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The Mindset and Intellectual Development Scale (MINDS): Metacognitive Assessment for Undergraduate Students

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The purpose of this study was to develop a concise composite measure of mindset and intellectual development in order to inform pedagogical strategies to support students' intellectual growth. A development sample of undergraduate students (n = 295) completed the 37-item pilot Mindset and Intellectual Development Scale (MINDS). The dataset was analyzed using Principal Component Analysis to determine the orthogonal dimensionality of the scale and for item reduction. The MINDS was shown to have eleven items describing two orthogonal dimensions: Intellectual Maturity and Mindset. An additional item was included to control for the social desirability bias. The MINDS collapsed what often are seen as separate dimensions of learning in order to capture a more robust underlying construct of intellectual development with which to assess undergraduate students' metacognitive states.

The context in which the need arose for ascertaining a student's metacognitive status was the collaborative learning environment, which fosters conscious intellectual development and knowledge creation through social processes (Johnson, Johnson & Smith, 1998; Powell & Kalina, 2009). By developing this collective metacognitive awareness, a student may transition from a low level of intellectual development, in which all knowledge is certain and instructors' statements and texts are meant to be memorized, towards a higher level of intellectual development, in which all knowledge is contextual and the student takes responsibility for critically examining information sources (Baxter Magolda, 1992; Felder & Brent, 2004; Marton & Saljo, 1984). While an instructor has the ability to craft a learning environment that challenges students to become aware of their learning and problem-solving skills (Mandeville, Ho & Valdez, 2017; Mandeville & Stoner, 2015), instructors commonly encounter resistance from students operating at low levels of intellectual development who feel threatened and confused when they are asked to critique and synthesize information (Felder & Brent, 2004). Adverse reactions from those in lower levels of intellectual development are similar to how those with fixed mindsets respond to challenges: those with fixed mindsets are often concerned with how they will be judged for successes or perceived failures rather than seeing a challenge as an opportunity to learn and grow (Dweck, 2006).

Understanding students' levels of intellectual development and mindset can support the instructor's ability to achieve the metacognitive goals of collaborative learning and, importantly, defuse student resistance to the method. Instructors can use this information to avoid overwhelming students with metacognitive tasks beyond their current level of intellectual development and to craft the reasonable assessment criteria for their current level of development. Furthermore, knowing students' level of intellectual development can help instructors organize peer groups in which students are well-suited to both give and receive peer assistance. Determining a student's level of development has previously been reported as assessing a student's reaction to different levels of scaffolding (Allal & Ducrey, 2000). However, it is important to note that students may have multiple levels of development, depending on subject and context. These multiple levels of development are comprised of subject-level knowledge, metacognitive practices, self-regulation, self-concept, and other features (Allal & Ducrey, 2000).

Students who are frustrated by the collaborative learning environment are likely anxious to seek validation in conventional ways and see their basic self-worth and likeability questioned if they are asked to actively engage but respond incorrectly (Covington, 2000). According to Dweck's (2006) model of self-theory, these students may have a fixed mindset in which their acquired self-belief is that their moral and intellectual qualities are determined at birth. Students with the fixed mindset may avoid learning opportunities where they risk exposing their deficiencies as this reflects negatively on their perceived self-worth. Students with this mindset have been shown to have a performance (extrinsic) goal orientation, seeking to outperform peers on summative assessments (Tagg, 2003). As the fixed mindset is intolerant to perceived failure, student interest and enjoyment in learning may be replaced with helplessness unless they experience immediate success in learning situations (Felder & Brent, 2004). Students at this level of metacognitive development may question the competence of the instructor who they believe is responsible to tell them what to know rather than helping students "figure it out."

Fortunately, one's mindset is modifiable based on the educational environment, and a progression is possible towards the self-theory in which one believes that one's basic qualities can be developed across time—the growth mindset (Dweck, 2000; Tagg, 2003). Students with the growth mindset often believe that perceived failures are actually opportunities to cultivate knowledge. Students with this mindset have been shown to have a learning (intrinsic) goal orientation, seeking to increase their capabilities across the long term (Tagg, 2003). The belief that challenges, when met with effort and support, are an opportunity to elicit intellectual development allows students to sustain learning in the midst of real-world situations of ambiguity and failure (Dweck, 2006). Thus, instructors' ability to advance students' intellectual development via the collaborative learning environment is strongly connected to a student's underlying self-theory or mindset.

In order to advance students' intellectual development and mindset, the learning environment must provide a meaningful challenge in which students are supported to do a task they could not do independently but can accomplish with iterative formative feedback (Wass & Golding, 2014). Creating this supportive classroom environment is based on demonstrating respect for students at all levels of intellectual development and recognizing that students' zones of proximal development also vary. Another important aspect of the respectful classroom environment is avoiding overwhelming students with tasks beyond their proximal zone of development by realizing that students advance one ability level at a time. Within Vygotsky's (2012) social constructivism theory, the zone of proximal development describes learning occurring when more capable peers or instructors assist students to operate at a higher level than they could on their own. Over time, this classroom support enables students to learn to operate independently at this new ability level. Thus, to effectively advance students' intellectual development by challenging the beliefs that characterize their current level, an instructor must first understand and support students' current levels of intellectual development.

The problem is that there are limited composite measures of mindset and intellectual development available to gauge a student's current level of metacognitive development. The Motivated Strategies for Learning Questionnaire (MSLQ) by Pintrich, Smith, Garcia, and McKeachie (1993) is one popular socio-cognitive measurement tool that brings together goal orientation, task value beliefs, control beliefs, perceptions of self-efficacy, and critical thinking strategies. The MSLQ is extensive and examines many components of metacognition, but it does not incorporate mindset, or how malleable one believes one's intelligence, personality, and other characteristics to be. Therefore, our goal was to develop a concise composite measure of mindset and intellectual development to be used to identify students' metacognitive states. In addition to being a diagnostic tool that can help instructors tailor content to students' intellectual development levels, this information could be used to chart undergraduate students' progression towards achieving the metacognitive goals of collaborative learning and also to help instructors create more productive peer work groups. Ideally, the various instructional uses of the MINDS will help instructors coach their students on becoming life-long learners with growth mindsets.

Method

Survey Administration

A development sample of undergraduate students, (n = 295, mean age = 20.2 ± 2.5 years, female = 70.7%, freshman = 31.1%, sophomore = 22.6%, junior = 21.85%, senior = 24.44%), were studied during the Spring Semester, 2017. Students were enrolled in the Department of Health Sciences at a midsized comprehensive college in the Northeast. Students who enrolled in the study completed informed consent protocols and the pilot Mindset Intellectual Development Scale (MINDS) questionnaire during the first fifteen minutes of an undergraduate course offered in the department. A member of the research team proctored the data collection while the course instructor was absent. Before completing the questionnaire, students were instructed to reply as accurately as possible as their responses would remain anonymous and would not affect their course grade. Fourteen respondents from the sample failed to complete the demographic section of the MINDS; however, their responses were included into the data set.

Survey Creation

The pilot MINDS questionnaire represented an initial attempt to condense and unify the underlying constructs of metacognition in higher education. These constructs had previously been operationalized separately in one dimensional scales and included: mindset, intellectual development, goal orientation, and self-reflection. Each of these constructs was composed of multiple construct related items, or prompts. By combining these constructs together, the initial item pool of the pilot MINDS included 37-items (Figure 1a and 1b) in which the following steps were followed for item selection.

Step 1. Items were drawn from scales previously reported in peer-reviewed sources which had satisfactory validity and internal consistency. The mindset construct was comprised of eight items, four depicting each end of the continuum of the implicit

Figure 1a.

The initial 20 items of the pilot MINDS; which were previously described as operationalizing constructs known to influence student metacognition: mindset (Dweck, 2006) and intellectual development (Baxter Magolda, 1992).

category	Item	**Mindset:**
fixed	M1	My intelligence is something very basic about me that I can't change very much.
fixed	M2	I can learn new things, but I can't really change how intelligent I am.
fixed	M5	I am a certain kind of person, there is not much that can be done to change that.
fixed	M7	I can do things differently, but the important parts of who I am can't be changed.
growth	M3	No matter how much intelligence I have, I can always change it quite a bit.
growth	M4	I can always substantially change how intelligent I am.
growth	M6	No matter what kind of person I am, I can always change substantially.
growth	M8	I can always change basic things about the kind of person I am.

category	item	**Intellectual Development:**
absolute	I1	All knowledge that matters is certain; all points of view are either right or wrong.
absolute	I2	I believe that authorities have knowledge and the responsibility to communicate it.
absolute	I3	My job is to memorize and repeat the knowledge.
transitional	I4	I believe that some knowledge is certain and some is not.
transitional	I5	I believe that authorities have responsibility to communicate certainties.
transitional	I6	I must make my own judgments regarding the uncertainties.
independent	I7	I believe that most knowledge is uncertain.
independent	I8	I take responsibility for my own learning rather than rely on authorities.
independent	I9	I believe that all knowledge is contextual and individually constructed.
contextual	I10	I take responsibility for making judgments in the face of uncertainty.
contextual	I11	I use all possible sourcces of evidence to make conclusions.
contextual	I12	I remain open to changing my conclusions if new evidence is found.

theory of intellegence: entity (fixed) vs. incremental (malleable; Dweck, 2006). The mindset scale relating to intellegence was chosen as students' implicit theories of their intelligence have been shown to predict resilience and academic outcomes when they are faced with challenging work (Blackwell, Trzesniewski & Dweck, 2007; Yeager & Dweck, 2012). Across 6 previously reported studies, measures of the implicit theory of intelligence have shown a high internal consistency (Cronbach's alpha = .94 - .98; Dweck, Chiu & Hong, 1995).

The intellectual development construct was composed of twelve items, three for each of the four stages of the continuum described by Baxter Magolda (1992). The four levels of intellectual development represent the construct of personal epistemological reflection as socially constructed and context-bound (Baxter Magolda, 2004). These levels of intellectual development emerged from an operationalizing scheme based on empirical data from more than 1,000 undergraduate students (Baxter Magolda, 2004) and have an internal consistency range of .62 - .82 (Baxter Magolda, 1988).

The goal orientation construct consisted of ten items, four each for the dichotomy (extrinsic vs. intrinsic) and one each depicting leadership and responsibility (Pintrich et al., 1993). These motivational items were based on the general social-cognitive model of motivation, specifically the value contructs which focus on the reasons why students engage academically. The intrinsic goal orientation items represent a student's focus on learning and mastery and have an internal consistency of .74, while the extrinsic goal orientation items represent a student's focus on grades and the approval of others and have a Cronbach's alpha of .62 (Pintrich et al., 1993).

The self-reflection construct was composed of seven items: four construct-related items (Aukes, Geertsma, Cohen-Schotanus, Zwierstra, & Slaets, 2007), and three validity items depicting social desirability (Ballard, 1992) so as to control for responses distorted by one's desire to present themselves as socially agreeable (Devellis, 2016). Self-reflection was described as the introspective appraisal of experience occurring as a prerequisite for reframing

Figure 1b.
The remaining 17 items of the pilot MINDS; which were previously described as operationalizing constructs known to influence student metacognition: goal orientation (Pintrich et al., 1993) and self-reflection (Aukes et al., 2007).

category	item	**Goal Orientation:**
extrinsic	G1	Getting a good grade is the most satisfying thing for me right now.
extrinsic	G4	The most important thing for me is improving my GPA.
extrinsic	G5	I want to get better grades than most other students.
extrinsic	G8	I want to do well because it is important to show my ability to my friends and family.
intrinsic	G2	I prefer course material that really challenges me so I can learn new things.
intrinsic	G3	I prefer course material that arouses my curiosity, even if it is difficult to learn.
intrinsic	G6	I want to understand the content as thoroughly as possible.
intrinsic	G7	I choose assignments that I can learn from even if they don't guarantee a good grade
general	G9	My goal is to take personal responsibility for my work.
general	G10	My goal is to take the opportunity to practise my leadership skills.

category	item	**Self Reflection & Social Desirability:**
self reflection	R1	I examine my own habits of thinking.
self reflection	R2	I am able to view my own behavior at a distance
self reflection	R7	I want to know why I do what I do.
self reflection	R8	When I read or hear a conlcusion in class, I think about possible alternatives.
soc desirabty	R3	I'm always willing to admit when I make a mistake.
soc desirabty	R5	I am always courteous, even to people who are disagreeable.
soc desirabty	R6	No matter who I'm talking to, I'm always a good listener.

one's beliefs (Aukes, Geertsma, Cohen-Schotanus, Zwierstra, & Slaets, 2007). The social desireability bias is understood as the tendency in self reports to present oneself in the best possible light at the expense of accurate reporting. The internal consistency for the self-reflection construct items has been reported to range from .83 - .74 (Aukes, Geertsma, Cohen-Schotanus, Zwierstra, & Slaets, 2007). The short form Marlowe-Crowne social desirability items' internal consistency has been reported to be .70 (Ballard, 1992).

Step 2. Each item was operationalized by assigning a five point Likert Scale (1 = strongly disagree, 5 = strongly agree) to the prompt so that students could rate how important the item was to their course work.

Step 3: The items were randomized and then divided into four groupings to increase ease of use for students.

Survey Analysis

The pilot MINDS data set was evaluated using Principal Component Analysis (PCA, SPSS) in order to determine the orthogonal dimensionality (independent dimensions) of the scale and to reduce the item number. The PCA included varimax rotations and standardized factor loading procedures which cluster items onto dimensions based on shared variance space. Pearson product moments ($p < .01$) were used to assess relationships between scale items vs. social desirability, as well as scale items vs. age, sex, and year in college.

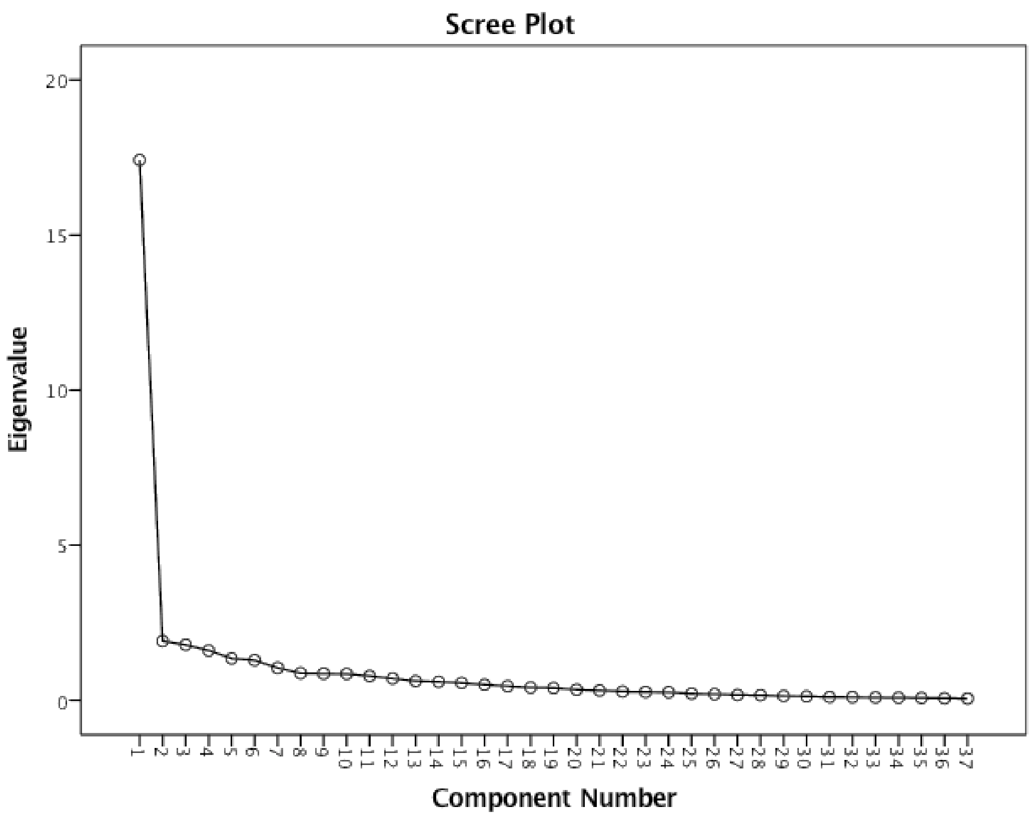
Results

The PCA indicated that seven orthogonal components achieved threshold for retention (eingenvalues > 1) and explained 71% of the shared variance space (Table 1). The first two components explained 50.6% of the shared variance space, and diminishing returns were seen for the remaining five components, each explaining from 3.5 – 4.5% (Figure 2). Thus, the first two principal components were retained for further analysis, each representing an orthogonal dimension of undergraduate student metacognition. Decisions to retain components were made with the Taraban, Kerr, Rynearson, and Kerr (2004) criteria in mind: 1) eigenvalue is greater than one; 2) the factor accounts for a significant proportion of variance; and 3) the component is located on the curvilinear portion of the scree plot. Each had a factor loading value beyond the .3 - .35 threshold that researchers commonly use when analyzing a PCA.

Table 1
Total Variance Explained, Rotation Sums of Squares Loadings for the Seven Orthogonal Dimensions With Eigenvalues > 1. The first two components were chosen for further analysis and explained 50.6% of the total variance from the pilot MINDS.

Eigenvalue	% Variance Explained	Cumulative % Explained
16.815	45.446	45.446
1.905	5.148	50.595
1.734	4.687	55.281
1.660	4.485	59.767
1.658	4.480	64.247
1.321	3.571	67.818
1.303	3.521	71.338

Figure 2
Scree plot of the components of the pilot MINDS in descending order of variance explained, where diminishing returns were seen after the second component.



The first principal component (Table 2) explained 45.4% of the shared variance space and was composed of Intellectual Development (five items) + Self-reflection (three items) + Responsibility (one item) + Mindset (one item) + Goal orientation (one item) + Leadership (one item). Though the first principal component captures items primarily from the intellectual development dimension, the other original dimensions also merged onto this array suggesting that the underlying construct represented a broader construct of Intellectual Maturity.

The second component (Table 3) explains 5.14% of the shared variance space and was composed of four items from the original mindset dimension. Thus, the second dimension can be thought of as representing Mindset.

The results of the PCA indicate that the MINDS had two orthogonal principle components (dimensions): Intellectual Maturity and Mindset, which explained

50.6 % of the shared variance. These dimensions were composed of sixteen items (Intellectual Maturity = 12 items; Mindset = 4 items). Thus, 21 of the original 37 pilot MINDS items were removed as a result of the PCA. Further, the dimensionality of the MINDS was reduced from the original four dimensions to two orthogonal dimensions.

Pearson's correlations ($p < .01$) of social desirability vs. Intellectual Maturity items indicate that 5 items were significantly and strongly related: I7 (r = .662), R1 (r = .759), I6 (r = .709), M3 (r = .478) & R7 (r = .746). These items were removed from the scale as they were strongly confounded by the social desirability bias. Two items showed no significant correlation to social desirability: R8 (r = .062) & I5 (r = .136). Five items showed significant ($p < .01$) but weak correlations to social desirability: I12 (r = .265), G3 (r = .168), G10 (r = .187), I10 (r = .192) & G9 (r = .234). These items were retained, but the Intellectual Maturity component should be interpreted with caution as social desirability influenced student responses to a weak degree. Pearson's correlations of social desirability vs. items from Mindset indicate that item M2 was significantly and strongly related (r = .500) and was removed from the scale due to the confound of the social desirability bias. Inclusion of items of the Intellectual Maturity component which were weakly correlated to social desirability was tolerated as the amount of overlap of the constructs was minimal and future interpretation of average tendencies and individual differences of the MINDS will control for this confound by including an item representing this bias.

Therefore, assessing the relationship of social desirability to the two orthogonal dimensions of MINDS indicated that six of sixteen items are strongly influenced by social desirability and were discarded, leaving a ten item, two-dimension scale of mindset and intellectual maturity. The final version of Intellectual Maturity includes the following seven items: intellectual development (I5, I10, I12) + goal orientation (G3) + responsibility (G9) + leadership (G10) + self-reflection (R8). The final outlay of Mindset includes the following 3 items: mindset (M6, M7, M8). An item representing social desirability (R5) was included for future control purposes, bringing the final total of MINDS items to eleven (Figure 3).

Correlations of the final eleven MINDS items to student age, sex, and year in college indicated that the first principle component, Intellectual Maturity, was significantly ($p < .01$) but weakly correlated to: age (I12, r = .163), sex (I12, r = .156), and year in college (G3, r = .162). Age and year in college had positive correlations with Intellectual Maturity, and women scored significantly higher than men on the Intellectual Maturity component. The second principle component, Mindset, was not found to correlate to age, sex, and year in college.

Table 2
The Rotated Factor Loadings for the First Principal Component, Intellectual Maturity, Which Show the Constituent Items and the Strength of Their Relationship.

Item	Factor Loading
Goal - respns G9	.954
Indev - cont I10	.938
Indev - trans I6	.932
Mind - grow M3	.927
Indev - ind I7	.923
Indev - cont I12	.916
Goal - intr G3	.915
Selfrefl R1	.913
Goal - ldrsh G10	.912
Indev - trans I5	.883
Selfrefl - crthk R8	.877
Selfrefl R7	.864

Table 3
Rotated Factor Loadings of the Second Principal Component, Mindset, Which Show the Constituent Items and the Strength of Their Relationship.

Item	Factor Loading
Mind - fixed M5	.634
Mind - fixed M7	.614
Mind - fixed M2	.419
Mind - grow M8	-.536

Figure 3

The Final 11 - item Mindset, Intellectual Development Scale (MINDS) Including Two Orthogonal Dimensions: Mindset (Q1 – 3) and Intellectual Maturity (Q4 – 10), as well as, a Social Desirability Control Question (Q11).

Instructions: mark to the right of each statement how important it is to your college course work.

Q	Item		strongly disagree	disagree	no opinion	agree	strongly agree
1	M6	No matter what kind of person I am, I can always change substantially.	1	2	3	4	5
2	M7	I can do things differently, but the important parts of who I am can't be changed.	1	2	3	4	5
3	M8	I can always change basic things about the kind of person I am.	1	2	3	4	5
4	I5	Authorities have responsibility to communicate certainties.	1	2	3	4	5
5	I10	Students take responsibility for making judgments in the face of uncertainty.	1	2	3	4	5
6	I12	Students remain open to changing their conclusions if new evidence is found.	1	2	3	4	5
7	G3	I prefer course material that arouses my curiosity, even if it is difficult to learn.	1	2	3	4	5
8	G9	My goal is to take personal responsibility for my work.	1	2	3	4	5
9	G10	My goal is to take the opportunity to practise my leadership skills.	1	2	3	4	5
10	R8	When I read or hear a conclusion in class, I think about possible alternatives.	1	2	3	4	5
11	R5	I am always courteous, even to people who are disagreeable.	1	2	3	4	5

Discussion

The purpose of developing a practical composite scale to assess undergraduate student mindset and intellectual development was to have a tool to effect positive change in their metacognitive state, as well as to defuse resistance to collaborative learning. The unique contribution of the MINDS is that it offers educators a concise composite measure of mindset and intellectual maturity to be used to identify students' metacognitive states. The MINDS was shown to capture mindset and intellectual maturity dimensions independently, which is consistent with Dweck's idea that one's self-theory underlies one's many attributes (2006).

Of interest was the formation of the Intellectual Maturity dimension from the merging of the Pintrich's (1993) construct of goal orientation and Baxter Magolda's (2004) construct of personal epistemology (intellectual development). The collapsing of these constructs makes sense given the previously described link between students' intellectual development and their goal orientation (Felder & Brent, 2004). In addition, the merging of items into one dimension avoids the multicollinearity problems of highly related subscales. Thus, the MINDS dimension of Intellectual Maturity was seen to uniquely capture variance related to a robust description of a student's metacognitive development, which includes both their intellectual development and goal orientation.

The self-reflection items of the Intellectual Maturity component assess students' attitudes toward authorities and their roles in critiquing information to draw conclusions (Sobral, 2005). Students displaying these metacognitive attributes embrace challenges as opportunities while assuming responsibility for the outcomes of the decisions they make in their learning journey. These metacognitive traits would enable students to adjust to the active role of collaborative learning and minimize their fear and resistance to education paradigms beyond the traditional passive role (Terenzini, Cabrera, Colbeck, Parente & Bjorklund, 2001). Ideally, through collaborative learning experiences, students will take agency over their learning, engage in critical thinking processes, and embrace the opportunity to be life-long learners (Springer, Stanne & Donovan, 1999). As the MINDS captured core metacognitive aspects of Intellectual Maturity, it may serve to document and foster students' intellectual development in the collaborative learning environment.

Metacognitive knowledge (Dunn, Lo, Mulvenin & Sutlcliffe, 2012) is defined as the awareness students have about themselves which informs both a current task, as well as the students conceptions of themselves as learners and problem solvers (Desautel, 2009; Zepeda, Rickey, Ronevich & Nokes-Malach, 2015). Gathering, processing, and incorporating new information can be seen as the constant in a learning situation rife with uncertainty. A learner needs to be comfortable with that process if the learner is to progress along the stages of intellectual development (Baxter Magolda, 1992). Experts, educators, facts, and theories do not provide answers (as we see in epistemic stages of absolute and transitional, knowing Baxter Magolda, 1992); rather, they are inputs in the feedback loop that an intellectually mature learner draws from. In this way, the MINDS may assist students in advancing towards the goal of becoming contextual knowers who operate at a high level of intellectual development. In addition, students may be able to ascertain their mindset using the MINDS and be able to develop confidence in their abilities to solve new problems and tackle new educational challenges.

The MINDS scale may also help instructors reach their students by better understanding the impact of the Mindset construct that emerged from the PCA, which does not reference intelligence. The three Mindset items focus on being able to change the kind of person one is or the important parts of who one is, what Dweck (2006) calls the personality mindset (compared to the intelligence mindset). These broader constructs of mindset represent a flexible self-concept that transcends intelligence. Participants who viewed themselves as able to change have more agency over their self-concept and likely feel they have agency over their experiences and circumstances; thus, they have a growth mindset.

Because the initial item pool was grounded in scales previously reported in the literature and due to the plausible theoretical explanation for the two orthogonal dimensions, we believe that MINDS has the necessary construct validity for capturing two independent metacognitive dimensions which elucidate undergraduate students' frame of mind and comfort with learning. While the internal consistency of the items used in the MINDS has been previously reported as acceptable, a limitation of the present study is that both the predictive validity and the test-retest reliability of the MINDS remains unknown. Future longitudinal study is needed to determine how well one's MINDS score predicts an academic outcome such as a course grade or critical thinking. Additional work is need to assess the stability of one's Mindset score (perhaps across various abilities), as well as how modifiable it is to collaborative learning. We have demonstrated and attempted to control for the social desirability response bias; however, it is likely that other confounds exist for the MINDS as 50% of the variability remains unexplained. Because the results of the MINDS generalize to undergraduate Health Science students, future work is required to know if it captures metacognitive constructs for students of different sexes, age groups, and majors.

In spite of these limitations, we believe the value of the MINDS remains as an assessment of a student's current metacognitive state so as to group students for collaborative learning, develop scaffolding criteria for the zone of proximal development, and to assess the student's intellectual development across time. The MINDS is a concise assessment which can be given in class and takes approximately 15 minutes. However, future work is required to clarify the meaning of the MINDS scores by determining item response values for students grouped by cognitive performance. Pending such clarification, caution is urged when implementing and interpreting the MINDS.

Conclusion

The eleven-item, two-dimensional Mindset and Intellectual Development Scale (MINDS) captured a Mindset construct independently from an Intellectual Maturity construct while controlling for the social desirability response bias. The Intellectual Maturity dimension collapsed several different constructs of metacognition including intellectual development, goal orientation and self-reflection, suggesting a robust representation of the construct.

Thus, the MINDS may serve as an assessment of a student's self-appraisal of their learning, information which can be used to develop a student's personal theory (Dweck, 2000), as well as provide for the opportunity for the purposeful review of a student's intellectual development as a learning outcome.

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