“I’m going to fail”: How youth interpret failure across contextual boundaries

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Abstract: Previous research on youth’s perceptions and reactions to failure established a view of failure as a negative, debilitating experience for youth, yet STEM and in particular making programs increasingly promote a pedagogy of failures as productive learning experiences. Looking to unpack perceptions of failure across contexts and potential differences between self-identified sexes, youth who participated in making activities were interviewed about their experiences with failure and thoughts about the term. Youth’s perceptions of failure fell into four categories: *failure as enhancing*, *failure as debilitating*, *failure as mosaic*, and *failure as fluid*. For the majority of youth (70%), their perception of failure transcended situational boundaries and was not entirely negative as previous research suggested. These results have implications on design of learning contexts and complicate prevailing understandings of youths’ failure experiences.

Problem statement

Within science, technology, engineering, and mathematics (STEM) education, failure has been viewed as the point in which an individual stops an activity (Thomas, 2014); as giving up or not trying (Lottero-Perdue & Parry, 2014); as not obtaining an expected goal or outcome (Bidjerano, 2010); and as a learning opportunity (Simpson & Maltese, 2017). Research has illustrated how youths’ reactions to failure include hopelessness, depression, embarrassment, negative self-feelings, decrease of interest in a subject area, and reduced time in extracurricular activities, to name a few (e.g., Guler, 2013; Riketta & Ziegler, 2007). Moreover, youth tend to attribute experiences with failure to external loci or factors out of their control (Weiner, 1986), such as boring presentations, unclear expectations, and task difficulty (e.g., Boruchovitch, 2004). As such, the presence of failures within and educational experience and youths’ reactions to failures typically dwell in a negative space, despite the promotion of failures to spur innovation or inventions (Martin, 2014).

However, an emerging literature on experiences of failure within the making context suggests that the added complexities of open-ended design (Litts et al., 2016), hands-on materials (Sheridan et al., 2016) and multiple resources and supports (Ryoo et al., 2015) have the potential to reframe failure in a more positive light. As such, the focus for this study was on making contexts as failure is considered an inherent and productive part of making (e.g., Martin, 2015), which may drive learning through reflection and the process of coming unstuck (Kapur, 2008). We present this work to continue building upon this making-related scholarship by posing the following research question: *How does youths’ view of failure transcend beyond making contexts and activities, if at all?* We define *making contexts* as situations or spaces that invoke the creation of a tangible (e.g., robot) or digital object (e.g., computer program) for a purpose or play (Vossoughi & Bevan, 2014). *Making activities* are defined as the type of task, problem, and/or investigation the maker is engaged including the available tools, materials, human resources, and support.

Theoretical grounding

This study is grounded in the notion of boundaries, specifically the concepts of boundary objects and boundary crossing (Akkerman & Bakker, 2011). *Boundary objects* are defined as concrete or abstract artifacts that inhabit multiple intersecting sites and can “adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites” (Star & Griesemer, 1989, p. 393). Here, we conceptualize the word *failure* as a boundary object that has different meanings for different people across multiple contexts, known as a boundary crossing. As such, a *boundary crossing* is defined as transitions or interactions across sites (Suchman, 1994). In this study, boundary crossings include making, academic, and sporting contexts, among others. This theoretical grounding also affords researchers to consider the potential of boundary objects to invoke learning opportunities for youth (Akkerman & Bakker, 2011).

Methodology

This study is part of larger study in which we are examining how youth and educators attend, interpret, and respond to failure while engaging in making and tinkering activities. This particular study was situated within two locations that implement maker programming for youth, an informal educational setting (i.e., museum) and a formal educational setting (i.e., public middle school), both within the United States. Youth in grades 4-8 (ages 9-14) volunteered to be interviewed regarding their perception and experiences with failure after participating in making-related activities within one of three contexts (i.e., summer camp, drop-in, school), and how this compared to their perception and experiences with failure in other areas of their life. We interviewed 133 youth: 43 in an academic setting, 46 enrolled in a week-long maker focused summer camp held at a science museum, and 44 in an informal drop-in exploration setting at the same museum. Participants across the three contexts were engaged in a variety of making-related activities, which we categorized using Bevan's (2017) three types of educative Maker activities - *assembly, creative construction,* and *tinkering.* Assembly refers to activities that are structured or procedural; creative construction to activities that were based on a pre-set design goal and included some constraints; and tinkering to activities that provided opportunities for exploration and experimentation without a goal in mind. Interviews averaged 13 minutes in length and were transcribed verbatim.

Data analysis

Each interview was analyzed by two researchers using a constant-comparative holistic coding process as the research team had an idea of what might emerge from the data based on experiences with youth in makerspaces (Fram, 2013; Saldaña, 2013). Researchers read and reread through each interview to gain an understanding of youths' mindset around failure across various sites. Specifically, we utilized and built upon Dweck's (2006) scholarship on fixed and growth mindsets. As argued by Dweck, individuals' mindsets tend to change based on context (e.g., mathematics versus art class). From our analysis, four categories surfaced: *failure as enhancing*, *failure as debilitating*, *failure as mosaic*, and *failure as fluid*. *Failure as Enhancing* indicates a view of failure as an opportunity for growth and opens up a space for moving forward productively; a learning-oriented perspective. *Failure as Debilitating* indicates a view of failure as hindering one's progress and a need for help to continue toward one's goal or end product; a performance-oriented perspective. *Failure as Mosaic* indicates a view of failure as enhancing in some contexts and debilitating in other contexts. Lastly, *Failure as Fluid* indicates neither a positive or negative view of failure; allowing failure to direct a course of action through a "go with the flow" mentality. Next, we conducted two Kruskal-Wallis tests (by making context and by making activity) to determine if statistically significant differences existed among the four groups or four categories. If differences were found, researchers conducted post hoc Mann-Whitney U test to evaluate pairwise differences among the four groups. To control for Type I error, the researchers used the Bonferroni correction ($\alpha = .008$).

Findings

With the exception of *Failure as Mosaic* perspective, youths' views of failure did not change based on context or situation; thus, their views of failure seem to transcend multiple settings. Table 1 and Table 2 displays youths' perspective of failure based on the making context and the making-related activity, respectively. Descriptives are presented as number of participants and percentages.

Table 1: Youths' perspective of failure by making context.

	School	Summer Camp	Drop-In	Total
Failure as Enhancing	22 (16.5%)	17 (13%)	13 (10%)	52 (39%)
Failure as Debilitating	3 (2%)	13 (10%)	15 (11%)	31 (23%)
Failure as Mosaic	17 (13%)	15 (11%)	8 (6%)	40 (30%)
Failure as Fluid	1 (0.8%)	1 (0.8%)	8 (6%)	10 (8%)

Table 2: Youths' perspective of failure by making activity.

	Assembly	Creative Construction	Tinkering
Failure as Enhancing	15 (11%)	22 (16.5%)	15 (11%)
Failure as Debilitating	11 (8%)	14 (10.5%)	6 (4.5%)
Failure as Mosaic	11 (8%)	23 (17%)	6 (4.5%)
Failure as Fluid	0 (0%)	2 (1.5%)	8 (6%)

Failure as Enhancing is exemplified by youths' view of failure as a means to make improvements either in the process of making, or in not manufacturing the same "mistake" the next time whether in school, in making, in cooking or in sporting events. In other words, failure is viewed as an opportunity to learn regardless of context. For example, a youth in the academic setting stated, "Setbacks and failure can both teach you. Whilst I was working with this I tried out several tools and several tools failed so I have more of an understanding of what they do and how to accomplish what I want." This was discussed within a three-dimensional design of a fictional starship from a popular television show, as well as within mathematics. Fifty-two of the 133 youth (39%) in this study exhibited this perspective.

Failure as Debilitating is similar to a fixed mindset; framed here as a negative view of failure personally (e.g., low confidence) and in limiting one's progress toward the end product or expected outcome. Youth are not concerned with learning from failure, but focused on completion and correctness. For instance, failure implies hopelessness in the following quote.

> When something breaks or something doesn't go correctly, and you can't do anything about it. Like if you lost something and you can't re-find it. . . . When you get an assignment wrong and you can't redo it or if you take a test and you miss the whole thing, you can't redo the test.

As with *Failure as Enhancing*, this perspective transcends multiple contexts and was expressed by 31 of the 133 youth (23%) in this study.

Failure as Mosaic does not transcend sites as youths' perspective of failure changes based on context. In this study, views within making context were typically *Failure as Enhancing*, while views in other contexts, academic contexts for example, were typically *Failure as Debilitating*. For example, one youth noted how the camp setting was less serious and expressed having the ability to try new things, whereas failure in a school setting was more serious and may lead to one stating, "I'm going to fail. I'm not going to make it." Moreover, this perspective of failure varied by classroom contexts, school subjects, and/or academic tasks. The following quote captures this idea. "There's a difference between my core classes and this class because, in this class [Creative Design], if you fail you can re-do it. And, in other classes, you can't retake tests multiple times." In this study, 40 of the 133 youth (30%) did not view failure the same across multiple sites or boundary crossings.

Failure as Fluid was less often expressed by youth in this study (n = 10, 8%). One youth building any structure or object using small rubber bands and small wooden dowels commented, that after his structure fell apart, "I don't really know what I did, I just started putting sticks together. I just put more rubber bands on it." Upon further probing, the youth was unable to articulate how he decided to make changes. As exemplified in this quote, failure is not positioned as a learning opportunity (i.e., *Failure as Enhancing*) nor as being detrimental (i.e., *Failure as Debilitating*), but as some thing or abstract boundary object that just occurs and tends to work itself out for better or for worse.

Lastly, in conducting Kruskal-Wallis tests, a significant difference was found for how youth viewed and experienced failure in different learning environments based on the making activity ($\chi^2(3, 133) = 14.205$, $p = .003$), but not the making context ($\chi^2(3, 133) = 5.438$, $p = .142$). The follow-up analysis revealed that youth with a *Failure as Enhancing* perspective ($p = .002$), *Failure as Debilitating* perspective ($p = .001$), and *Failure as Mosaic* perspective ($p = .0001$) differed significantly from youth with a *Failure as Fluid* perspective.

Significance & Implications

More often than not (approximately 70%), youths' views of failure in this study transcend across boundaries or contexts, as well as making activities. These views were framed as opportunities for growth (i.e., *Failure as Enhancing*) more often than views framed as limiting one's progress (i.e., *Failure as Debilitating*), 39% and 23%, respectively. This finding seems to both confirm and contradict research that situates failure as only a negative experience (e.g., Guler, 2013). It seems that youths' views of failure are on par with professionals across STEM fields (Simpson & Maltese, 2017). Additionally, youth continuing to view failure as a negative experience regardless of context, particularly in a making setting where there is a focus on rapid prototyping and celebrating failure as part of the process of creative design (e.g., Martin, 2015), is of concern as it diminishes the opportunity to learn across boundaries.

Furthermore, about 30% of youths' views of failure in this study did not transcend across boundaries, but changed based on context and making activity. Youth who expressed *Failure as Mosaic* most often exhibited *Failure as Enhancing* during making-related activities, implying the potential power of making in shifting one's view of failure across multiple sites, which in turn may invoke learning opportunities for youth (Akkerman & Bakker, 2011). This may indicate a transition to viewing failure as a learning opportunity regardless of contexts; hence, transitioning to a view of failure that transcends boundaries. Likewise, youth here expressed *Failure as*

Debilitating during school contexts, and even sporting events, as youth were typically not afforded an opportunity to re-do mistakes and/or failures. Therefore, a change in the learning context and/or task could potentially shift these youths' views of failure within an academic setting from negative experiences to positive experiences.

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