

INDIVIDUAL DIFFERENCES AND COGNITIVE LOAD

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Individual differences in learner characteristics take many different forms, ranging from preferences for learning from different presentation formats (verbal or pictorial) or modalities (auditory or visual) and preferences for learning under different environmental conditions to cognitive style (dependency or independency), cognitive abilities (verbal or spatial ability) and intelligence. The influence of individual differences on learning has been studied for several decades as aptitude-treatment interactions. This kind of interaction occurs when different instructional treatment conditions result in different learning outcomes depending on student aptitudes. Different aptitudes may influence learning in specific instructional environments, and the impact of a particular attitude on a particular condition may only be observed for a particular type of learning outcome. Learners with visualizer vs. verbalizer learning preferences use multimedia links in reading environment for second-language acquisition differently, resulting in different learning outcomes for text comprehension but not for vocabulary acquisition. That is why it could be noted that learner characteristics are likely to affect the amount of available working memory and therefore, are expected to influence cognitive load during learning.

According to cognitive load theory, the magnitude of mental load in learning depends on the schemes that have been previously acquired by the learner. Learners with different levels of prior knowledge regulate their own learning by employing different learning strategies. Students with higher prior knowledge usually apply deeper and more effective self-regulation strategies that use the available working memory resources more efficiently than students with low prior knowledge. There is evidence that under low cognitive load conditions, students use less appropriate strategies for self-regulation than under low cognitive load conditions. The cognitive processes involved in self-regulation can add to the experienced cognitive load as a function of the effectiveness of an individual's learning strategies. However, when

goals and scaffolds are well designed, this extraneous cognitive load can be reduced and learning process can be facilitated.

Determining the most appropriate instructional design for each individual learner is a difficult task. The decision should provide sufficient verbal and visual information and guidance to allow each student to comprehend the material, yet avoid unnecessary verbal or visual information that may create extraneous cognitive overload and hinder learning. A major instructional implication of the statistical interactions found between learner individual characteristics and learning is that instructional designs should be tailored to students' levels of knowledge, skills and abilities.

To achieve the required levels of flexibility, dynamic online instructional systems might include different interactive learning models that allow different learners to access the same information represented in different formats. The same instructional material may also be presented in different ways to the same individual at different stages of learning as his or her level of experience in the domain increases. For example, only selected elements of the text, graphics, and links could be displayed on the screen, and auditory explanations could be turned on or off when required by an individual learning. In such learner-adapted instructional systems, the tailoring of instructions to an individual learner can be guided by continuously assessing the person's learning performance based on either a sophisticated computational student model such as intelligent tutoring systems or using appropriate dynamic diagnostic assessment tools. Developing suitable embedded diagnostic tools is, therefore, a major prerequisite for adapting instruction to individual learner characteristics and optimizing cognitive load. Even experienced tutors often lack sufficient diagnostic skills for adapting their level of instructional guidance to the individual needs of their students. As a result, instead of adapting learning tasks to student characteristics, the same uniformly prescribed "subject matter logic" is often followed. Online learning environments usually constrain computer-mediated communications, thus making as accurate diagnosis of individual student characteristics even more difficult. At the same time, these technologies offer new potentials for building adaptive learning environments based on embedded assessments of individual learners.