Measuring Activation: The Act Lab App

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Rationale

Science Learning Activation is a theoretical conception of a key malleable factor that positions children for successful long-term engagement with science (in and out of school), building up recent advances in cognitive and affective research literatures. The Lab has developed an assessment (Science Learning Activation Assessment) to measure children’s (ages 10-15) levels of the dimensions (fascination, values, perceived autonomy, competency beliefs, and scientific sensemaking) of the construct of science learning activation. This poster describes the current and emerging state of this assessment and the App we are developing to administer it.

Why did we develop an App?

- Digital environment offers improved processing time and accuracy over paper-pencil format.
- Dedicated App allows for data collection when Wi-Fi is not available or is unreliable (field trip, classroom, etc.).
- Integrated “back-end”, dedicated sessions, merge data and code student responses.
- It is “fun.” User Interface (UI) does not feel like a school test.

Who would use this app?

- Researchers of science learning activation.
- Evaluators of science learning experiences.
- Educators interested in assessing science learning activation.

Values

By values science we mean that the learner understands various interactions of self with science knowledge and skills and places value on those interactions within their social context. This dimension draws upon identity development theory (Tan & Barton, 2007), however it also considers the ways in which learners value science value (1) the knowledge learned in science, (2) the ways of reasoning used in science, (3) the role science plays in their own families and community contexts, and (4) others’ perceptions of science learners that value science are more likely to identify it as a possible career, as they believe it is worthwhile and a valuable pursuit. We hypothesize that those who value science and the role it plays both in their own lives and in society are more likely to engage in learning science in and out of school whether or not they find it fascinating.

Example Items:

1. In general, I find science:
   - I want to learn as much as possible about science.
   - I find learning science activity is over, I can’t stop thinking about it.
   - In general, when I work on science: I like it / I dislike it; enjoy it/don’t enjoy it; love it/hate it.

Perceived Autonomy

Perceived autonomy includes both noticing that there are choices to be made in a situation about science learning AND a sense of autonomy in making those choices. Although there is a large literature showing that interest, value, and self-efficacy are important motivational variables, we argue that they are not sufficient for predicting choices and engagement. If you do not perceive that there are choices to make (because the choice is not thought to be available to them) or that they have the authority to make choices (because others always make those choices for them), then you may not make the choice even if it involves interesting content, produces valuable outcomes, and you believe they are likely to be successful in the chosen situation. Many youth may have not been exposed to optional science learning situations during the elementary learning years, and thus this possible bottleneck to choice may be common. Further, a basic tenant in self-determination theory (SDT) of motivation (Ryan & Deci, 2000; Ryan & Deci, 2006) is that when youth have a feeling of autonomy in controlling their behaviors in a learning process they will be more likely to engage during learning.

Example Items:

1. When I do science activities in class, I can choose the amount of work that I put into it.
2. I can watch shows about science on TV at home if I want to.
3. I can find websites about science if I want to.
4. I can talk to an adult in my life about science-related things if I want to.
5. If there’s a school science club, I would be allowed to attend it.

Fascination

By fascination we mean emotional and cognitive attachment or obsession with science topics and tasks. Accordingly, this dimension includes aspects of what many researchers have referred to as curiosity (Harty & Beatty, 1984; Gardner, 1987; Linnenbrink, 1994; Umen & Spellerberg, 2003), interest in science both in and out of school (Hidi & Renninger, 2006; Kind et al., 2007; Reid, 2006; Osborne et al., 2009; Gardiner, 1975; Baram-Tsabari & Yarden, 2005; Dawson & Bennett, 1982; Gernandt, 1986; Gardner, 2001; Girod, 2001), and mastery goals for science content (Ames, 1992). It also includes affective elements such as emotions related to science, scientific inquiry, and knowledge. Research data in each of these areas suggests that these constructs may be contributing to engaging, persistence, and attainment in, as well as choice towards, science learning.

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Scientific Sensemaking

Our notion of scientific sensemaking denotes cognitive engagement with science-related content as a sensemaking activity using methods generally aligned with the practices of science. The behaviors associated with this cognitive engagement include asking good questions, seeking mechanistic explanations for natural and physical phenomena, engaging in argumentation about scientific ideas, interpreting data tables, designing investigations, and understanding the changing nature of science (Apedoe & Ford, 2010; Lehrer, Schaulze, & Petroczi, 2001). The literature suggests that scientific sensemaking will position a child well to engage in science learning (Zimmerman, 2005; Sanger et al., 2009; Tarch, et al., 2010). More specifically, engaging with science-related content as a sensemaking activity propels engagement in science learning, interest in choosing to spend time on further related activities, and the likelihood that learners will actually learn what is introduced/classified as science.

Example Items:

1.rijah wonders if the temperature of the water makes a difference in how much dolphins play. Which question is the best way to investigate this?
2. Seth says that dolphins are full after they eat 32 pounds of fish. Which piece of evidence in the table above makes Seth think this is true?
3. Yamena wonders if dolphins like to swim in shallow or deep water better. What should she do to answer her question?
4. What would make one scientific explanation better than another?
5. Scientists sometimes change their explanations. Why?
Science Learning Activation is a theoretical conception of a key malleable factor that positions children for successful lifelong engagement with science (in and out of school), building up recent advances in cognitive and affective research literature. The Lab has developed an assessment (Science Learning Activation Assessment) to measure children’s (ages 10-15) levels of the dimensions (fascination, values, perceived autonomy, competency beliefs, and scientific sensemaking) of the conception of the construct. This poster describes the current and emerging state of this assessment and the App we are developing to administer it.

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Example Items:

• I like to read about science.
• I enjoy thinking about science.

Values

By values science we mean that the learner understands various interactions of self with science knowledge and skills and places value on those interactions within their social context. This dimension draws upon identity development theory (Tan & Barton, 2007). However, it also considers the ways in which learners that value science value (1) the knowledge learned in science, (2) the ways of reasoning used in science, (3) the role science plays in their own families and community contexts, and (4) others’ perceptions of science. Learners that value science are more likely to identify it as a possible career, as they believe it is worthwhile and a valuable outlet. We hypothesize that those who value science and the role it plays both in their own lives and in society are more likely to engage in learning science in and out of school whether or not they find it fascinating.

Example Items:

• How important is it for you to learn about science?
• Do you think you could become a scientist someday?

Perceived Autonomy

Perceived autonomy includes both nothing that there are choices to be made in a learner’s environment about science learning AND a sense of autonomy in making those choices. Although there is a large literature showing that interest, value, and self-efficacy are important motivational variables, we argue that they are not sufficient for predicting choices and engagement. If youth do not perceive that there are choices to make (because the choice is not thought to be available to them) or that they have the authority to make choices (because others always make those choices for them), then they may not make the choice even if it involves internally high valued outcomes, and youth believe they are likely to be successful in the chosen situation. Many youth may have not been exposed to optional science learning situations during the elementary learning years, and thus this possible bottleneck to choice may be common. Further, a basic tenet in self-determination theory (SDT) of motivation (Ryan & Deci, 2000; Ryan & Deci, 2006) is that when youth believe they have control over controlling their behaviors in a learning process they will be more likely to engage during learning.

Example Item:

• When I do science activities in class, I can choose the amount of work that I put into it.
• I can watch shows about science on TV at home if I want to.

Competency Beliefs

Competency beliefs are a core construct in social cognitive theory defined as “an individual’s judgment of competencies that enables one to organize and execute courses of action required to attain desired levels of performance of a given activity” (Bandura, 1986, p. 36). In general, educational and psychological research has revealed that competency beliefs (or self-efficacy) are an important predictor of many of achievement behaviors (i.e., choice of task, effort, and persistence) (Schunk, et al., 2008). Educational and psychological research makes a clear distinction between learners’ actual competency and knowledge and their subjective judgment and perceptions of their knowledge. Further, this body of research also distinguishes between the role of actual and perceived competency in predicting learners’ achievement tests and achievement behaviors. For example, Lawson found that college students’ reasoning ability plays a more significant role than self-efficacy in predicting their achievement in science learning (Law & Ross, 2002; Lawson, Banks, & Logino, 2007). By contrast, learners with high self-efficacy beliefs are more likely to be behaviorally and cognitively engaged in a learning process in terms of choice, effort, persistence, and so on (Onwuehr & Collins, 2008; Onwuehr & Collins, 2008; Onwuehr & Collins, 2008; Onwuehr & Collins, 2008; Onwuehr & Collins, 2008; Onwuehr & Collins, 2008; Onwuehr & Collins, 2008; Onwuehr & Collins, 2008; Onwuehr & Collins, 2008). These definitions and subject-specific competency beliefs (e.g., reading) predicted their career aspiration. Thus, competency beliefs are relevant to both near-term and long-term decision making.

Example Item:

• I can do the science activities I get in class.
• I can answer all the questions on a science test in class.
• If I was asked to do something, I could understand what was going on.
• If I went to a science museum, I could figure out what is being shown in most areas of the museum.

Scientific Sensemaking

Our notion of scientific sensemaking denotes cognitive engagement with science-related content as a sensemaking activity using methods generally aligned with the practices of science. The behaviors associated with this cognitive engagement include asking good questions, seeking mechanistic explanations for natural and physical phenomena, engaging in argumentation about scientific ideas, interpreting data tables, designing investigations, and understanding the changing nature of science (Aposord & Ford, 2010; Lehrer, Schauerte, & Pinosso, 2000). The literature suggests that scientific sensemaking will position a child well to engage in science learning (Klemmt & Neumann, 2009; Logvin, et al., 2010). More specifically, engaging with science-related content as a sensemaking activity propels engagement in science learning, interest in choosing to spend time on further related activities, and the likelihood that learners will actually engage in these activities (Balley et al., 2009).

Example Item:

• Elijah wonders if the temperature of the water makes a difference in how much dolphins play. Which question is the best to ask to investigate this?
• Seth says that dolphins are full after they eat 12 pounds of fish. Which piece of evidence in the table above makes Seth think this is true?
• Yael wonders if dolphins like to swim in shallow or deep water better. What should she do to answer her question?
• What would make one scientific explanation better than another?
• Scientists sometimes change their explanations. Why?

References