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Flexible thinking in learning: An individual differences measure for learning in technology-enhanced environments

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ABSTRACT

In an era of global changes, flexible thinking is a key competency, necessary for learning in technology-enhanced environments. Advancements in instructional science and educational technologies call for an updated conceptualization of 'flexible thinking' to address current educational challenges. Echoing this need, the goal of this study was to re-conceptualize flexible thinking and to generate a valid and reliable instrument for measuring an individual's inclination to think flexibly in contemporary learning situations. A Six-stage study was designed to assess and validate the new instrument. As a result, the Flexible Thinking in Learning (FTL) scale was generated, consisting of three subscales: Acceptance of new or changing technologies, Open-mindedness to others' ideas, and Adapting to changes in learning situations. Within the framework of the current study, findings confirmed the FTL scale's content, construct, and concurrent validity, indicating stability across populations and over time. Consequently, the FTL scale may serve as both a research instrument and a self-assessment tool. It may assist in the evaluation of learners' inclination to think flexibly or in explaining individual differences regarding the utilization of new learning methods. Yet, generalizability should be carefully considered and additional studies should be conducted to examine the FTL scale among learners from different age groups and academic background.

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1. Introduction

In the age of rapid educational and technological changes, learners are required to think flexibly and adapt to new ways of learning and communicating (Barak, Watted, & Haick, 2016; Griffin, McGaw, & Care, 2012; NRC, 2012a). Flexibility is one of many skills necessary for success in work, life, and learning in the 21st century (OECD, 2013; P21, 2009). In this study, we focused on "flexible thinking" since it receives little attention in comparison to other 21st century skills, such as: creative thinking (e.g. Navarrete, 2013), critical thinking (e.g. Kong, 2015; Lee, 2015), or problem solving (e.g. Chao, 2016; van Merriënboer, 2013). The following sections provide some insights into the way 'flexibility' was conceptualized in past studies, indicating a need for a more up-to-date definition, with an emphasis on technology-enhanced learning.

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1.1. Conceptualization of flexible thinking

Studies in the 1960's and 1970's, considered 'flexibility' as one of the four basic functions of divergent thinking, together with elaboration, fluency, and originality (Guilford, 1967; Torrance, 1974). According to this approach, flexibility is described as the variety of categories or themes generated while producing an idea. It is also described as the number of ideological shifts in thinking (Torrance, 1974). The definitions of 'flexible thinking', used interchangeably with the term 'cognitive flexibility', are varied. Spiro and Jehng (1990) viewed cognitive flexibility as "the ability to spontaneously restructure one's knowledge, in many ways, in adaptive response to radically changing situational demands" (Spiro & Jehng, 1990, p. 165). According to studies in psychology, cognitive flexibility is considered as a higher order thinking skill and an aspect of executive functions (Garner, 2009). It concerns instantaneous consideration of multiple perspectives and the ability to make changes in one's thoughts or beliefs (Garner, 2009). More recently, the Assessment and Teaching of 21st Century Skills project, addressed flexibility as part of the 'ways of thinking' domain, indicating the need for educating people to become "open and fair minded, flexible in considering alternative opinions" (Griffin, McGaw, & Care, 2012, p.40).

In a social perspective, flexible thinking is conceptualized as the ability of an individual in a group to collectively assess her/his own behavior, and make the required adjustments for effective functioning (McComb, Green, & Dale Compton, 2007). The Organization for Economic Cooperation and Development (OECD, 2009) viewed flexibility and adaptability as examples of essential competencies in the context of collaboration and teamwork. Similarly, the Partnership for 21st Century Skills (P21, 2009) conceptualizes flexibility as willingness to make necessary compromises in order to accomplish a group's common goal. It is referred to as being flexible in incorporating feedback effectively, dealing positively with praise, setbacks, and criticism. It is described as the ability to understand, negotiate, and balance diverse views and beliefs to reach workable solutions, particularly in multi-cultural environments (P21, 2009). Interpersonal flexibility positively affects group work and the members' ability to collaborate (McComb et al., 2007; P21, 2009).

In the context of education, flexible thinking is a key competency necessary for adapting to new learning environments, for transferring knowledge to new situations, and for understanding and solving unfamiliar problems (OECD, 2013; P21, 2009; Spiro, Collins, & Ramchandran, 2007). Recent studies suggested modifications, calling for a comprehensive conceptualization of 'flexibility' while emphasizing a more contemporary approach (DeYoung, Peterson, & Higgins, 2005; Garner, 2009; Ionescu, 2012). Such an approach is relevant to technology-enhanced learning environments that are supported or facilitated by web-based technologies and mobile devices (Barak & Ziv, 2013; Plesch, Kaendler, Rummel, Wiedmann, & Spada, 2013). In the realm of contemporary education, the need for re-conceptualization of "flexible thinking" is reinforced in light of recent developments in information and communication technologies.

1.2. Flexible thinking in technology-enhanced learning

Guided by recent studies, we identified three main factors that may indicate a learners' dispositional inclination to think flexibly in technology-enhanced learning: Acceptance of new or changing technologies (Technology acceptance), Open-mindedness to others' ideas (Open-mindedness), and Adapting to changes in learning situations (Adapting to new situations). The three factors are described in the following paragraphs.

1.2.1. Technology acceptance

The development of advanced information and communication technologies (ICTs) together with mobile devices (e.g. laptop computers, tablets, and smart phones) has changed the way teaching and learning are conceptualized and conducted (Barak, 2014; Barak et al., 2016; Barak & Ziv, 2013; OECD, 2013). Technology-enhanced learning is a common practice nowadays, describing learning activities or environments that are mediated, supported, facilitated, or augmented by web-based technologies and mobile devices (Barak, 2007; Plesch et al., 2013). Technology-enhanced learning promotes active and ubiquitous learning, location-based learning, and the generation of learning communities (Barak, 2012; 2014; Plesch et al., 2013; Rafaeli, Barak, Dan-Gur, & Toch, 2004). As ICTs continue to develop, new learning methods evolve, requiring learners to be flexible in their ability to use them efficiently (Barak, 2014). Hence, technology acceptance and adoption, in various contexts, is a main factor of contemporary flexible thinking in learning (P21, 2009).

Following the need to examine an individual's ability to accept and adopt new technologies, the Technology Acceptance Model was generated (e.g. Davis, 1989; Edmunds, Thorpe, & Conole, 2012; Legris, Ingham, & Collerette, 2003; Venkatesh & Bala, 2008). This model consists of four constructs: perceived ease of use, perceived usefulness, attitudes toward using technology, and behavioral intention (Davis, 1989). Perceived ease of use is the degree to which a person believes that using a particular system will be free from effort, while perceived usefulness signifies the degree to which a person believes that using a particular system will enhance their performance (Davis, 1989). Attitude toward using is the degree to which a person prefers a particular technology, and behavioral intention is the degree to which a person is open and willing to use a particular technology (Davis, 1989; Legris et al., 2003). Flexible thinkers are open to new experiences and therefore are more likely to accept and adopt new technologies (Barak, 2014; Legris et al., 2003). In this study, relevant items of the Technology Acceptance Model were incorporated and slightly modified to reflect the first facet of flexible thinking in learning.

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