Chapter 2
The Role of Authentic Tasks in Promoting Twenty-First Century Learning Dispositions

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Abstract Authentic tasks are widely acknowledged by educators to foster desirable twenty-first century (21C) learning dispositions in students, particularly in terms of motivated and engaged learning. In mathematics education specifically, authentic tasks are commonly upheld as essential to the development of positive student affect towards mathematics, as well as mathematical problem-solving competencies and its encompassing socio-cognitive processes—reasoning, communication and connections—among learners (Beswick K, Int J Sci Math Educ, 9(2):367–390, 2011). Despite this widespread belief in the value of authentic tasks, there is surprisingly limited empirical evidence on the relationship between the use of authentic tasks in classrooms and productive learning dispositions (Pellegrino and Hilton (eds) Education for life and work: developing transferable knowledge and skills in the 21st century. National Academies Press, Washington, DC, 2013), particularly from the perspective of students as a critical stakeholder group. This chapter attempts to address this knowledge gap.

Drawing from a comprehensive study involving more than 4,000 students across 129 classrooms from 39 secondary schools in Singapore, this chapter foregrounds the extent to which the use of authentic tasks predict a suite of productive 21C learning dispositions. These comprise positive beliefs, attitudes and motivational dispositions that lend themselves towards deeper learning, namely, mastery-approach and performance-approach goal orientations, self-efficacy and task value and individual and collaborative learning engagement. Hierarchical linear modelling results underscore the significance of authentic tasks in predicting students' individual engagement levels and mastery-approach and performance-approach goal orientations, as well as the extent to which they consider mathematics to be interesting, useful and important. Authentic tasks, however, were not a significant predictor of students' collaborative engagement and self-efficacy in learning mathematics. The implications of these results are discussed, particularly in light of current understandings of Singapore secondary school students' self-reported dispositions towards learning mathematics and their strong global performance in international mathematics achievement tests.

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Introduction

Social commentators and futurists have produced a variety of characterisations of our current millennium. These include the Digital Age (Brown 2006; Thomas and Brown 2011), the Creative Age (Florida 2002) and the Conceptual Age (Pink 2005), just to name a few. Despite semantic differences, all of these labels acknowledge that our twenty-first century (21C) social and economic landscape has distinctive features that set it apart from preceding historical periods. Where standardisation and mass production used to be primary generators of economic wealth in the Industrial Age, the current 'digital revolution'—embodied in personal, mobile and networked technologies—has replaced manual and routine mental labour with personalised services, ideas and innovation. These are in turn argued to be key commodities that drive new economic growth (Freeman 2004; Perez 2002).

This significant epistemological and sociological shift is exerting substantial pressure on the social institution of schooling worldwide to evolve and respond in terms of what Harvard Professor Richard Elmore (1996) terms the 'core of educational practice', that is, 'how teachers understand the nature of knowledge and the student's role in learning, and how these ideas about knowledge and learning are manifested in teaching and classwork' (p. 2). While the specifics of school curriculum may remain contested, there now appears to be some convergence among global educational scholars, policymakers and practitioners around what constitutes 21C literacies and dispositions and the enabling pedagogical approaches that are likely to foster them (Hanna et al. 2010). The use of authentic tasks is widely acknowledged to be one such pedagogical approach. While commonly referenced '21C literacies and dispositions'—such as digital, creative and critical literacies, collaboration and lifelong learning aptitudes such as engagement, interest and self-efficacy—have always played important roles in the progress of human history, they have traditionally been viewed as 'expressive affordances' (Bernstein 2000). In a knowledge-centred economy, characterised by complexity and rapid change, exponential technological advancements, multiplying bandwidth and increasing global consumer demand, these individual and collective attributes come to play a more central role in determining access to and productive participation in local, global and virtual societies.

As highlighted earlier, however, a review of extant literature appears to indicate an incommensurate gap between (a) the advocacy of authentic tasks as a means to motivate and engage students towards deeper learning and (b) the availability of empirical evidence beyond assorted qualitative small-scale research examples that can provide robust insights into the relationships between authentic tasks and productive student learning dispositions, including engagement and motivation. While the authors recognise the value of qualitative research studies that provide highly contextualised understandings on the use and efficacy of authentic tasks in classrooms, there undoubtedly remains an empirical knowledge gap in the literature that warrants further attention. This serves as the primary focus of our chapter—to contribute robust empirical understandings on the extent to which the use of authentic tasks statistically predict a suite of productive learning beliefs and motivational dispositions that are essential in the current 21C knowledge economy.

While a comprehensive treatise on authentic learning, 21C literacies and learning is beyond the scope of this chapter, the following section provides a brief outline of what constitutes authentic tasks and the 21C learning dispositions of pertinent interest to this study, namely, adaptive achievement goals, individual and collaborative learning engagement, self-efficacy and task value. Collectively, these will serve as both a conceptual and contextual frame for the results and discussion that follows.

Authentic Tasks and Productive 21C Learning Dispositions

Authentic Tasks

The roots of authentic tasks can arguably be traced back to the several decades leading up and into the 1940s known as the 'progressive period' of educational reform in the West, particularly the United States. A priority agenda of this period, led by influential intellectuals such as John Dewey, among others, was that of changing the pedagogical core of schooling, from 'a teacher-centred, fact-centred, recitation-based pedagogy' to one 'based on an understanding of children's thought processes and their capacities to learn and use ideas in the context of real-life problems' (Elmore 1996, p. 7). This pedagogical intention and 'red thread' carried through the following periods of large-scale educational reforms, in the United States and other parts of the world, which saw an intensifying paradigmatic shift away from a *Cartesian* approach towards more *ecological* understandings of the nature of knowledge and learning.

The Cartesian model of learning paradigm lies at the root of conventional transmissionist-oriented instructional approaches, which tends to produce passive or inert knowledge. In sharp contrast, a key premise of the ecological learning paradigm is that of situating the learner within the learning context, which bears 'real-world' relevance and is community based rather than individual based (Barab and Plucker 2002; Brown 2006; Vygotsky 1978). As a study of knowledge, it shifts from focusing on individual forms of cognition and rationality to multiple social forms of knowing, being and doing, where situated cognition and active learning take place within communities of learners as they engage in meaning-making through experiential activities that are relevant and connected to the learners' lives beyond the staid classroom and textbook exercises (Dawson and Siemens 2014; Tan and McWilliam 2008). It is within this 'pedagogical common sense' that authentic tasks are situated.

Authentic tasks, sometimes referred to also as 'situated learning' in new literacy studies (Tan 2008; The New London Group 2000) or 'context problems' in mathematics education, bear several definitions and understandings in varying degrees of specificity. For instance, Brophy and Alleman (1991) provided a general definition of authentic tasks as 'anything students are expected to do, beyond getting input through reading or listening, in order to learn, practice, apply, evaluate or in any other way respond to curricular content' (p. 10). Reeves et al. (2002), on the other hand, identified ten specific attributes of authentic tasks as: (1) relating to real life, (2) encompassing ill-defined problems as complex as real life, (3) providing opportunities to relate/connect various subject areas in fulfilling the task, (4) consisting of complex goals that students pursue over a period of time, (5) providing opportunities to define a problem from various viewpoints using various resources, (6) providing opportunities for collaboration which is essential in classrooms as well as in real life, (7) providing opportunities for self-expression, (8) allowing for different products to emerge at the end of process, (9) encompassing both process and product evaluations and (10) giving way to multiple interpretations and products.

Particular to mathematics education, Kramarski et al. (2002) specifically defined authentic tasks as conveying common contexts 'for which there is no ready-made algorithm' (p. 226). In contrast, Jurdak (2006) provided a more general definition that did not specify exclusions but described authentic tasks as 'meaningful, purposeful and goal-directed' tasks that simulated real-world problem-solving (cited in Beswick 2011, p. 369).

Regardless of subject domains and the specificity or generality of the definition, a key point of convergence is that authentic tasks require a 'real-world' element—whether in terms of meaningfulness, relevance and/or application to the personal lifeworlds of learners, as well as an element of connectedness to other subject domains and contexts beyond the textbook and school. In similar vein, for the purpose of this study, we described and operationalised authentic tasks as the frequency to which students consider their teacher to have:

1. Provided opportunities for pupils to apply ideas to everyday nonschool-related situations
2. Focused the lesson on what is personally meaningful rather than what is in the syllabus
3. Attempted to link subject knowledge to their personal experiences
4. Provided opportunities for them to apply ideas learnt in class to other subjects

Productive 21C Learning Dispositions

By 21C learning dispositions in the context of this chapter, we are referring to a suite of productive beliefs and motivational inclinations towards learning. Specifically, these include (1) two achievement goal orientations—mastery approach and performance approach—that are largely understood to be strongly associated with adaptive learning, (2) self-efficacy and task values and (3) engagement in learning, both individual and collaborative.

Before we further elaborate on our conceptualisation and operationalisation of these dispositions, it is important to highlight that we refer to these productive beliefs and motivational inclinations as essential 21C learning dispositions not because they only emerged or became important to learning in the 21C. Rather, understandings about these learning constructs and their positive impact on learning started coming to the fore since the mid- to late 1990s, primarily through the theoretical and empirical work of educational motivational psychologists and social psychologists. Some outstanding contributors include: John Nicholls (1984) and Carol Dweck (1986, 2000, 2006) on self-theories and achievement goal orientations, Albert Bandura (1982, 1997) on self-efficacy and Jacquelynne Eccles and Allan Wigfield (1983, 2000) on expectancy-value theory of achievement motivation and the impact of subjective task value on learning outcomes.

It was, however, not until the most recent wave of national and international curricular reforms attempting to specify the teaching and learning of 21C competencies that these critical learning dispositions have been explicitly acknowledged in curricular frameworks as an important, even foundational component in the development of 21C skills among learners. A most recent '21C curricular framework' published by the National Academy of Sciences in the United States entitled *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century* (Pellegrino and Hilton 2013) identified 'positive dispositions towards learning'—comprising productive beliefs and motivation towards learning—as one of five core pillars of knowledge that together fostered 21C skills, deeper learning and transfer. In similar vein, the International Baccalaureate's (IB) suite of K-12 educational programmes—which are seeing increasing uptake worldwide by both private and government schools not only for its academic rigour but also pedagogical and assessment approaches, deemed to be highly relevant for nurturing 21C global capacities in learners—are connected through ten explicitly stated 'Learner Profile' dispositions that together serve as flagship learner outcomes for the programmes. At the heart of many of these Learner Profile attributes as conceptualised by the IB (IBO 2006) lie positive beliefs and intrinsic motivations towards learning that are essential to continuous personal growth and development during and beyond formal schooling throughout one's lifetime. The Partnership for 21st Century Skills (2011) proposed the framework for 21C learning. Singapore Ministry of Education (2010) defined desired educational outcomes (i.e. a confident person, a self-directed learner, a concerned citizen, an active contributor) and 21C learning competencies (e.g. critical and inventive thinking, communication skills, social emotional learning) in Singapore education. The dispositions examined in this study are either listed as important values and skills or considered as important factor to enhance this skills and competencies in 21C learning nationally (Singapore) and internationally.

It is within this advancement in educational theory and practice that we frame the following adaptive motivational beliefs and behaviours as essential 21C learning dispositions pertinent to this study.

Mastery and Performance Achievement Goal Orientations

Achievement goal theory purports that the underlying intentions for engaging in particular learning tasks, that is, their achievement goals, tend to drive individuals' learning processes and outcomes (Dweck 2000; Nicholls 1989). Broadly, there are four forms of achievement goals: mastery, performance, mastery avoidance and performance avoidance, with the first two being recognised as more adaptive in nature and generally conducive to learning, whereas the latter two are associated with maladaptive and unconstructive learning behaviours (Liem et al. 2008; Nie and Lau 2009).

This chapter focuses on the first two forms of achievement goals. According to Dweck (2000), learners driven by *mastery goals* are focused on increasing competence, learning new skills, understanding new concepts and 'to get smarter'. These learners tend to exhibit more adaptive responses to complexities and challenges. On the other hand, learners driven more by *performance goals* are primarily focused on 'getting the right answer' and winning positive judgments of their competence and to 'avoid looking dumb'.

While such learners may aspire towards high levels of performance, they concurrently exhibit a higher tendency to experience intellectual paralysis in the face of challenging problems and complexities, as well as feelings of being overwhelmed by the inability to get the right answer. The important thing to note, however, is that current research in the field has raised concerns about a potentially dysfunctional 'mastery-or-performance' binary logic. Rather, productive and sustainable learning are most likely to occur when both mastery and performance goals are present in about a 50/50 ratio (Dweck 2000; Tan and McWilliam 2008).

Self-Efficacy and Task Value

According to the expectancy-value theory posited by Eccles and Wigfield (1983, 2000), two beliefs are most salient in explaining successful learning outcomes: (1) *self-efficacy*, that is, the degree to which one is confident of his/her capability in successfully accomplishing a given task (Bandura 1997), and (2) *task value*, that is, the extent to which one believes the task to be important, valuable and worth pursuing.

Self-efficacy is considered by many to be one of the most important adaptive learning motivation constructs, with numerous empirical studies illustrating its positive relationship with a range of behavioural choices and outcomes, including higher levels of effort and persistence, resilience to adversity and learning engagement (Yeung et al. 2011).

Task value, relative to self-efficacy and achievement goals, has historically received less attention by achievement motivation researchers (Wigfield and Eccles 1992). Empirical findings from various studies, however, have clearly shown that while self-efficacy relates more strongly to task achievement outcomes, task value more strongly predicts learners' intentions and choices to engage with tasks (Greene et al. 2004; Liem et al. 2008). This is particularly important in the context of K-12 formal schooling where early task disengagement, particularly of core subjects such as literacy and numeracy, could lead to sustained disadvantage in terms of academic achievement and therefore future social access and mobility. Through this lens, one might even argue that positive task value bears more significance in sustaining primary and secondary students' ongoing interest and engagement in learning tasks and subjects, such that they become more resilient learners who can productively traverse the ebb and flow of formal success indicators such as test grades.

Individual and Collaborative Engagement

Learning engagement generally refers to students' willingness to participate in routine school activities, such as attending and paying attention in classes, completing assigned tasks and following teachers' explanations and instructions in class (Chapman 2003; Yeung et al. 2011). Students who are engaged in learning have been found to invest greater effort and exhibit more persistence and determination, thereby contributing to higher-quality learning and better learning outcomes (Fredricks et al. 2004; Skinner et al. 2008). Learning engagement has been defined and measured in various ways, but studies generally focus more on individual engagement rather than group or collaborative engagement. Given that collaboration is widely acknowledged to be an increasingly important and essential 21C competency, for the purpose of this study, we extend the engagement construct to include both individual and collaborative engagement because they are closely linked processes in classroom learning.

By individual engagement, we refer to students' self-perception of the extent to which they pay attention and participate in class activities. Collaborative engagement, on the other hand, refers to students' perception of the extent to which they participate in and contribute to group work and discussions.

To recap, authentic tasks and the aforementioned productive learning beliefs and behaviours present as important pedagogical and dispositional constructs essential to quality learning in the 21C. To date, however, there exists limited empirical evidence on the relationship between the use of authentic tasks in classrooms and these productive learning dispositions, particularly from the perspective of students as a critical stakeholder group. This chapter aims specifically to address this gap.

To this end, it asks the question: to what extent does the use of authentic tasks predict (1) mastery and performance achievement goals, (2) self-efficacy, (3) task value and (4) individual and collaborative learning engagement in students? The following sections present the method and results of this empirical inquiry.

Method

Sampling, Design and Participants

The sample was drawn by a stratified random sampling technique. The participants in this study were 4,164 Grade 9 students from 129 classrooms in 39 secondary schools in Singapore. The secondary schools in Singapore were first divided into three strata based on their prior aggregate school achievement. Thirteen schools were randomly selected from each stratum. About half of the Grade 9 classrooms in each participating school were randomly selected.

The ethnic distribution of the participants was as follows: 71 % of the participants were Chinese, 20 % were Malay, 7 % were Indian, and 2 % were of other ethnic groups. The gender distribution of the sample was about even (53 % girls and 47 % boys). The mean age of the students was 15.5 years (SD = .61).

Procedure

An online survey was conducted. Half of the students within each class were randomly selected to complete Form 1 in which students reported their motivation related to learning mathematics (student-level data). The other half of the students in the same class completed Form 2 in which students reported the frequency of authentic tasks that their mathematics teachers gave to them (class-level data). Although different groups of students provided student-level and class-level data, these multilevel data could be linked through common class identifications.

Measures

All items on the questionnaires were rated on 5-point Likert scales ranging from 1 (never) to 5 (always) or from 1 (strongly disagree) to 5 (strongly agree). These items are presented in Appendix A. Factor analysis results are not reported in this paper due to space constraints but can be made available to interested readers upon request.

Use of Authentic Tasks

The measure of use of authentic tasks included four items. This scale measures the frequency of using authentic tasks in the classrooms. All items on the questionnaires were rated on 5-point Likert scales ranging from 1 to 5. 5 means 'always', 4 means 'often', 3 means 'sometimes', 2 means 'seldom' and 1 means 'never'. A one-factor structure provided a good fit for the data, $\chi2$ (1, N = 2,070) = 10.15, TLI = .979, CFI = .998, RMSEA = .066, internal consistency reliability, and Cronbach's alpha

Table 2.1 Descriptive statistics and zero-order correlations among motivational variables

	M	SD	1	2	3	4	5	6
1. Individual engagement	3.64	.86	–					
2. Group engagement	3.81	.77	.48**	–				
3. Mastery-approach goal	3.55	.79	.54**	.35**	–			
4. Performance-approach goal	3.09	.99	.13**	.17**	.26**	–		
5. Efficacy	3.74	.72	.47**	.31**	.64**	.26**	–	
6. Task value	3.77	.77	.44**	.26**	.72**	.18**	.56**	–

**$p<.01$

was .87. The mean of authentic task at class level was 3.06 and standard deviation was .45. The mean 3.06 showed that teachers not very frequently used authentic task in classroom teaching and learning.

Productive 21C Learning Dispositions

Six productive 21C learning dispositions were measured in the current study. The scales were adapted from the Motivated Strategies and Learning Questionnaire (MSLQ, Pintrich et al. 1993) and Patterns of Adaptive Learning Scales (PALS, Midgley et al. 2000). All items on the questionnaires were rated on 5-point Likert scales ranging from 1 to 5. 5 means ‘strongly agree’, 4 means ‘agree’, 3 means ‘partly agree and partly disagree’, 2 means ‘disagree’ and 1 means ‘strongly disagree’. The mastery goal orientation scale consisted of five items (Cronbach’s $\alpha=.89$). The performance goal orientation scale consisted of four items (Cronbach’s $\alpha=.88$). The self-efficacy scale consisted of five items (Cronbach’s $\alpha=.86$). The task value scale consisted of five items (Cronbach’s $\alpha=.88$). The individual engagement and collaborative group engagement scales consisted of four items (Cronbach’s $\alpha=.87$ and .90). The higher score means higher mastery goal orientation, higher performance goal orientation, higher self-efficacy, higher task value, higher individual engagement and higher collaborative group engagement.

Confirmatory factor analysis was conducted to examine the factor structure of the six constructs. A six-factor structure provided a good fit for the data, $\chi2$ (305, $N=2{,}094$) = 1809.25, TLI = .946, CFI = .957, RMSEA = .049. The inter-factor correlations ranged from .13 to .72 (see Table 2.1 for details).

Results

Analytic Approach to Modelling Student Outcomes

All predictors and outcome variables were standardised before running hierarchical linear modelling (HLM) analyses. The unconditional model (model 0, no predictor variables) was used to estimate the proportion of variance within classroom and among classrooms (Raudenbush and Bryk 2002). The next set of HLM analyses (model 1) was performed to evaluate the predictive relations between the use of authentic task and student motivational outcomes. Furthermore, we estimated the proportion of variance reduction as a result of adding authentic tasks in model 1, that is, comparisons of level 2 variances between model 1 and model 0.

Authentic Tasks Predicting Dispositional Outcomes

The results from HLM analyses predicting students' dispositional outcomes are presented in Tables 2.2, 2.3, 2.4, 2.5, 2.6, and 2.7. The results showed that the use of authentic task was a positive predictor of mastery goal orientation ($\gamma = .161$, $p < .001$), performance goal orientation ($\gamma = .065$, $p < .01$) and task values ($\gamma = .112$, $p < .001$) and individual engagement ($\gamma = .103$, $p < .01$). Comparison between, model 1 and model 0 yielded 11–28 % reduction in between-class variance in the above motivational outcomes (please refer to Tables 2.2, 2.3, 2.4, 2.5, 2.6, and 2.7 for detailed results).

On the other hand, the use of authentic tasks was not a significant predictor of self-efficacy ($\gamma = .025$, $p = .377$) and collaborative engagement ($\gamma = .022$, $p = .458$).

Discussion

The results of this study bear important implications for our understandings related to 21C pedagogy and learning in general and mathematics education specifically. We discuss these in turn.

Table 2.2 Results from HLM analyses predicting *individual engagement*

Variable	Model 0		Model 1	
The use of authentic tasks				
Fixed effect	γ	SE	γ	SE
Intercept				
γ_{00}	−.004	.034	−.001	.032
Authentic task (γ_{01})			.103**	.031
Random effect	Variance		Variance	
u_{0j}	.090		.080	
r_{ij}	.912		.912	
			Proportion reduction in variance	
	ICC		M1 vs. M0 (L2)	
	.089		11 %	

Note: *ICC* intraclass correlation coefficient, L2 indicates that the calculation of proportion reduction in variance is based on level 2 variance
**$p < .01$

Table 2.3 Results from HLM analyses predicting *group engagement*

Variable	Model 0		Model 1	
The use of authentic tasks				
Fixed effect	γ	SE	γ	SE
Intercept				
γ_{00}	−.007	.031	−.006	.031
Authentic task (γ_{01})			.022	.030
Random effect	Variance		Variance	
u_{0j}	.068		.068	
r_{ij}	.935		.935	
			Proportion reduction in variance	
	ICC		M1 vs. M0 (L2)	
	.067		0 %	

Note: *ICC* intraclass correlation coefficient, L2 indicates that the calculation of proportion reduction in variance is based on level 2 variance

Table 2.4 Results from HLM analyses predicting *mastery-approach goal*

Variable	Model 0		Model 1	
The use of authentic tasks				
Fixed effect	γ	SE	γ	SE
Intercept				
γ_{00}	.001	.034	.005	.030
Authentic task (γ_{01})			.161**	.030
Random effect	Variance		Variance	
u_{0j}	.088		.063	
r_{ij}	.913		.913	
			Proportion reduction in variance	
	ICC		M1 vs. M0 (L2)	
	.088		28 %	

Note: *ICC* intraclass correlation coefficient, L2 indicates that the calculation of proportion reduction in variance is based on level 2 variance
$^{**}p < .001$

Implications for Twenty-First Century Pedagogy and Learning in General

First, the results show that the use of authentic tasks is a significant predictor of adaptive mastery and performance achievement goal orientations, task value and individual engagement. This makes a strong quantitative empirical contribution to extant literature that advocates the potential of authentic tasks for enhancing positive learning dispositions—particularly motivation and engagement—in students (e.g. Jurdak 2006; Kocyigit and Zembat 2013; Norton 2006). As highlighted earlier, studies to date advocating for authentic tasks have largely been found to be more

Table 2.5 Results from HLM analyses predicting *performance-approach goal*

Variable	Model 0		Model 1	
The use of authentic tasks				
Fixed effect	γ	SE	γ	SE
Intercept				
γ_{00}	.000	.025	.003	.024
Authentic task (γ_{01})			.065**	.022
Random effect	Variance		Variance	
u_{0j}	.018		.015	
r_{ij}	.982		.981	
			Proportion reduction in variance	
	ICC		M1 vs. M0 (L2)	
	.018		17 %	

Note: *ICC* intraclass correlation coefficient, L2 indicates that the calculation of proportion reduction in variance is based on level 2 variance
$^{**}p < .01$

Table 2.6 Results from HLM analyses predicting *efficacy*

Variable	Model 0		Model 1	
The use of authentic tasks				
Fixed effect	γ	SE	γ	SE
Intercept				
γ_{00}	−.007	.030	−.006	.030
Authentic task (γ_{01})	.11121		.025	.029
Random effect	Variance		Variance	
u_{0j}	.061		.061	
r_{ij}	.941		.941	
			Proportion reduction in variance	
	ICC		M1 vs. M0 (L2)	
	.061		0 %	

Note: *ICC* intraclass correlation coefficient, L2 indicates that the calculation of proportion reduction in variance is based on level 2 variance

speculative in nature or comprise generally small-scale case studies based on small number of participants and classrooms (Beswick 2011). Given that the use of authentic tasks are often explicitly recommended in numerous published 21C skills curricular frameworks as a desirable pedagogical approach, the results of this study go some length to empirically validate this theoretical stance. The significance of this empirical contribution is further underscored by the pertinence of adaptive achievement goal orientations, task value and individual engagement as salient dispositional predictors of learning quality and schooling outcomes.

On the other hand, the results show that authentic tasks do not significantly predict self-efficacy and collaborative engagement in learners. This finding is somewhat surprising and of great interest to the authors, as it appears to run against the grain

Table 2.7 Results from HLM analyses predicting *task value*

Variable	Model 0		Model 1	
The use of authentic tasks				
Fixed effect	γ	SE	γ	SE
Intercept				
γ_{00}	−.001	.033	.002	.031
Authentic task (γ_{01})			.112***	.032
Random effect	Variance		Variance	
u_{0j}	.080		.069	
r_{ij}	.921		.921	
			Proportion reduction in variance	
	ICC		M1 vs. M0 (L2)	
	.080		14 %	

Note: *ICC* intraclass correlation coefficient, L2 indicates that the calculation of proportion reduction in variance is based on level 2 variance

***$p<.001$

of popular beliefs about the use of authentic tasks. A clear implication of this finding is that we should be cautious in accepting general claims extrapolating the efficacy of authentic tasks in fostering learners' motivational dispositions in all its forms. Rather, as aptly pointed out by Rahim et al. (2012), the nature and quality of tasks may differ substantially even within the umbrella of what is considered to be 'authentic tasks'. As such, in-depth consideration must be given to the design of tasks and what counts as 'authentic' for the purposes at hand.

Authentic tasks, as operationalised in this study, refer to the extent that students perceived their teachers to have provided opportunities for them to learn and apply ideas in personally meaningful ways beyond the school and in connection to other subjects. This operationalisation does not specifically include aspects of collaborative learning. This may account for why no significant relationship emerged between authentic tasks and collaborative engagement in this study. This is, however, an educated inference at best. Further research is warranted to shed robust insights on this finding.

In similar vein, more investigation is needed to better understand the relationship between authentic tasks and self-efficacy. The findings of this study suggest that the 'real-world' relevance, personal meaningfulness and connectedness elements of an 'authentic' learning task have limited influence on raising learners' self-perceived competency levels associated with successfully accomplishing a given task and/or subject domain. Nie and Lau's (2010) research found that constructivist instruction was positively related to self-efficacy in English learning. In their definition, constructivist instruction included three key elements, i.e. deep thinking, communication and real-life experiences. Taken together, the results of that study suggest that instruction which draws on students' real-life experiences on their own might not foster self-efficacy, especially in the learning of multiple subject domains; but if combined with deep thinking and communication in learning as a whole package in pedagogy, it may then be effective. Given that authentic tasks may be defined and operationalised to varying degrees of context specificity, more comparative research on authentic tasks across different subject domains will likely yield meaningful and insightful contributions to our current understandings in the area.

Implications for Mathematics Education: Singapore in Global Context

We now move more specifically to discussing the results within the context of mathematics education. Mathematical tasks, defined as a set of problems or a single complex problem that focuses students' attention on particular mathematical ideas, are central to mathematics lessons (Kaur and Toh 2012). In fact, according to the results of a large-scale transnational video survey research of Grade 8 mathematics and science teaching across seven countries, conducted by International Association for the Evaluation of Educational Achievement and the US National Center for Education Statistics, more than 80% of the time in mathematics class were spent on mathematical tasks (Hiebert, 2003). Given the significant amount of time accorded to mathematical tasks, the nature and quality of tasks, as well as their impact on learning dispositions and outcomes, become paramount.

This is further underscored by growing concerns, especially in developed countries, over what appears to be waning participation in mathematics and related fields in post-compulsory schooling—a trend that if left unattended could possibly represent a threat to national economies resulting from an undersupply of qualified mathematicians, statisticians, economists and engineers (Australian Academy of Science 2006; Beswick 2011).

Mathematics researchers have found that many students disengage with mathematics learning as early as in middle school (Sullivan et al. 2006). To this end, authentic tasks or context problems, as they are sometimes referred to in mathematics education, are often enrolled on the premise that they are more likely to interest and engage learners. However, a common critique that follows within the field is that evidence for the efficacy of such tasks is wanting, particularly in relation to raising student affect towards mathematics, and therefore, the premise is more a claim than actuality (Beswick 2011). In this regard, the findings reported in this chapter go some length to address this significant knowledge gap, especially from the invaluable perspectives of Grade 9 students as a critical stakeholder group.

More specific to Singapore and its high-performing East Asian peers who consistently top the Trends in International Mathematics and Science Study (TIMSS) results, the findings reported here bear some pertinent implications. Frederick Leung (2008) in his analysis of East Asian mathematics classrooms and students using the 1999 and 2003 TIMSS results and video studies highlights two important trends:

1. East Asian students (Korea, Japan, Hong Kong, Taipei), other than Singaporean students, neither valued mathematics highly (*task value*) nor enjoyed studying

the subject (*engagement*). This is despite achieving high scores on the international mathematics test. It is important to note that although Singaporean students' reported higher levels of task value and enjoyment of mathematics relative to their East Asian peers, these were still only marginally higher than the international average and noticeably lower than other peers worldwide (see Mullis et al. 2004 for details).

2. East Asian students, including Singaporean students, despite achieving high test scores, consistently reported low levels of self-confidence (*self-efficacy*) with respect to learning mathematics, as compared to their global peers.

Triangulating these results to the video study, Leung (2008) concluded that while mathematics lessons in East Asia exhibited the strengths of engaging with more complex and advanced contents requiring more deductive reasoning, they also had some consistent weaknesses. In particular, mathematical tasks were found to be largely unrelated to real life. Coupled with the highly challenging content, this may explain students' negative beliefs and attitudes towards the subject and ultimately serves to alienate students from sustained and advanced participation in the study of mathematics and related disciplines. An important upshot, therefore, is that high student achievement in mathematics should not blindside teachers to the equally important objective of stimulating students' positive beliefs and motivational learning dispositions towards mathematics.

In light of the above global trends pertaining to mathematics teaching and learning, the results of this study provide empirical support that one productive recourse is the employment of authentic tasks that are specifically designed to provide students with more opportunities to connect the mathematical ideas they learn in class to their personal experiences, lifeworlds as well as other ideas learnt in other subject domains. This has the potential to improve their mastery orientation in learning mathematics (and performance orientation, although this does not appear to be a significant problem in general for East Asian students) as well as foster higher levels of engagement, importance and value they place on the learning the subject.

The results of our study do not shed much light on the concern of East Asian students generally lacking self-efficacy and confidence in the learning of mathematics. As highlighted earlier, our results suggest that the relevance and connectedness of mathematical tasks to real-life contexts and other subjects on their own do not improve students' perceptions of their competency in mathematics. On one hand, this could partially be due to the highly challenging nature of mathematics content taught in East Asian countries (Leung 2008), resulting in students' perceptions that they may not do well even if given more time or effort. More insidious could be the possibility that students hold a 'fixed' rather than 'incremental' belief (Dweck 2006) about their own mathematical intelligence or ability, which could be reinforced in 'ability-driven' education systems such as Singapore where the practice and philosophy of 'ability banding' or differentiated instruction takes on highly institutionalised forms with multiple points of high-stake testing determining future academic 'tracks' and pathways. Such unproductive learning beliefs regarding one's ability may be bridged to some extent by adaptive motivational processes such as mastery goal orientation (Dweck 2006; McWilliam 2008). Given that our results showed authentic tasks to be a positive predictor of mastery goals, one may surmise that they bear potential for inadvertently raising self-efficacy in mathematics. This is however a hopeful conjecture at best, one that future research would do well to address.

Last but not least, our results indicate that authentic tasks did not significantly predict collaborative engagement among students. This suggests the possibility that even though authentic tasks, as they are currently designed in Singapore mathematics classes, may allow opportunities for students to connect their learning to real-world experiences and other subject domains, these tasks may remain largely individualised in nature (Boaler 1994). In similar vein, a local Singapore study conducted by Foo (2007) on the use of authentic performance tasks in mathematics lessons revealed teacher concerns that authentic tasks were carried out at the expense of content, thereby comprising test preparation and performance in semestral examinations, which are largely individual based. To this end, we can logically deduce that mathematic tasks used in mathematics lessons, at least in relation to those experienced by the participants of our study, even those learning tasks designed to be authentic in nature, tend more towards individualised learning rather than affording significant opportunities for meaningful collaborative learning. This deduction is further validated by a review of the key reference material used in Singapore to guide preservice teachers in designing authentic tasks in their mathematics lessons (e.g. Fan 2011). The exemplar tasks provided in this key reference text were found to be overwhelmingly individual based rather than collaborative in nature. In this regard, further research on ways to enhance the design of authentic tasks to incorporate powerful collaborative learning elements and their impact on group engagement would likely prove invaluable to move the field forward.

Conclusion

In conclusion, we highlight some limitations of the study presented in this chapter. First, like many survey-based research studies, despite our best efforts to ensure that the constructs are conceptualised in a theoretically informed and empirically grounded manner, our operationalisation of authentic tasks are unavoidably limited to a set of attributes. Future research could consider measuring a broader set of instructional elements and practices associated with authentic tasks, given their inherent richness of design. Second, the correlational and cross-sectional design of our study does not allow for causal understandings and is likely to lead to an underestimation of the task effects on students' dispositional outcomes (Nie and Lau 2010; Rowan et al. 2002). The findings of this study could be enhanced by other designs that are experimental and/or longitudinal in nature. These could shed more robust insights into the causality, as well as the cumulative effects of the use of authentic tasks and their impact on students' learning dispositions, and how these may change over time. Third, students' self-reported measures were used as the sole source of data in this study. Multiple data corpuses such as classroom observations, teacher reports, lesson artefacts and qualitative interviews would do well to enhance our understandings of the findings reported here.

Despite these limitations, it is our hope that this chapter goes some length to address a significant empirical gap in extant literature regarding the efficacy of authentic tasks in fostering students' productive learning beliefs and motivational dispositions, in general as well as specific to mathematics education.

As educators, we have an implicit yet unequivocal obligation to ensure that the formal schooling experiences of students amount to much more than accruing high achievement scores in exams. Rather, students should graduate from the formal schooling institution having experienced ample opportunities to develop as literate and responsible citizens armed with the relevant dispositions to contribute productively to the wider economy, workplaces and civic life. This endeavour is a complex one indeed. The mere incorporation of some form of authentic tasks into lessons may be simple enough but hardly sufficient in and of themselves. The true challenge lies in designing lessons, learning tasks and units of work with coherence, continuity and progression such that productive dispositions, values and practices are able to be cultivated and sustained, by being relevant to the culture of the school and the life futures of its most important stakeholders—the students.

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Appendix A

The Use of Authentic Tasks

1. How often does your MATHS teacher provide opportunities for you to apply mathematical ideas learnt in your class to other subjects?
2. How often does your MATHS teacher provide opportunities for pupils to apply mathematical ideas to everyday nonschool-related situations?
3. How often does your MATHS teacher focus the lesson on what is personally meaningful to you, rather than what is in the syllabus?
4. How often does your MATHS teacher attempt to link subject knowledge to your personal experiences?

Individual Engagement

1. I pay attention well.
2. I keep my attention on the work during the entire lesson.
3. I listen carefully when the teacher explains something.
4. I try my best to complete classwork.

Group Engagement

1. I try my best to contribute during small group discussions.
2. I share my ideas during group work.
3. I try my best to get involved in class discussions.
4. I try my best to contribute to group work.

Mastery-Approach Goal Orientation

1. An important reason I do my MATHS work is that I like to learn new things.
2. I like the work in my MATHS class best when it challenges me to think.
3. An important reason I do my work in MATHS class is because I want to get better at it.
4. An important reason I do my MATHS work is that I enjoy it.
5. An important reason I do my MATHS work is that I want to learn challenging ideas well.

Performance-Approach Goal Orientation

1. I want to show pupils in my MATHS class that I am smart.
2. I like to show my teacher that I am smarter than the other pupils in my MATHS class.
3. It is important to me that the other pupils in my MATHS class think I am smart.
4. I feel successful in MATHS if I get better marks than most of the other pupils.

Self-Efficacy

I am sure I can learn the skills taught in MATHS class well.

1. I can do almost all the work in MATHS class if I do not give up.
2. If I have enough time, I can do a good job in all my MATHS work.

3. Even if the work in MATHS is hard, I can learn it.
4. I am sure I can do difficult work in my MATHS class.

Task Values

1. I think learning MATHS is important.
2. I find MATHS interesting.
3. What I learn in MATHS is useful.
4. Compared to other subjects, MATHS is useful.
5. Compared to other subjects, MATHS is important.

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