Personalized Education to Increase Interest

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Abstract

A long-standing ideal of school education has been to connect instruction to a student's life outside school in order to render subject matter interesting. New technologies enable instructors to personalize learning materials to increase situational interest. After distinguishing three main methods to personalize education (context personalization, choice, and active personalization), we review recent intervention studies designed to increase situational interest, which is necessary for the emergence of individual interest. Across all three kinds of interventions, some studies point to the possibility of increasing interest for students low in initial interest. Despite progress in developing personalized interventions for school practice, research on the theoretical mechanisms behind the success of the interventions has just begun.

Keywords

personalized education; interest; context personalization; choice; utility-value intervention

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Recently, personalized medicine has emerged as a new "form of medicine that uses information about a person's genes, proteins, and environment to prevent, diagnose, and treat disease" (National Cancer Institute, 2015). We propose, in analogy to personalized medicine, personalized interventions in education, which use a student's individual interests, values, and preferences to increase interest in school subjects. The basic idea to connect a child's experiences outside school with the learning materials in school goes back to Dewey (1913/1975). Although it is possible to increase interest in the classroom with an intervention that fits all, for example, through teacher enthusiasm (Keller, Woolfolk Hoy, Goetz, & Frenzel, 2016), the ideal would be to customize learning materials to students' personal interests. The greatest obstacle to this ideal has been the classroom model, in which a teacher provides instruction for 20 students or more. Such settings limit the opportunities to personalize the learning experience. However, new developments in multimedia learning have made it possible to provide more customized learning materials and practice tasks.

Following the personalized-medicine model, we focus on personalized education to increase interest (for reviews of effects of educational interventions on learning outcomes, see Harackiewicz & Priniski, 2018, and Walkington & Bernacki, 2018). The studies reviewed here range from middle school to undergraduate studies, focusing on interventions that increase interest in science and math.

Individual and Situational Interest

Fostering students' interest in school is essential because interest has positive effects on persistence and learning (Ainley, Hidi, & Berndorff, 2002) and determines academic and vocational choices (Henriksen, Dillon, & Ryder, 2015). It is therefore alarming that interest — especially in science and math—declines from elementary to high school (Frenzel, Goetz, Pekrun, & Watt, 2010; for qualitative shifts in mathematics interest, see Frenzel, Pekrun, Dicke, & Goetz, 2012). Motivating the students of the 21st century is one of the major challenges in education (Hidi & Harackiewicz, 2000).

Interest develops over time and in phases from situational interest to individual interest. Hidi and Renninger's (2006; Renninger & Hidi, 2016) four-phase model of interest development assumes that in the first phase, it is necessary that the materials attract a student's attention and lead to momentary enjoyment; this is triggered situational interest (TSI). In the second phase (maintained situational interest, or MSI), external factors sustain a learner's attention. Factor-analytical approaches identified two kinds of MSI—one related to feelings such as enjoyment (MSI-F) and the other to the experience of value (MSI-V; Linnenbrink-Garcia et al., 2010). The last two phases include emerging individual interest (Phase 3) and well-developed individual interest (Phase 4). Individual interest is defined as an enduring predisposition to willingly reengage in a particular activity that leads to enjoyment or has intrinsic value.

Hidi and Renninger's (2006) model predicts that, to increase individual interest, educators have to first increase situational interest before a more stable disposition to reengage in the learning materials can emerge. Interventions therefore aim at increasing TSI and MSI (Phases 1 and 2) to facilitate the emergence of individual interest (Phase 3). Because learners come from diverse backgrounds and have differing out-of-school interests and preferences, this model predicts that the development of interest is an individual process. Therefore, we propose that personalizing education to the interests, values, and preferences of the individual student is more likely to increase situational interest compared with one-size-fits-all approaches.

Personalized education has been implemented through three kinds of interventions (for an overview of interventions and studies, see Table 1): (a) context personalization, (b) providing students with learning choices, and (c) encouraging students to actively generate personalized connections.

Context Personalization

In context personalization, learning contents and tasks are customized to the individual student. Such customization often includes personal details, such as the student's name or

birth date, or preferences, such as the student's favorite drinks and clothing brands. In an early study, Lopez and Sullivan (1992) compared a group that learned mathematics materials from individualized contents (individual personalization) with a group whose texts included the most popular but not the learner's individual details and preferences (group personalization). A control group received the generic materials used in textbooks. Students in the individual-personalization group were more interested than students in the control group in solving additional math tasks, with students in the group-personalization condition in between. A later study by Ku, Harter, Liu, Thompson, and Cheng (2007) showed that learners in an individual-personalization condition, compared with nonpersonalized computer-based instruction, liked the program more and were more willing to reengage in it; however, learners did not find the program more interesting. Because these early studies measured interest with single items, it was difficult to distinguish between the different facets of situational interest.

Later studies used measures based on Linnenbrink-Garcia et al.'s (2010) analysis of the different facets of situational interest. Høgheim and Reber (2015) implemented context personalization by customizing learning materials on the basis of individuals' self-reported interests (e.g., sports or movies). Compared with students in a control group who received generic learning materials, students in the context-personalization condition experienced higher situational interest (TSI, MSI-F, and MSI-V), especially when preintervention individual interest was low.

Using the same learning materials and tasks, Høgheim and Reber (2017) used preferences pertaining to objects (e.g., favorite beverage) instead of interests pertaining to sustained engagement in activities (e.g., doing or watching sports) to implement context personalization. For preference-based context personalization, MSI-V increased for learners with low perceived competence but decreased for those with high perceived competence, compared with learners in a control group. These results suggest that interest-based context personalization, as used by Høgheim and Reber (2015), may provide deeper connections of materials with the learner (see Walkington & Bernacki, 2014) and is therefore more effective than preference-based personalization.

Bernacki and Walkington (2018) showed that context personalization had positive effects not only on situational interest but also on individual interest and performance in high school students. Their study was the first to test context personalization in a longitudinal design, applying the intervention at different time points in school instruction. This enabled the authors to test and support the assumptions of the interest-development model by Hidi and Renninger (2006), which posits that situational interest is a necessary component in the emergence of enduring individual interest. In sum, context personalization, compared with generic materials, is an effective tool to increase interest.

Choice

It has long been known that choice increases interest and related motivational states. In their meta-analysis, Patall, Cooper, and Robinson (2008) documented positive effects on interest when students were given the choice of activities; versions of the same task (e.g., different

puzzles); procedures, such as self-paced timing; and rewards. Interestingly, the strongest effects stemmed from instructionally irrelevant choices, such as the choice of names of characters in a computer game (Cordova & Lepper, 1996) or the choice between two text packages with unknown content (Flowerday, Schraw, & Stevens, 2004). Such findings suggest that mere choice, or just the experience of making a choice, is enough to increase interest, presumably through increasing autonomy support (see Deci & Ryan, 1985).

These choice paradigms increase situational interest by providing superficial choices rather than connecting materials to personal interests, as implemented in context personalization and as proposed by Dewey (1913/1975). However, an approach called *example choice* does exactly this. When learners must study a principle, such as confirmation bias in psychology or probability calculus, they are given a choice among different examples to work with (Høgheim & Reber, 2015, 2017; Reber, Hetland, Chen, Norman, & Kobbeltvedt, 2009). After students select the example or topic that they are most interested in, an online system provides conceptually or mathematically identical learning materials embedded in the chosen example. Reber et al. (2009) found that first-year psychology students were more interested in learning about the confirmation bias if the learning materials were embedded in the chosen topic (choice group) rather than a given topic (given-example group), suggesting that personally meaningful choices were effective in promoting interest.

More recently, Høgheim and Reber (2015) extended this finding, using measures that assessed the facets of situational interest with more sophisticated scales than earlier studies on choice. Norwegian middle school students could choose among 12 examples from six popular topics, such as sports, music, or gaming. After selecting 1 example, they received instruction on probability calculus, embedded in the chosen example. Again, the choice group showed higher ratings on TSI and MSI-F than the control group, with the given-example group in between. Consistent with students in the personalization condition in Høgheim and Reber (2015), students low in pretest individual interest showed high increases in interest. Unlike in the personalization condition, example choice did not result in increased MSI-V (for a summary of the results, see Table 1).

Høgheim and Reber (2017) further extended the findings on example choice by providing middle school students with choices among the most popular topics and examples. Although the topics were already highly popular, example choice increased TSI even further. In contrast to interest in the example-choice condition of Høgheim and Reber (2015), preintervention individual interest did not moderate the effects in the new study.

In conclusion, there seem to be different mechanisms underlying choice. Whereas some forms of choice, such as choice of details that are instructionally irrelevant, may provide autonomy support, example choice aims at connecting learning materials to everyday interests and preferences. Although more research is needed, instructionally irrelevant choices may trigger interest, but it might take more personalized types of choices, such as those offered in example choice, to promote MSI.

Active Personalization

In active personalization, students contribute to the connection between the learning materials and their interests, preferences, or future career aspirations. A well-tested intervention is the utility-value intervention, which exists in both nonpersonalized and personalized form. In the nonpersonalized form, all students passively receive the same information about the utility value of the learning materials for everyday life or future career opportunities. In its personalized form, students must write an essay about the potential utility value of the learning content for their life or future career. So far, only one study has compared active personalized and passive nonpersonalized conditions in the same experimental design. Canning and Harackiewicz (2015) found that the personalized version tended to enhance task interest for learners low in confidence, whereas the nonpersonalized, passive version enhanced interest for high-confidence learners. Another experiment within the same study revealed that an intervention that combined both personalized and nonpersonalized utility value had the greatest effect on interest for learners low in confidence.

The effectiveness of the personalized version of this intervention, especially for students with low confidence or low performance, is well documented for college students (Hulleman, Godes, Hendricks, & Harackiewicz, 2010; Hulleman, Kosovich, Barron, & Daniel, 2017), high school students (Hulleman & Harackiewicz, 2009), and middle school students (Gaspard et al., 2015). Hulleman et al. (2010) found that the intervention increased self-reported situational and maintained interest for learners with low levels of initial performance. Extending these findings to groups of students who traditionally underperform, Harackiewicz, Canning, Tibbetts, Priniski, and Hyde (2016) found an effect of the intervention on behavioral engagement with the writing assignment (measured by essay length) in addition to performance, suggesting that the intervention supported situational interest. Moreover, personalized utility-value interventions have begun to show long-term effects on interest by increasing reengagement and retention within the field (Canning et al., 2018), pointing to the potential of the intervention to move learners from situational interest to emerging individual interest.

Other ways of active personalization that have become popular in mathematics and science education include question asking (Rothstein & Santana, 2011), digital storytelling (Sadik, 2008), and problem posing (Brown & Walter, 2005; Kapur, 2015). In these interventions, students can ask questions, tell stories, or pose problems that match their personal interests, values, or preferences. In a study that explored problem posing, Walkington and Bernacki (2015) found that both affective and utility-value components of interest in mathematics increased from before to after the intervention. As the main objective of this study with 24 students was to explore difficulties of problem posing in algebra tasks, there was no control group. Future research should examine how these promising and popular techniques affect interest by using the same experimental designs as the other studies on context personalization, choice, and utility-value interventions.

Discussion and Outlook

Recent experimental studies observed that personalized education increases situational interest in the short term, which is essential to promote individual interest in the long term. Indeed, the findings of the longitudinal study by Bernacki and Walkington (2018) suggest that Hidi and Renninger's (2006) model of interest development is a useful framework to explore interventions to increase interest in the classroom.

Studies using each type of personalized education— context personalization, choice, and active personalization— found that the interventions increased interest in learners who had low initial interest or low performance expectations. Although not every study obtained this result, finding this pattern across different interventions is important because often the most academically advantaged students benefit from interventions to improve psychological outcomes whereas the poorest do not (the so-called Matthew effect; Bakermans-Kranenburg, van IJzendoorn, & Bradley, 2005). These experimental studies fuel hopes that interventions to increase interest may reverse the Matthew effect and that the academically disadvantaged students might benefit most, in terms of interest, from personalized education.

There are at least three ways in which personalized education could be extended. First, research may examine dependent variables related to interest, such as the effects of personalized teaching on well-being in the classroom, social belonging, or the subjective meaning of school education (for the latter, see Reber, 2018). Moreover, it is important to assess the effects of personalization on learning, transfer, and performance. Second, research may explore new interventions that help customize learning materials. Much propagated but untested interventions use question asking or storytelling as methods to purportedly increase interest. Finally, there is little research about the processes underlying personalized teaching to increase interest. Walkington and Bernacki (2014) introduced a useful classification of dimensions for personalization by asking how deep the connection of learning materials with the learner goes, whether learning materials are customized to individuals or groups, and the degree of ownership (does the teacher or the learner create the connection?). Such models are a first step toward a firm foundation for evidence-based practice and offer a way to explore the processes underlying the positive effects of personalized education on student interest.

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Table 1.

Summary of Studies Using Three Kinds of Interventions (Context Personalization, Example Choice, and Active Personalization) To Personalize Education

Intervention type and study	School level	Main finding for effect of personalization on interest
Context personalization		
HØgheim & Reber (2015)	Middle school	If low initial interest: increases in TSI, MSI-F, MSI-V
HØgheim & Reber (2017)	Middle school	If low perceived performance: increase in MSI-V; otherwise, decrease in MSI-V
Lopez & Sullivan (1992)	Seventh grade	Increase in task interest
Ku, Harter, Liu, Thompson, & Cheng (2007)	Middle school	Increases in liking and reengagement
Bernacki & Walkington (2018)	Ninth grade	Increases in situational interest and individual interest
Example choice		
HØgheim & Reber (2015)	Middle school	If low initial interest: increases in TSI and MSI-F
HØgheim & Reber (2017)	Middle school	Increase in TSI
Reber, Hetland, Chen, Norman, & Kobbeltvedt (2009)	First-year university	Increase in task interest
Active personalization		
Canning & Harackiewicz (2015)	College	If low confidence: increases in task interest; otherwise, decrease in task interest
Canning et al. (2018)	First-year university	Increases in reengagement and retention within the field
Gaspard et al. (2015)	Middle school	Increase in utility value
Harackiewicz, Canning, Tibbetts, Priniski, & Hyde (2016)	College	If low initial interest: increase in behavioral engagement with the writing assignment
Hulleman & Harackiewicz (2009)	High school	Increase in situational interest
Hulleman, Godes, Hendricks, & Harackiewicz (2010)	College	If low initial performance: increases in situational interest; maintained interest
Hulleman, Kosovich, Barron, & Daniel (2017)	College	If low initial performance: increase in situational interest

Note: TSI = triggered situational interest; MSI-F = maintained situational interest related to feelings; MSI-V = maintained situational interest related to value.