P4ELECS
Platform for Electrification Skills & Competences

Quicksheet

About prior knowledge

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About

Students do not start your Building Block (BB) as a blank sheet. They might already know a lot about the topic or not; they might have experience as a professional on the topic and learn about it in mainstream media for example. They have had experiences in their daily life, and they might like or dislike the topic. All these knowledge, skills and attitudes we call ‘prior knowledge’. Hence, the concept ‘prior knowledge’ concerns more than what we usually understand as ‘knowledge’. It is a concept from educational sciences. Within the P4ELECS context, we will use the term “prior knowledge and skills”.

Research shows that prior knowledge influences significantly student achievement (Hailikari, 2008). Learners co-construct knowledge and skills based upon and integrate it with their prior knowledge and skills. A BB designer has to expect variations in learners´ knowledge bases. This knowledge can be inadequate, incomplete or fragmented when the learner engages with a BB or course.

A special type of prior knowledge and skilss are misconceptions: They are part of a research tradition on teaching STEM sciences. Misconceptions are commonly shared ideas or beliefs that differ from or contrast scientifically accepted explanations or empirical facts. They are different from errors or lack of knowledge. They often contain some correct understanding but the idea as a whole is not correct. Misconceptions can result in errors, often multiple errors in disciplinary knowledge (Elen, e.a., 2022). It is known that even experts may retain misconceptions embedded in their brain's neural networks, requiring inhibition to respond scientifically. These misconceptions can become deeply ingrained in learners` minds and may be resistant to change. Misconceptions are important obstacles in studying physics and thus lead students to the failure when studying physics (Widodo, e.a., 2018). In the area of electricity for example, Widodo e.a. (2018) state that misconceptions include the

consumption model, the current collision model, confusion between current and voltage (equalizing or exchanging them), and the closed circuit model that omits the voltage source. Additionally, some students misunderstand series and parallel circuits, particularly regarding current and voltage properties. Misconceptions in electrical circuits are not isolated from a single concept but are often interconnected. Moreover, students frequently hold multiple misconceptions rather than just one.

Misconceptions could not easily be refuted: it has been shown in studies that even though they have been elaborated as false, misconceptions can continue to exist in the knowledge structure of students. Cognitively they might be more appealing than scientifically substantiated conceptions or facts. **For better performance connected to your BB, it is important to consider misconceptions in the content area and think about how to address them in your BB. This does not necessarily need to be in an explicit way.**

Benefits

- **Explicitly addressing** prior knowledge and skills makes students aware of wat they know or do not know and, hence, what to prepare or address before starting you BB.
- Students experience that the BB-designer and course designer **cares about their learning**.
- A good way to **rehearse and activate** prior knowledge and skills.
- It helps instructors **recognize problems** in the knowledge and skills area for the BB.
- To **bridge the gap** between instructor´s expectations and students´ actual knowledge and skills base.
- **Be aware** that necessary concepts might not always well known or understood in the way you assume. Make a clear reference to other BBs to refresh or learn knowledge if not known.
- By **anticipating misconceptions** in the topic area of your BB, you can avoid learning deficiencies; when addressing misconceptions with correct facts and information, keep it simple for it not to compete with the continuation of the misconception.

Step-by-step creation guide

Step 1: Identify prior knowledge

First, discriminate between different forms of knowledge (Hailikari, 2008) identifying prior knowledge. They are connected to the performance differently. Deeper level knowledge (procedural knowledge) is more strongly collated to final performance).

- **Declarative knowledge**: knowing about a phenomenon.
  - Knowledge of facts: recognizing, enumerating, recalling, remembering.
  - Knowledge of meaning: defining, reproducing, understanding the meaning of a concept.
- **Procedural knowledge**: know how.
  - Integration of knowledge (to understand): understanding concepts and their relations, classifying, comparing.
  - Application of knowledge (to apply): problem solving, application of knowledge, producing, implementing.

Step 2: Make prior knowledge specific

When making expected prior knowledge explicit in your BB, be as specific as possible: action verb (by prefence observable behavior in stead of e.g. understand) + specific content + with support of instruments or tables or ....

Step 3: Anticipate misconceptions

You can indicate them in the part of prior knowledge and skills or you can address them in your BB by e.g. emphasizing/repeating empirical evidence or by integrating exercises concerning the content of the misconception (without necessarily being explicit about the misconception).

Tools

Use the self-assessment answer model for users to map prior knowledge.

Tips

- Students could feel anxious and worried when assessing prior knowledge and skills. They might not be used to assessment to be used for learning and at the beginning of the process. Therefore, explain the objective of prior knowledge and skills assessment, why they are questioned on the spot without time to prepare for this test and what the benefits for them.
- Provide feedback on prior knowledge and skills assessed
- **Misconceptions**:
  - Mentioning and repeating misconceptions could carry the risk of reinforcing them; try to avoid it and keep the scientific conception or explanation simple
  - Engage students in cognitive dissonance by showing real-world examples that contradict incorrect beliefs.
  - In case a misconception plays an important role in your BB and this is deeply engrained, revisit concepts multiple times in different contexts or use spaced repetition and different examples to reinforce accurate understanding.

Useful sources

Elen, J., Piro, Y., Wevers, B., Maddens, L., & Raes, A. (2022). Misconceptions of upper-secondary school students on doing behavioral sciences research. International Journal of Educational Psychology, 11(1).

Hailikari, T., Katajavuori, N., & Lindblom-Ylanne, S. (2008). The relevance of prior knowledge in learning and instructional design. American journal of pharmaceutical education, 72(5).

Widodo, W., Rosdiana, L., & Fauziah, A. M. (2018, November). Revealing student's multiple-misconception on electric circuits. In *Journal of Physics: Conference Series* (Vol. 1108, No. 1, p. 012088). IOP Publishing.