefined change of an individual in time. Learning, on the other hand, usually happens if there is an appropriate environment and deliberate influence (Pellegrino et al., 2001).

Having in mind the fact of deliberate influence, this critique is focusing on specific theories on human learning. The focus is in particular on how people learn the content and procedures of specific subject domains, and the differences in thinking between experts and novices. The critique focuses on two books that cover a topic of obtaining expertize from

similar standpoints but with slightly different perspectives. Both books are basing the information presented on the external research done in relation to expert knowledge. In general, both books are useful for wide audience interesting in improving their teaching and assessment techniques. The two perspectives on expert knowledge are handled without bias and with logical arguments. However, the approach to defining expertize in each book does not completely cover all the potential aspects, resulting in the need for an integrated approach of these two books, that could be potentially expanded with additional research in cognitive sciences.

The first book (Pellegrino et al., 2001) approaches expertize from a more theoretical standpoint, presenting it through perspective of advances in the sciences of thinking and learning. Consequently, this book is not intended for direct implementation by education practitioners but to provide extensive theoretical base. This chapter establishes wider theoretical context around expert learning, by providing information on learning theories, components and features of human cognitive system, while also providing methods for observation and inference.

The theory on expert knowledge starts with a wide-spread opinion that experts have more extensive amount of knowledge and skills in the particular domain compared to novices. However, the further claim is that the experts' organization of knowledge itself is different. That knowledge is stored in the well-connected schemes in the long-term memory, and is closely linked with the contexts and conditions for its use. In addition to different organization of the knowledge, the experts have strong metacognitive skills. These skills enable them to monitor the problem-solving process itself, question their knowledge in different situations, and avoid oversimplification in the problem solving-process. Experts have some other important features, such as predicting outcomes and efficient resource management while problem-solving.

This book states that learning is usually not a simple linear processes, and it strongly depends on the contexts and situations. Developing expert knowledge requires extensive practice and feedback on that practice, since it requires investment in time and related information base. In addition, learning in new settings requires understanding of conditions for knowledge application. Finally, this chapter states that expert learning happens in a

social context with the interactions between individuals that are each influenced through cultural norms and beliefs.

The research presented in the second book (Ambrose et al., 2010) is focusing on a slightly more practical approach to expertize. This chapter tries to extract a set of specific principles for improving learning environments in order to achieve expertize among students. This book also introduces a slightly different terminology of expertise naming it as mastery. As defined by the authors, the mastery is an attainment of a high degree of competence within a particular area. The main idea that the authors are trying to convey is that in order to develop mastery students must acquire component skills, practice integrating them, and know when to apply what they have learned. In essence, the authors are revolving the idea of mastery around the following three integrated components:

- Learning sequence of steps for acquiring component skills
- Practicing integration of components and skills
- Learning to recognize the context for application of skills and knowledge

Contrary to the some ideas in the previous book, these authors are recognizing the development of competence as a linear process going through the following four steps:

1. unconscious incompetence
2. conscious incompetence
3. conscious competence
4. unconscious competence

The authors of this book, similar to the authors of the previous book, do recognize that experts have greater knowledge, but that they also organize, assess, and apply their knowledge very differently than novices. In addition, experts are able to immediately recognize meaningful patterns, skip steps, link specific information to deeper principles, and transfer knowledge across contexts.

In addition to this information, this book presented an interesting perspective on the problem that occurs when experts are conveying or assessing knowledge. The phenomenon is called the expert blind spot and happens when expert instructors do not notice the actual

learning needs of students as novices. The main part of this chapter is an extensive list of practical recommendations for the developing mastery and reducing expert blind spot trough decomposition of complex tasks, reduction of cognitive and extraneous load, provision of worked-examples, reinforcement of understanding of underlying principles, providing of sufficiently diverse contexts, and helping students make connections between knowledge and new contexts.

Comprehensive approach for improving program or curriculum design

It is interesting that some of the research from these two books is suggesting development of intelligent computerized tutors. However, I do not see a clear advantage over intelligent, educated, and engaged human instructor – especially considering that artificial intelligence is only emulated components of human intelligence. In general, we as members of global educational community have a responsibility to support a shift in the general educational culture that needs to value different types of "outputs". The current educational system is not investing enough into understanding or organizing pre-existing knowledge, or using that knowledge for better learning of future expert knowledge.

These two books are presenting two approaches to the subject of obtaining expertize – one primarily theoretical and one primarily practical. However, the actual potential of these books is in a combined approach that could help educational practitioners have a list of practical principles supported by strong scientific concepts. This holistic and comprehensive information could help educators helping students achieve expertise. For example, in teaching, there is a potential to develop a higher emphasis on the conditions for applying the knowledge. In assessment, there is a potential to develop a higher emphasis on testing if students know when, where, and how to use their knowledge. In addition, informing students about the expectations to have metacognition because of its importance to effective thinking, then teaching metacognitive skills, and later assessing their implementation can improve students gain of the mastery. Finally, reducing expert blind spot would require awareness of the breakdown of key component skills, practice of effective integration, and emphasizing of when to apply the knowledge. Having all of these points developed from a strong cognitive science theory with an extensive list of practical

applications could result in improvements in curriculum or program design in engineering education.

References

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