



Supporting interest of middle school students in mathematics through context personalization and example choice



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ABSTRACT

An experimental study examined the effect of context personalization and example choice on situational interest in mathematics of adolescent students. Middle school students ($N = 736$) learned about probability calculus and were assigned to one of four instructional conditions. Individual interest and perceived competence in mathematics was examined as moderator on three measures of situational interest: triggered situational interest, maintained situational interest, and perceived value. Context personalization promoted triggered and maintained situational interest, and perception of value among students with low individual interest and perceived competence in mathematics. Similar results were observed for example choice, with the exception of perceived value. Although context personalization and example choice promoted effort for students with low individual interest, we observed no effect on performance. We discuss the theoretical and practical implications of the findings.

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1. Introduction

Students' affective and cognitive reactions toward the learning environment play an important role in their choice to reengage in similar activities (Eccles & Wigfield, 2002), as well as for the opportunity to develop and sustain interest in the specific content (Hidi & Renninger, 2006; Renninger & Su, 2012). Situational interest captures this instant reaction, referring to the likelihood that features of the immediate learning environment will trigger a response that may or may not last (Renninger & Su, 2012).

Although situational interest arises from students' interaction with the environment, this state is shaped by their individual interest and perceived competence related to the content at hand (e.g. Durik, Shechter, Noh, Rozek, & Harackiewicz, 2015; Linnenbrink-Garcia, Patall, & Messersmith, 2013). In contrast to situational interest, individual interest is a relative enduring predisposition to reengage in a particular content, which results in experiences of positive affect and value of engagement (Renninger & Su, 2012; Schiefele, 1991). Perception of competence is often related to individual interest (Eccles & Wigfield, 2002; Skaalvik & Skaalvik, 2008), suggesting that these constructs co-occur in learning situations (Köller, Baumert, & Schnabel, 2001). Individual interest tends to decrease with age (Hidi & Harackiewicz, 2000; Wigfield, Eccles, Roeser, & Schiefele, 2008), particularly in the domain of

mathematics during the middle years (e.g. Fredricks & Eccles, 2002; Frenzel, Goetz, Pekrun, & Watt, 2010; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002; Watt, 2004). As inner engagement decreases when learning mathematics, educators of middle school students encounter the challenge to elicit situational interest by adapting situational factors. The present study addresses this challenge by examining interventions to increase situational interest in middle school students. To boost situational interest does not only contribute to increase immediate engagement but also to the maintenance and development of a more enduring individual interest (Renninger & Su, 2012).

In the present study, we hypothesize that the written learning material can provide the external support needed to elicit situational interest, especially among students with low individual interest and perceived competence. In an experimental study on learning mathematics, we examined two text-based interventions among middle school students: context personalization and example choice. Context personalization refers to an instructional strategy that involves customization of features of an academic text to the learners' out-of-school interests or preferences (Walkington & Bernacki, 2014). Example choice is an instructional approach that offers students a choice between predefined topics for an academic text, prior to learning something new. Students can then select the topic they find most interesting and work a subject matter in a self-chosen context that they may find exciting (Reber, Hetland, Chen, Norman, & Kobbeltvedt, 2009). Context personalization and example choice bridge school mathematics with students' out-of-school interests, which is supposed to stimulate interest in content (Walkington & Bernacki, 2014). These authors note that current

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evidence for such an effect is mostly based on indirect inferences, and in the present study we directly address this assumption.

1.1. Situational interest

Situational interest refers to an immediate state during learning, and is associated with engagement, task involvement, motivation, and performance (Hidi & Renninger, 2006; Linnenbrink-Garcia et al., 2010, 2013). However, the experience of situational interest is also regarded as a central construct in the development and maintenance of individual interest (Hidi & Renninger, 2006; Linnenbrink-Garcia et al., 2013; Renninger & Su, 2012), making it particularly relevant for the challenge of declining interest in middle school.

According to Hidi and Renninger (2006), situational interest represents the first two phases in a four-phased, sequential development that may lead to an enduring individual interest (see also: Renninger & Su, 2012). This development is initialized by something in the environment catching the attention of the learner and eliciting a short-term affective response (Phase 1: triggered situational interest: Hidi & Renninger, 2006). If the external factors sustain the learner's attention, triggered situational interest can in turn develop into maintained situational interest (Phase 2) which increases positive affect and encourages a connection between the learner and content to be learned (Hidi & Renninger, 2006; Renninger & Su, 2012). These experiences of situational interest may lead to an emerging individual interest (Phase 3), and in turn to a well-developed individual interest (Phase 4). This theoretical framework posits a development of individual interest that is initialized by an emotional response toward the learning environment, but as interest develops, the perception of value as well as knowledge develops concurrently, while affect continues to be a central characteristic (Renninger & Hidi, 2011; Renninger & Su, 2012).

In their research on situational interest in education, Linnenbrink-Garcia et al. (2010) operate with a similar distinction between triggered and maintained situational interest; however, they differentiate between maintained situational interest based on the affective and value-based connection to content (see also: Linnenbrink-Garcia et al., 2013). Perceiving a content as meaningful and useful (Eccles & Wigfield, 2002; Linnenbrink-Garcia et al., 2010) is thought to be important for the development of interest, especially in the transition between Phase 2 and Phase 3. In the present study we use the term *perceived value* for students' situations-specific value perception of content; however, we acknowledge that this state represent a stage of maintained situational interest, in line with Linnenbrink-Garcia et al. (2010). As shown in Linnenbrink-Garcia et al. (2013), triggered situational interest as well as both types of maintained situational interest contributed to the development of interest, as posited by Hidi and Renninger (2006).

1.2. Interventions and situational interest

Renninger and Su (2012) emphasize the need for instructional support in order to trigger and maintain situational interest. Indeed, several instructional and textual features have been found to influence situational interest, some related to the interventions examined in the current study. Prior research on context personalization in mathematics education has revealed more positive attitudes toward customized rather than generic material (e.g. Ku, Harter, Liu, Thompson, & Cheng, 2007; Ku & Sullivan, 2000, 2002; López & Sullivan, 1992), suggesting a possible effect on triggered situational interest. In one of the few studies examining context personalization and situational interest, Bernacki and Walkington (2014) observed that context personalization had an effect on triggered but not maintained situational interest, supporting the assumption that context personalization has an effect on situational interest (Walkington & Bernacki, 2014), at least at the initial

level. However, in a study of elementary school students, Renninger, Ewen, and Lasher (2002) examined whether interests from other domains could serve as context in mathematics in order to motivate learners to work on a topic in which they did not initially show interest. They found that interest-based contexts, compared to generic contexts, both enabled students to focus on the meaning in tasks and offered students with low individual interest in mathematics an opportunity to make a more personal connection with the subject matter to be learned. The context to which mathematics is embedded appears to be able to help students in forming a connection to the content to be learned (see also: Ainley, Hidi, & Berndorff, 2002). Research on an instructional approach labeled *relevance interventions* showed that conveying the value of mathematic content, either directly by stating why this may be relevant for learners' lives or indirectly by encouraging learners to generate relevance of content, can influence learners' maintained situational and perception of value (Durik & Harackiewicz, 2007; Durik et al., 2015; Hulleman, Godes, Hendricks, & Harackiewicz, 2010; Hulleman & Harackiewicz, 2009).

The opportunity of choice in the learning environment has repeatedly been associated with situational interest and intrinsic motivation (Cordova & Lepper, 1996; Patall, 2012, 2013; Patall, Cooper, & Robinson, 2008; Patall, Cooper, & Wynn, 2010; Patall, Sylvester, & Han, 2014; Reber et al., 2009), and is often related to the need for autonomy within the theoretical framework of self-determination theory (e.g. Deci & Ryan, 2000). Krapp (2005) posited that the need for autonomy, as well as the remaining psychological needs in self-determination theory, may play a crucial part for the experience of situational interest, the affective reactions in particular. Linnenbrink-Garcia et al. (2013) observed that the perception of choice during a three-week residential summer program made a significant contribution to triggered and affect-based maintained situational interest, but not perceived value. According to Patall (2012), the effect of choice on intrinsic motivation and interest is not only based on the feeling of control and autonomy, but also the absence of external control in a choice situation (see also: Patall et al., 2008 for review).

Studies have shown that students' individual interest and perceived competence moderate how they experience interventions targeted at increasing situational interest, and even the effect of choice in learning activities (Patall, 2013; Patall et al., 2014). For example, collative features (e.g. varied fonts and vivid pictures) have been found to trigger situational interest only among those with low individual interest, whereas directly communicating the relevance of mathematics to students' lives was more effective in maintaining situational interest among students with high individual interest in the domain (Durik & Harackiewicz, 2007). These results were interpreted to suggest that collative features may have been perceived as irrelevant for students with a well-developed individual interest in the core content, but stimulated those with low interest.

Like individual interest, perceived competence in mathematics has been found to moderate the effect of interest-based interventions. Studies indicate that self-generated value interventions might be most efficient for students with low perceived competence (Hulleman et al., 2010; Hulleman & Harackiewicz, 2009) whereas passively receiving value information may benefit those with high perceived competence (Durik et al., 2015). These data suggest that students with low perceived competence benefit from interventions that encourage them to generate reasons for why contents are valuable and enjoyable instead of receiving the same reasons from an external source. Furthermore, competence perception and interest are often strongly related (Eccles & Wigfield, 2002; Fortier, Vallerand, & Guay, 1995); therefore, students with low perceived competence might respond like those with low individual interest in the core content.

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