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Engendering situational interest through innovative instruction in an engineering classroom: what really mattered?

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Abstract Instructors often try out innovative interventions (INTRs) in their classrooms to promote student engagement and learning interest. While such efforts are commendable, thinking through how individual and environmental characteristics influence interest development in learners is crucial to meeting such teaching objectives. In this study, we examined the role of personal interest, students' perceptions of meaningfulness (MNG) and the instructional utility of an innovative hands-on learning module in the development of triggered and maintained situational interests in an engineering classroom that used hands-on learning modules. Participants were undergraduate students enrolled in an engineering classroom who were taught fluid mechanics concepts using an innovative instructional approach. Results of the study indicate that the instructional INTR and the MNG learning material were significant predictors of situational interest. Theoretical and practical implications of the findings are discussed.

Keywords Interest · Situational interest · Interest development · Hands-on learning · Active learning

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Introduction

Stakeholders in students' success often attribute student low academic achievement to either their lack of *ability* to succeed or a failure to put in the *effort* needed to succeed in school (Harackiewicz et al. 2008; Kaplan and Maehr 2007). The relationships between these two variables, *ability* and *effort*, on learning efficacy and achievement have been copiously discussed in extant literature (Weiner 2010). While the ability to learn is a rather entrenched learner trait, the effort students expend in their learning is transient. Effort expended on *learning tasks* often depends on students' motivation to succeed, self-efficacy, meta-cognitive self-regulation and interests (Zimmerman 2008)—variables that are responsive to the instructional stimuli students receive within their learning environment. Learning interest often mediates learner involvement and meaningful engagement. On the contrary, declining interest in learning erodes meaningful engagement and depletes academic achievement (Ainley and Ainley 2011; Appleton et al. 2006). Underperforming students often lose a sense of belonging in their academic programs and end up being at risk of attrition (Wilson et al. 2012).

Interest is a pliable learner variable that has the tendency to respond to instructional innovation in any given learning situation. To stimulate student interests in learning, instructors often explore innovative instructional interventions (INTRs; Marra et al. 2000; Jonassen et al. 2006). For example, an instructor may try innovative INTRs during lecture time to stimulate the interests of otherwise uninterested students in a bid to increase their emotional and cognitive investment in learning tasks assigned in the classroom. If successful, such induced interests may influence students' perception of task value, which in turn may encourage learning engagement and foster learning habits that promote higher academic performance (Harackiewicz et al. 2008).

The probability that an attempted instructional innovation will successfully engender learning interest in students cannot be guaranteed. In fact, efforts aimed at igniting students' interest sometimes fail and could have counter-productive effect on students learning. Because planning and implementing instructional innovation can be costly in terms of the time and resources involved, instructors would be better-served if their efforts are channeled very early on in ways that would optimize the chances of successfully implementing instructional innovations aimed at cultivating learner interests. Interest development is influenced by a host of interacting learner and instructional variables within the learning environment. In this study, we examined the relative contributions of two important instructional variables (student *perception of the instructional utility* of an INTR, and the perceived *meaningfulness* (MNG) of the content of their learning material), and a learner variable [*personal interest* (P-INT)], in predicting three kinds of induced or *situational interest.*

Interest development

Learner interest has been linked to increasing intrinsic motivation to learn and a number of other positive learning behaviors (Schraw et al. 2001). Interest plays a significant role in the early stages of learning, and often differentiates between experts and moderately skilled performers because it, in many ways, mediates engagement (Hidi and Renninger 2006). It is construed by some theorists as a psychological *state of being*—characterized by focused attention, increased concentration and persistence—that occurs when learners interact with objects within their environment. Besides being a state of being, interest may also describe a person's *pre-disposition* to re-engage with particular objects, events or ideas, deemed interesting, within his environment (Harackiewicz et al. 2008; Hidi 2006; Hidi and Renninger 2006). In its dimensions, interest may be viewed as being both cognitive and affective. Affective in the sense that it sometime reflects an individual's emotional response to stimuli he receives from his surroundings, and cognitive in that it could also be rooted in deeply held values (Ainley et al. 2002).

Based on its source, theorists conceptualize interest as being *personal* (inherent in the learner) or *situational* (i.e., occasioned by the environment). *Individual* or *personal* interest describes a person's relatively stable predisposition to interact with objectives, ideas, or events; or to engage in certain activities with some degree of cognitive and affective devotions (Hidi and Renninger 2006). As an illustration a student who is personally interested in astronomy would readily seek opportunities to acquaint himself with concepts within the body of knowledge in that domain, and expend efforts in learning any related materials, even those considered intrinsically challenging, because of her need for such knowledge. Having developed over time, individual interest is relatively stable and is always inclined towards something—we could say a *personal interest in astrophysics*, for example (Lamb et al. 2012). Research has shown that individual interest preludes focused attention and persistent effort on learning-related tasks—interested learners enjoy their involvement in learning activities relevant to their interest and are willing to re-engage in such activities with little restraint, compared to those who showed little or no interest (Hidi and Renninger 2006; Harackiewicz et al. 2008).

While individual interest describes a psychological predisposition that the learner brings to the learning situation, certain stimuli or conditions within the learning environment may also excite affective responses, referred to as *situational interest*, in learners (Hidi and Renninger 2006; Schraw et al. 2001). Unlike individual interest which develops over time based on learners' cognitive and epistemic commitments, situational interest describes the kind of interest engendered by interesting environmental details that momentarily capture the attention, resulting in learners committing more attentional and emotional resources to learning a topic. Earlier research indicates that the resource commitments associated with situational interests often result in such desirable cognitive learning outcomes as: focused attention on learning, narrowing inferences and better integration of new information into prior knowledge (Hidi and Renninger 2006; McDaniel et al. 2000). Although both individual and situational interests are relevant to learning, situational interest is fluid and could more readily respond to instructional INTRs (Renninger and Hidi 2011). Some theorists have suggested that academic motivation may be enhanced by seeking ways to engender situational interest in learners (Hulleman et al. 2010; Renninger and Hidi 2011; Mitchell 1993). Researchers have proposed different models in describing the progression of interest development in learners; one of this is the four-phase model of interest development proposed by Hidi and colleagues.

Hidi's interest development model

Hidi and Renninger (2006) proposed a four-phase model that describes the cognitive and affective processes associated with the transitional stages of interest development. According to this model, interest progresses from *a triggered state* through four developmental phases as it morphs into a more ingrained form of P-INT. The model holds that triggering situational interest is the basic starting point in nurturing profound and deeply held P-INT in learners. *Triggered situational interest* (T-SI) refers to learners' psychological state of interest that describes their affective, and sometimes cognitive, response to features of the learning condition (Hidi and Renninger 2006; Renninger and Hidi 2002; Sadoski 2001). Even at the early stages of development, fledging interest could predict an individual's disposition to re-engage in particular contents or learning activities. For example, a learner whose attention was drawn by some fringe features of a learning environment may latter commit significant affective and cognitive resources to exploring the subject that caught his attention. Interest is most transient at the T-SI stage of interest development—unless sustained, triggered interest may fizzle as quickly as it is triggered.

Maintained situational interest (M-SI) refers to learners' psychological state of interest as a result of perpetuating initially triggered interest. M-SI may involve focused attention, task persistence, and a disposition to re-engage with tasks or content of learning over an extended time period. It may also be precursory to an emerging, more stable, personalized interest in the learner (Harackiewicz et al. 2000; Mitchell 1993). Unlike T-SI, M-SI tends to be more driven by the content of the learning material than by peripheral aspects of the learning material (Linnenbrink-Garcia et al. 2010). As evolving interest finds sustenance, formally transient states of interest may morph into more stable and deeply held interests. Hidi and colleagues proposed that an *emerging individual interest* is the initial progression in the development of more stable psychological states of interest from earlier transient interest forms. Well-developed individual interest is the terminal phase in the interest development model. In its most final form of development, interest is often characterized by a positive feeling, stored knowledge and value for the subject of its attention. In summary, as a result of acquaintance with some stimulating tasks, learners may become cognitively and emotionally committed to re-engaging with learning activities. And once they have internalized and personalized a psychological state of interest they once held lightly, learners could expend efforts beyond those required in completing basic learning tasks in order to indulge their curiosity (Renninger and Hidi 2002).

Engendering situational interest

From the foregoing, P-INT could develop from an initial stage of *triggered* interest, which if *maintained* by some instructional agency could emerge into deeply held P-INTs. Researchers have indicated that instructor can leverage on the fluidity of interest by incorporating instructional elements that facilitate interesting learning environments (Rotgans and Schmidt 2011a; Schraw et al. 2001). The presence of discrepancy, modelling, novelty effect, the inclusion of hands-on activities, incorporating interesting instructional INTRs, etc., could induce situational interests in learners. Researchers studying situational interest have introduced games and puzzles, problem-based learning, group learning, hands-on and problem-solving, simulations, etc., to stimulate situational interests in their participants (Mitchell 1993; Rotgans and Schmidt 2011a, 2011b; Tapola et al. 2013).

Given the potential benefits of interest on intrinsic motivation and positive learning behaviors that impact student achievement, cultivating and nurturing interest in the classroom is pedagogically expedient (Rotgans and Schmidt 2011b; Schraw et al. 2001). Instructors who seek to stimulate the interest of students in their classroom may choose to deviate from the status quo when designing their class curriculum by integrating different teaching aids or instructional elements in the hope of triggering situational interests in the subject of their instruction in students. However the success of such effort would depend on a variety of interacting variables in the learning environment. Because the planning and implementation of innovative pedagogies do entail time and resource commitment, it is essential that such implementations be carefully designed for upmost impact. As such, clearer understanding of how different variables relevant to the learning conditions in the class impact interest development would be deemed a research imperative.

Researchers have examined the relationship between different learner variables and interest development in the classroom. Some studies suggest that background knowledge positively influence interest development. Tapola and colleagues posit that exposure to familiar information, and being able to relate new information with existing knowledge may increase attentional engagement, and low prior knowledge could portend superficial engagement (Tapola et al. 2013). Harackiewicz and colleagues found that MNG of learning task is crucial to maintaining situational interest (Harackiewicz et al. 2000; Mitchell 1993). Others have proposed that constructs such as vividness, task authenticity and relevance could also influence interest development (Rotgans and Schmidt 2011a, b; Schraw et al. 2001). More also, learners' individual or P-INT could determine their pre-disposition to engage or re-engage with activities they find interesting, and has also been thought to influence the development of situational interest (Krapp and Lewalter 2001; Tapola et al. 2013).

The present study

Previous studies have examined the links between situational interest, academic achievement and cognitive engagement (e.g., Rotgans and Schmidt 2011a). Some of these studies also examined the effect of different variables on situational interest in different learning contexts (e.g., Rotgans and Schmidt 2011a, b; Tapola et al. 2013). While these studies have made notable contributions toward our understanding of the nature of situational interest, and parameters associated with interest development in the classroom, most of these research efforts only examine the *situational interest* construct more broadly. Since extant models suggest a rational theoretical pathway in interest development, understanding how different learner variables, and variables associated with the learning condition impact interest development could provide resourceful information in implementing innovative learning INTR intended to engender interest in the classroom. This study examines the relative contributions of two variables associated with the learning condition: *perception of instructional utility* of an INTR and *MNG*; and a learner variable: *P-INT* in predicting T-SI and M-SIs.

Situational interest has often been associated with novelty effect (Hidi 2001; Rotgans and Schmidt 2011a, b). The novelty effect that accompanies innovative instructional presentation in the classroom could trigger situational interest in learners. For example, using hands-on activities in teaching abstract concepts could trigger students' interest in concepts being taught, such that a student who has not shown any prior interest in the topic might end up being comparably engaged with the learning tasks as another student who was interested in a topic prior to class contact. The present study examines the relative contributions of an innovative INTR in predicting both T-SI and M-SI in learners. Innovative INTR in this study describes an alternative instructional method which deviates from how students have been taught similar concepts in the past. Because of the novelty factor associated with instructional innovation, we anticipate that student perception of the instructional utility of the INTR would be a significant predictor of T-SI. However, we are uncertain about the relative contributions of the INTR in predicting M-SI in learners.

The instructional aid used in a classroom can only serve as a medium for conveying learning. Researchers have proposed that task MNG, vividness, authenticity and relevance could also influence interest development (Mitchell 1993; Schraw et al. 2001; Tapola et al. 2013). MNG describes students' perception of the relevance and applicability of what is being taught in the classroom in real life contexts. This study examines the relative contributions of the perception of *meaningful* in predicting both T-SI and M-SI in learners. Although we are uncertain about the relevance of MNG in predicting T-SI, some have suggested that M-SI tends to be more driven by the content of the learning material (Linnenbrink-Garcia et al. 2010), suggesting that the MNG of learning content could be a significant predictor of M-SI in learners.

We expect that P-INT could substantively influence subsequent interest development (Krapp and Lewalter 2001; Tapola et al. 2013). However, being an existing learner predisposition, P-INT resides more outside of instructors' purview. In this study we examined the relative contribution of the instructional INTR and MNG of the learning material (variables that instructors can easily influence) and P-INT, which they have little influence over in predicting T-SI and M-SIs. P-INT is expressed both in terms of learners' affective feeling while engaging in an activity, and cognitively stored values for the object of interest (Hidi and Renninger 2006). Because M-SI is one step removed from P-INT, Linnenbrink-Garcia and colleagues proposed that maintained situation could indeed be decomposed into feeling and value components (Linnenbrink-Garcia et al. 2010). In this study, we explored that possibility by examining the relative contributions of the INTR, MNG and P-INT in predicting both feeling and value components of M-SIs in learners as well.

Methods

Participants and design

Participants in this study included 44 students (11 females and 33 males) enrolled into a fluid mechanics course in Chemical Engineering at a large public university in the US. Participants were mostly Caucasian ($n = 31$). Participants' ages ranged between 18 and 24 years, and are at the junior (93%) or senior levels of their engineering degree program in public research institution.

We conducted regression analyses to examine the relative contributions of three variables in the development of situational interest. The three predictor variables included: P-INT, i.e., students P-INTs in fluid mechanics; MNG, i.e., participants' perception of the relevance of the content of their instruction to life applications; and their *perception of the instructional usefulness* of the intervention, which we label Intervention (INTR) for brevity. The interest outcome variables were T-SI and M-SIs. We further sub-divided M-SI variable into feeling- and value-based (Mf-SI and Mv-SI) M-SI in order to examine the relative contribution of the predictors on each of these components.

Materials and measures

Desktop learning modules (DLMs)

DLMs were introduced as hands-on instructional aid to facilitate the learning experience of participants in this study. DLMs are miniaturized versions of industrial equipment designed to serve as visual and hands-on learning aids for teaching engineering concepts in the classroom. Most consist of a common base unit to which different detachable cartridges can be fixed depending on what concept is being taught. The module used in this study runs on batteries and has two fluid reservoirs, pumps, tubing and ports to which detachable cartridges could be fixed. It also has pressure and temperature display units, and a unit to control flow rate. Participants could simulate different flow rates and observe variations in temperature and pressure as fluids pass through the system. They could as well condition the system using established formulae to achieve particular objectives. As teaching aid, DLMs could provide visual reinforcements, and substantiate many of the abstract concepts taught in the classroom as students interact with the system as they learn. Figure 1 below is a type of the DLM used in this study.

Measures

We administered a 27-item instrument (with six sub-scales) to assess the predictor and outcomes variables. Items were assessed on a 7-point Likert type scale ranging from 1 to 7—with 1 being “not at all true of me” and 7 being “very true of me”. The survey was administered online on the Qualtrics® survey platform. Items used to assess the outcome variables were adapted from Linnenbrink-Garcia et al. (2010), while those used to assess the predictor variables were adapted from Mitchell (1993).

Personal interest The sub-scale is intended to measure students’ relatively stable pre-disposition to fluid mechanic prior to experiencing the INTR. Four items on this sub-scale assessed their interests in fluid mechanics relative to other topics in chemical engineering. Samples of items on the sub-scale include: (i) *Fluid Mechanics is enjoyable to me*; (ii) *Compared to other topics in chemical engineering*, *fluid mechanics is exciting to me*. Internal reliability of items on the scales was high, with Cronbach’s α of .92.

Meaningfulness The sub-scale included four items measuring participants’ perception of the relevance and usefulness of the content of their instruction to real life applications.

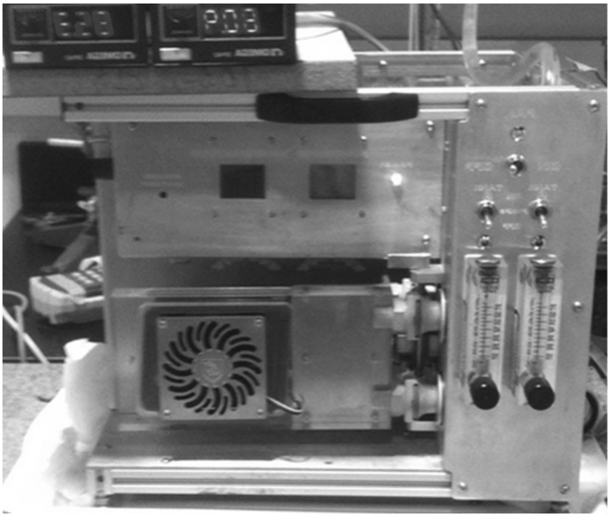

Fig. 1 Sample desktop learning module

Samples of items used on the sub-scale include: (i) "The stuff we learn in this class will never be used in real life"—an item which is reverse coded for scoring; (ii) "I see the topics we've learned in the fluid mechanics class as important in life." The sub-scale had a reliability coefficient Cronbach's α of .73.

Intervention The sub-scale included six items adapted from items on different INTRs labeled situational interest components on Mitchell's instruments. These items were intended to assess participants' appreciation, or perception of the instructional utility, of the learning aid and the instructional approach. Samples of items used on the sub-scale include: (i) "Learning is fun because I can see and discuss the topic we are learning when we use DLMs in class"; (ii) "Learning with the DLMs in our class helps me discover things on my own." Items on the sub-scale had an internal reliability coefficient Cronbach's α of .93.

The outcome variables assessed whether participants showed indicators of different components of situational interest after experiencing four sessions of DLM-facilitation instructions. The three sub-scales: T-SI, M-SI (Mf-SI) and M-SI (Mv-SI) each comprised four items and had internal reliability coefficients Cronbach's α of .78, .85, .88, respectively. An example of items on the T-SI scale include: "The DLM session really seem to drag on forever", which was reverse coded for analysis. Sample items on the Mf-SI and Mv-SI scales include: "I'm excited about fluid mechanics" and "I think what we are studying in fluid mechanics is useful for me to know", respectively.

Procedure

The study took place during the first 4 weeks of the semester. Participants attended two 50-min sessions on heat transfer each week. Heat transfer concepts were taught in lecture-only format during the first weekly sessions, and using DLM modules in the second weekly sessions. Both class sessions were taught by the same professor, who has taught chemical engineering courses for more than three decades. Prior to using a new DLM cartridge, participants received a video link that demonstrated to students how to use the DLM modules selected for their class session, to enable them get acquainted with the module, and to minimize any anxiety arising from interfacing with the learning module for the first time during actual class period. Because there were limited learning modules in each class; participants worked in groups of four or five during each class period.

At the beginning of each DLM-facilitated session, the instructor introduced the objective of the lesson, and ensured groups understood how to use the DLMs they were assigned. The instructor provided brief overviews of basic concepts and discussed associated formulae. Each group worked through what-if scenarios, and could manipulate the learning modules based on procedures described in the worksheets developed to guide the learning process. By manipulating different variables, like flow-rate and the temperature of fluids going through the DLMs, participants could observe and measure heat transfer and pressure change from one region to another along the system (e.g., in a venturi system). Groups could also predict what would happen under hypothetical conditions, and discuss how their predictions compared to their actual observation after manipulating the DLM.

Each group discussed their observations with the class, while the instructor facilitates the discussions, and clarifies issues relating to theory and the industrial relevance of the concepts. In order to ensure student engagement, participants in each group self-selected group roles: manipulators, observers, and facilitators. The manipulator's main duty was to adjust different variables on the DLM depending on the learning activity, while the observers monitored and recorded how corresponding variables respond to each module manipulation. Facilitators initiated the discussion of making sense of the learning activity as each group discusses their observation relative to their prior theoretical assumptions. To ensure distributed role experience, participants switched their group roles during subsequent class sessions. Participants received a link to an online survey that asked them to compare their learning experiences in the lecture-only sessions to those sessions that were facilitated using DLMs 4 weeks into the study.

Results

Four participants did not completely respond to every item on the survey and their partial responses were excluded, leaving only 40 responses included in this analysis. Preliminary analyses were conducted to examine correlations among the variables, reliability of the sub-scales, as well as to determine whether the data satisfied assumptions necessary for conducting linear regression analyses. Cronbach's α coefficient of internal reliability of items on the sub-scales ranged between .73 and .93. Descriptive statistics and reliability coefficients of the sub-scales are reported in Table 1 below. A Pearson product-moment correlation analysis indicated all the predictor variables had moderate to strong positive correlations with the outcome variables. The instructional INTR showed the strongest positive correlation with T-SI, while P-INT was positively correlated with both components of M-SI. The analysis also reveals weak to moderate positive correlation among the predictors.

Multiple regression analysis

Preliminary analysis was conducted to examine how well the data met assumptions for conducting multiple regressions. Coefficients of skewness and kurtosis showed all values

Table 1 Descriptive statistics and correlations among variables

	Variables	1	2	3	4	5	6
	Criteria						
1	Triggered-SI	1					
	Maintained-SI						
2	Mf-SI	.52**	1				
3	Mv-SI	.39*	.86**	1			
	Predictors						
4	INTR	.79**	.64**	.60**	1		
5	MNG	.46**	.45**	.53**	.37*	1	
6	P-SI	.40*	.88**	.73**	.62**	.21	1
	M	5.29	4.96	5.51	5.04	6.08	4.24
	SD	*1.35*	*1.27*	*1.10*	*1.30*	*0.94*	*1.32*
	Skewness	−.57	−.212	−.72	−.66	−1.34	−.19
	Kurtosis	−.54	−.44	.60	−.03	2.02	.16
	Cronbach's α	.78	.85	.88	.93	.73	.92

INTR intervention, *MNG* meaningfulness, *P-SI* personal interest

* $p < .05$ level, ** $p < .01$ (2-tailed)

were less than ±2 indicating normal distribution (Tabachnick and Fidell 2007) although MNG was marginal. Kolmogorov–Smirnov test indicated that the MNG data violated normality; hence we conducted logarithmic transformation on that variable. To determine multivariate outliers among our data, we compared Mahalanobis distance values to the χ^2 table with the number of predictor variables as degree of freedom. None of the values were below the critical value. Visual inspection of scatter plots indicated that the assumption of homoscedasticity was satisfied. Variance inflator factor values were within acceptable range, suggesting the absence of multi-collinearity. Besides, the predictor variables were not strongly correlated.

Stepwise multiple regression analysis was performed to develop models that determine the relative contributions of the independent variables—MNG, INTR, and P-INT—in predicting the outcome variables.

Triggered situational interest

A significant multiple regression equation based on the transformation was found, $F(1, 38) = 63.19$, $p < .001$. The first model indicated that participants' perception of the instructional utility of the INTR accounted for 62% of the variance in participants responses to the T-SI sub-scale ($R^2 = .62$, Adj. $R^2 = .62$). The second step model, $F(2, 37) = 38.61$, $p < .001$, indicated that the *perception of instructional utility* and *MNG* were significant predictors of triggered situation, accounting for 68% of the variance in participants responses to the T-SI sub-scale ($R^2 = .68$; *Adj.* $R^2 = .66$). However, the contribution of MNG was relatively small ($\beta = 7.21$; $p < .001$), compared to students perception of the INTR ($\beta = .34$; $p = .02$). Both models excluded personal because it was not a statistically significant predictor of the variance participants' response on the T-SI sub-scale. Please refer to Table 2 below.

Maintained-situational interest

Different regression models were computed for the components of M-SI examined in this study. The first step models for Mf-SI [$F(1, 38) = 128.46$, $p < .001$; $R^2 = .77$, Adj. $R^2 = .77$] and Mv-SI [$F(1, 38) = 42.01$, $p < .001$, $R^2 = .53$, Adj. $R^2 = .51$] indicated that students' *P-INT* prior to experiencing the INTR was the most significant predictor of both forms of M-SI. P-INT accounted for 77% of the variation in participants' response to the

Table 2 Stepwise multiple regression analysis for triggered situational interest

Variables	B	SE of B	β	t	VIF	F	R^2	Adj. R^2
Step 1								
INTR	7.96	1	.79	11.33*	1.00			
						63.19	.62	.62
Step 2								
INTR	7.21	.99	.72	7.27*	1.11			
MNG	.34	.14	.24	2.42*	1. 11			
						38.61	.68	.66

* $p < .05$ level (2-tailed)

Mf-SI sub-scale and 53% of variance in the Mv-SI. The second step models for Mf-SI [$F(2, 37) = 96.53$, $p < .001$; $R^2 = .84$, Adj. $R^2 = .83$] and Mv-SI [$F(2, 37) = 37.73$, $p < .001$; $R^2 = .67$, Adj. $R^2 = .65$] indicated that the *P-INT* and *MNG* were significant predictors of both components of M-SI. Compared to the first model, MNG accounted for 7 and 14% more variation in the Mf-SI and Mv-SI sub-scales, respectively. Standardized beta coefficients show that relative contribution of MNG was higher for the value component of M-SI [P-INT ($\beta = .819$; $p < 0.01$) and MNG ($\beta = .26$; $p < 0.01$)] than is feeling component [P-INT ($\beta = .643$; $p < 0.01$) and MNG ($\beta = .36$; $p < 0.01$)]. Participants' perception of instructional of utility of the INTR was excluded in the both models of forms of M-SI because its contribution in predicting M-SIs were not statistically significant. Results of both regression analyses are shown in Tables 3 and 4.

Discussion

Theoretical significance

Situational interest is an essential phenomenon in interest development. In this study, we examined the relative contributions of three variables (students' perception of the instructional utility of an innovative INTR, MNG and P-INT) in predicting three facets of situational interest. Research has shown that conditions in a learning environment can trigger situational interest in learners, and such triggered interest could be a first crucial step in developing deeply entrenched personalized interest in learners who otherwise have shown no such prior interest in a topic (Hidi and Renninger 2006). Although previous studies have examined the links between situational interest and different variables in a number of learning contexts, we were particularly interested in exploring how the three variables examined in this study would predict phases of situational interest when instructors alter students' learning experiences. Participants in this study reported their experiences in four classroom sessions facilitated using hands-on activities. Our findings provide vital support for prior discourses in extant interest literature, and provide insights that could inform the development and improvement of instructional practices in the classroom.

All three predictor variables examined showed positive significant correlations with T-SI, consistent with the theory of interest development. As noted in the literature,

Table 3 Stepwise multiple regression analysis for maintained situational interest (with feeling component)

Variables	B	SE of B	β	t	VIF	F	R^2	Adj. R^2
Step 1								
P-INT	.84	.07	.88	11.33*	1.00			
						128.46	.77	.77
Step 2								
P-INT	.81	.06	.84	12.62*	1.02			
MNG	4.24	1.1	.26	3.94*	1.02			
						96.53	.84	.83

* $p < .05$ level (2-tailed)

Table 4 Stepwise multiple regression analysis for maintained situational interest (with value component) before transformation

Variables	B	SE of B	β	t	VIF	F	R^2	Adj. R^2
Step 1								
P-INT	.61	.09	.73	6.48*	1.00			
						42.01	.53	.51
Step 2								
P-INT	.56	.082	.67	6.87*	1.02			
MNG	5.11	1.38	.36	3.71*	1.02			
						34.93	.65	.64

* $p < .05$ level (2-tailed)

participants' perception of the instructional innovation was highly positively correlated with the triggered interest (Renninger and Hidi 2011; Harackiewicz et al. 2008; Mitchell 1993). Of the three variables however, we found that participants' P-INT had the least correlation with T-SI. The regression model for T-SI indicates that the instructional INTR was the largest predictor of triggered interest, accounting for over 60% of the variance in T-SI responses among participants. Although P-INT is somewhat correlated with T-SI, our finding strongly suggests that it may not be indispensable in determining triggered interest. This finding suggests that novelty factor alone would be enough to arouse a psychological response to some interesting detail of the learning situation, and such response could result in students being emotionally invested in tasks associated with learning. According to the second T-SI model, participants' perception of MNG was weak, but statistically significant in predicting ($\beta = .239$, $p = .020$) triggered interests. Although, MNG contributed relatively less towards predicting triggered interest than the INTR itself, it does suggest that being able to make some cognitive connection with the learning situation could further strengthen the chances of triggering situational interest.

Although, to capture student learners' attention is a crucial first step in interest development, extant interest theories hold that initially triggered interest soon decays as the novelty effect that stimulated it dwindles (Hidi and Renninger 2006). As such, initially triggered interest must be maintained or held for its contributions in interest development to be tangible. Of the three variables examined, we found that P-INT was most germane to predicting maintained interest. Our regression models indicated that P-INT accounted for 77 and 53% of the variance in participants' responses to the feeling and value sub-scales of maintained situation interests, respectively. Along with P-INT, the second models in our analysis indicated that MNG was also a significant predictor of M-SI.

M-SI, construed as being more stable than triggered interest, is deemed to have similar feeling and value features as P-INT (Linnenbrink-Garcia et al. 2010)—interest may be sustained as result of having some psychological attachment and/or due to learners' epistemic commitment to mentally stored values about a subject of interest. Earlier theoretical discussions suggest that value components of interest would be content-dependent, while feelings would depend more on prevailing psychological state of being (Linnenbrink-Garcia et al. 2010). These hypotheses were supported by the pattern we observed among our participants. Although P-INT contributed more in predicting both types of M-SI, we observed that MNG had greater effects on value-based M-SI. Also consistent with theory, the effect of MNG relative to P-INT was larger for the value, than the feeling-based M-SI (Hidi and Renninger 2006; Linnenbrink-Garcia et al. 2010). The standardized weight of MNG was larger in predicting the value-based (β = .39) than the feeling-based (β = .28) M-SI among participants in our study. Comparing the contributions of the predictor variables to the T-SI, Mf-SI and Mv-SI models, our data suggested there was an increasing relevance of MNG as interest moved away from being feeling-based to value driven. Unlike in the case of T-SI, participants' perception of the instructional utility of the INTR had no significant effect in predicting M-SI.

This finding could suggest that although initially T-SIs may be maintained as learners find some affective connection with the subject of their learning, the likelihood of strengthening M-SI would increase as they make cognitive value-based connections that derive from their perception of the relevance of the instructional content in their classrooms to real-life applications. However, because MNG could be highly subjective, what is considered meaningful or relevant may also be deeply rooted in students' prior knowledge and experiences, P-INT, and their need for cognition. Because MNG is a malleable variable that predicts situational interest as our findings study suggest, future experimental studies could explore the degree to which explicitly stated instructional MNG would influence students' perception of instructional MNG. Such a study could highlight to what degree teacher-explicitly stated MNG could compensate for subjectivity in students' perception of the instructional relevance of an INTR.

Practical implication

Despite learners' initial predisposition and the intrinsic difficulty of a learning material, the instructional environment may be conditioned to excite learning interests. Consistent with the literature, we found that altering students' learning experience seemed to trigger situational interest in learners (Hidi 2006; Hidi and Renninger 2006). Our result suggests that students' P-INT predispositions may have no practically significant effect on triggered interest, if the source of interest trigger was stimulating enough. Rather, the chances of success could depend more on the novelty factor of the instructional INTR. Our study suggests that teachers may anticipate a degree of success in stimulating learning interest in students by seeking to manipulate necessary instructional elements in students' learning environment. Because students respond differently to changes in instructional approach, it would be expedient to continually assess the impact of any new instructional approach or innovative INTR on students learning in order to minimize accompanying unintended learning effects. For example, introducing elements that are not absolutely germane to learning a material may constitute seductive details—noted to be harmful to learning (Kirschner et al. 2011; Sanchez and Wiley 2006). Alternatively, poorly designed and implemented instructional innovative could also impose extrinsic cognitive load that increases the cognitive load associated with learning (Sweller et al. 2011). However, endeavoring to minimize both extrinsic cognitive load and seductive details is the hallmark of good instructional design (Park et al. 2015; Plass et al. 2010; Sweller et al. 2011).

Although the INTR and P-INT were the major predictors of T-SI and M-SIs, respectively, perceived content meaningful was also significant in predicting both phases of situational interests. Furthermore, MNG played a more substantive role in predicting the more M-SI than in predicting triggered interest in participants in this study. Students' P-INT prior to class-contact are predetermined and less likely to respond to INTR within a short timeframe, but our study suggests that instructors could leverage on choosing contents that accentuate task value and the MNG of content matter. We would expect that as learners cognitively engage with, and process the different instructional elements they encounter within their learning environment, they would gain deeper appreciation for the value of what they are learning in the classroom. Such appreciation may result in attention fixation, cognitive resources allocation and a desire to re-engage with specific learning tasks. Such appreciation may in turn strengthen their affective connections and P-INT in the learning material.

Limitations and conclusions

Because we conducted a multiple regression, using a larger sample size could have strengthened the degree of precision of the confidence intervals of regression coefficients obtained. The small sample size was however due to the nature of the course—class size was predetermined by programmatic policies. Besides, we only had a limited number of DLMs and teaching assistants, which would make facilitating a larger student group ineffective. An alternative approach would have been to obtain data over multiple semesters. However, this would also require obtaining data on a number of other variables to statistically control for cohort differences. Because interest is a transient variable that could be impacted by course facilitators (e.g., instructor or teaching assistants), varying facilitators could introduce nuances that would potentially threaten the internal validity of the study. Besides, historical events spanning the periods between cohort implementations may impact students' learning experience. The robustness of our findings about the relative contributions of variables examined in this study in predicting phases of situational interest could be further explored in future studies with larger sample size, and in classrooms that use other innovative instructional INTR.

Items on the sub-scales of this survey were adapted from two existing surveys to reflect the context in which this study was conducted. We acknowledge that adapting those items to be context-specific could potentially impair the validity of the sub-scales of the instrument used in our study. Because we had a low sample size, we were unable to conduct a factor analysis to examine the impact our effort at adapting these items had on the structural validity of the sub-scales on our surveys. A sample size of 200 participants or more is recommended to conduct a meaningful factor analysis (Yong and Pearce 2013). While the sub-scales have been validated in earlier studies (Linnenbrink-Garcia et al. 2010; Mitchell 1993), we ensured the items were adapted with minimal rewording in order to retain the face validity of the sub-scales in the instrument we administered.

Beside sample size, interest measures were only administered at one point during this study. Being a transient variable, a snapshot of participants' response about their classroom experience may mask the true picture of situational interest development. Rather administering the situational interest inventory at multiple time points could provide a better representation of interest development over class sessions (e.g., as examined Rotgans and Schmidt 2011b). Lastly, our finding is limited to the experience of a few college-level students who participated in our study. Younger students may respond differently to instructional innovation in their classrooms. Futures studies may also focus on other student population, especially in a different learning domain. We recognize that our findings were not based on independent comparisons groups, which is a potential limitation of the findings reported in this study. Since respondents participated in both the DLM and lecture sessions however, we hope that their responses were a reasonable reflection of their experience in study sessions.

Instructors sometimes implement innovative instructional INTRs in their classroom in order to promote student engagement and interest in learning in the classroom. While such effort is commendable, understanding how different variables in the learning environment might influence the outcomes of their effort is desirable. This study examined the role of P-INT, and students' perception of MNG and the instructional utility of classroom INTR on the development of T-SI and M-SIs. We found that student interest prior to class contact did not predict triggered interest. Rather T-SI depended more on implemented instructional INTR, suggesting that being able to capture students' attention and elicit affective response rests mostly with the novelty effect associated with an instructional INTR. M-SI was predicted by P-INT and MNG. Because instructors have less influence of students' P-INT prior to class contact however, they may increase instructional MNG by helping students readily see the relevance between classroom instruction and life application.

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Appendix

See Fig. 1 and Tables 1, 2, 3 and 4.

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