



Valued Defiance - Teachers' View on STEM and Students (fundamental, diversity)

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Introduction

In western societies, we value innovation, creativity, “outside the box thinking”, “pushing boundaries”, “challenging paradigms” and “coming up with new solutions” - particularly in STEM education (Hart Research Associates, 2015). Nevertheless, when we see these behaviors in our young learners, we try to shut it down (Ripley, 2016) and call them misbehaving students or “troublemakers”. Many teachers, for example, value compliant originality and conforming behavior over independent thinking (Beghetto, 2016). Kids will defy; the ones who can make productive use of it will become successful and productive members of society. Negative classroom management styles like suspension are often used due to what the teacher interprets as misbehavior (c.f., Lewis et al., 2008). Unfortunately, a large number of students, who are defiant and do not have the tools to adept, do disengage, lose interest and drop out of school.

Furthermore, negative disciplinary actions in an US-context are immoderately applied to non-white children, especially African Americans and Hispanics (Blomberg, 2004; Losen et al., 2015; Townsend, 2000) and though students of color and underrepresented minorities (URMs) are disproportionately more likely to be suspended and labeled “troublemakers” by their teachers, and thus suffer negative outcomes. But what did they do to be labeled “troublemaker”?

Bowditch (1993, p. 499) defines “troublemaker” in a rather criminal perspective as “students whose conduct is consistently at odds with normal school discipline,” e.g. damage or theft of school property, assault on school employees, physical abuse of another student, possession of weapons, drugs or alcohol, disruptive or offensive languages, etc.

Marsh et al. (2001, p. 412) propose a vague and circular definition of “troublemakers” as “students getting into physical fights, getting into trouble, and being punished for getting into trouble.”

More recently, Kwon et al. (2017, 2018) define “troublemaker” in a more cognitive/motivational way as students who have poor academic achievements, are not willing to study hard, and show delinquent or defiant behaviors at school.

From these definitions, we may conclude that “troublemakers” are students who have bad academic performance, hate to learn, frequently violate school rules, and show misbehavior in general. However, not all researchers deem troublemaking behaviors as bad. A more humanistic definition comes from Shalaby (2017), who described a “troublemaker” as a canary in a cage. She believes that “troublemakers” are students who explore the free mind and want to develop themselves in different ways.

For our research study, we adopt a positive psychology perspective. In this context, school and teacher variables have been widely neglected in “troublemaker” research (Fenning & Rose, 2007; Tajalli & Garba, 2014; Townsend, 2000). However, if one wants to particularly generate an engaged and positive emotional atmosphere and increase URMs participation in schooling and STEM, research needs to understand the nature of these disparities better. When and why are students believed “troublemakers” by teachers, how is a “troublemaker” defined from a teacher and a student perspective, how does the “troublemaker” status and teachers’ consequent reaction and behavior impact students and how to positively integrate “troublemakers” into schooling?

Although there is a large body of student misbehavior research, “troublemakers” have not been in the focus of studies, yet. In order to establish a basis for “troublemaker”

research, this paper seeks to explore teachers' views on troublemakers with the following research questions:

- What are teacher beliefs about “troublemaker” students’ potential achievement in STEM fields?
- How situational are teachers’ subjective theories of troublemaking behavior and troublemakers?
- What is the teachers’ existing range of interpreting troublemaking behavior?
- What are situational factors that shape the view of teacher on a student’s behavior in STEM instruction?

These questions a) serve as guidelines in the unbiased exploration of teachers’ views on “troublemaking” students, and thus do not explicitly include ethnic or gender aspects; b) The questions and the data acquisition methodology are designed to allow for variance in the definition of “troublemakers”; and c) are meant to allow teachers a deep review of what they had experienced in their career.

The overall goal is to have teachers and their perceptions as a starting point in an under-researched phenomenon, and to determine a basis for both, in depth and extensive, research on “troublemakers” including student and/ or parent views on “troublemaking” behavior.

Literature Review

Factors Causing Student Misbehaviors

Previous researchers have studied what factors may or lead to students’ troublemaking behaviors at school or in the classroom. A large-sample study indicated that sex, race, age, peer bonding, students’ trust in school rules, school involvement, and school effort had a

significant impact on student misconduct (Welsh et al., 1999). More specifically, Lee and Sondra (2005) found that students' self-perception of reputation, socioeconomic status, and school bonding were factors that led to their misbehaviors at school; McMinn (2006) claimed that students from a minority family, a single-parent family, or a low-income family are more likely to have misbehaviors at school, but she found no significant correlation between teachers' perception of students and students' misconducts; and Free (2014) reported a negative correlation between students' affiliation and belief bonds to school and their misconduct in the classroom: the less a student perceives that the school rules are fair, the more probably the student may become a "troublemaker" in the classroom. Different findings also exist. For instance, Cernkovich and Giordano (1992) stated that racial differences did not significantly affect school bonding on students' delinquency. That is, racial difference is not necessarily a factor causing student misbehaviors at school.

Previous studies also explored factors from the teachers' perspective. According to the results of a survey-based study, teachers believed that violence in using media (e.g., instant messaging, online discussion, etc.), broken families, and drug and alcohol use are three main causes of students' troublemaking behaviors (Greenlee & Ogletree, 1993). Furthermore, a good relationship with students and parents may help teachers to well manage the misbehaviors in classroom (Rampaola Mokhele, 2006), while lower teachers' expectation of students' performance or behaviors will lead to less support from teachers and thus a higher rate of students' misbehaviors at school (Demagnet & Van Houtte, 2012).

Teachers' attitudes and disciplinary strategies may impact student misbehaviors. For example, the more teachers trust their students, the more support teachers will provide to

students, while the less teachers do, the more extrinsic incentives will be used to motivate students (Woolfolk et al., 1990).

Additionally, previous researchers demonstrated that there was a negative correlation between teachers' stress level and their tolerance of student misbehaviors (Kokkinos et al., 2005) and that the extent of student misbehaviors is closely related to teachers' classroom management styles (Bru et al., 2002).

Impact of Misbehaviors on Students in STEM

Ibrabim and Johnson Jr. (2020) found that misbehaved students who suspended from schools would lead to lower math achievement. Finn et al. (2008) found that misbehaviors of high school students will not only affect their academic performance at high schools but also impact their entering and completion of a college program. Furthermore, a previous empirical study found that the eighth-grade seems to be an important watershed for students because misbehaviors in this grade significantly affect students' later educational attainment and future earnings from the labor market, especially for male students (Segal, 2013).

Misbehaviors not only impact students but also may impact teachers. Though novice STEM teachers mostly have positive expectations of their students (Jordan et al., 2017), as their perceptions of students' misbehaviors accumulate, they might feel tired of these behaviors and ultimately have a higher intention to quit their jobs (Tsouloupas et al., 2010).

In summary, teachers' perceptions of students and students' perceptions of schooling and their teachers have a significant impact on the well-being of students and teachers, and understanding the perceptions deeper, particularly how they relate to STEM education,

might be a starting point for improving classroom and school climate and the education of the next generation of STEM workers.

Methodology

Our exploratory research has been conducted using individual teacher interviews. Analysis followed both (a) a phenomenographic methodology (see Marton, 1986 for an introduction) by primarily focusing on and exploring the different views that teachers carry about defiance and (b) phenomenological research (Creswell, 2013) exploring commonalities of teachers' views on defiance. Both phenomenographic and phenomenological research are part of the interpretive paradigm of educational research (Guba & Lincoln, 1994). Both are concerned with phenomenon or experiences: While phenomenographic research works to uncover qualitatively different ways in which people experience or think about something (Beaulieu, 2017), phenomenological research focuses on the commonality of a lived experience. We chose both approaches in our study as we are equally interested in commonalities amongst our research participants as well as unique perspectives on how they experience what we loosely call "troublemakers". In the context of exploratory (case-oriented research), this methodological choice helps us to set a basis for further iterations in the data acquisition process, especially in terms of unexpected variables that may need deeper analyses.

Participants

Participants were six (6) STEM teachers from schools in the midwest area of the United States. Five of them were female, and one was male. Three of them taught in high

schools, one in a middle school, and one in an elementary school. Five of them had taught for more than ten years; only one of them had three years of teaching experience, but that teacher had worked in the industry for 23 years. Five of them taught in suburban schools; one taught in a rural school; none of them taught in urban schools. Only one teacher taught in a Title 1 school. The subjects they taught included science, biology, anatomy, and healthcare. A summary of participants' information can be found in Table 1 and Table 2.

Data Collection

Murphy et al. (2013) used interviews to study how female students perceived their compliant or non-compliant behaviors and how their interactions with teachers shape their view on their behaviors. We similarly conducted our six interviews. When doing the interview, we used a phenomenographic methodology, which allows us to get meaningful and reliable results with a small sample size (Åkerlind, 2012).

The interviews were conducted during March 2019, and the length of interviews ranged from 40 to 65 minutes. We used a human subject-approved protocol to guide each interview process, which included the purpose of the interview and let participants understand their rights during the interview. Then we prompted the demographic questions. After that, we asked the main questions which focused on how technology had impacted their teaching, how they perceive “troublemaker” students in their classrooms, what reasons they believed had made these students troublemaking, and how they see these students' probability to succeed in STEM fields in the future. In the end, we provided participants with opportunities to ask questions to us, and we clarified their concerns. We recorded the entire process of each interview.

Data Analysis

We transcribed the interview recordings using Otter (Otter.ai, 2020), which is an artificial intelligence (AI) supported online audio transcribing tool. After the transcription on Otter.ai, we also conducted manual checks to ensure the maximum accuracy of the transcription.

We used NVivo 12 Plus (QSR International Pty Ltd, 2018) to analyze the transcriptions of the interviews. We coded the transcription according to our research questions, clustered the text into several nodes (themes), and provided quoted evidence for each node (theme). We counted the frequency of interviewees' supports to each node (theme). We used a comparative case approach comparing teachers' views on STEM and attributes of defiance.

Results

Results indicate that teachers hold very common and shared conceptions of troublemakers, that their beliefs are fairly strong, and that there is a discrepancy about valued attributes of STEM and attributes of troublemakers. We present detailed analysis results in this section.

Any names that appear in the cited transcription are aliases that were used by the participants. For example, "*Anna does have an inquisitive mind.*" In this sentence, "*Anna*" is an alias used by the participant during the interview.

We used italic text in the brackets in the cited transcription for clarification purposes. For example, "*I have had some [students] that just do it [troublemaking behaviors]*"

because ...” In this sentence, “[students]” and “[troublemaking behaviors]” were added by the researchers to help readers understand the sentence better.

Any “...,” in the cited transcription indicates that the participant was thinking or hesitating at that moment. For example, “*She would ..., she had difficulties following directions and then also being motivated to do things on her own.*” In this sentence, “...,” after “*She would*” indicates that the participant stopped for a while at that moment and then continued to explain.

Participants’ Beliefs about Troublemakers’ Success in STEM Fields

We asked participants’ beliefs about the probability that their “troublemaker” students would succeed in STEM fields in the future. Two participants were optimistic about their students, while the other four showed negative opinions. Details can be found in Table 3.

The two participants who believed their students had a higher probability of succeeding in STEM fields mainly hold the following reasons:

- Students were inquisitive and wanted to understand things.
- Students could collaborate with other students.

For example,

P3, “*You know, he was an A student and was driven and wanted to understand things so he was inquisitive and you know, wanted to learn those things and problem-solving and he didn't have a problem collaborating with other people.*”

- As long as students do not just sit and write, but more to build and design.

For example,

P6, *“You know, I think that would be something and I think some of them like to be moving and up and, you know, not just sitting behind a desk. So, if it's something or they are building or designing, and they are getting up and moving around and not just sitting and writing on a piece of paper or typing on their Chromebook or whatever, that might be a possibility.”*

Other the other hand, the four participants who show pessimistic opinions to their students hold the following reasons:

- Will not go to college.
- No initiative to work hard.

For example,

Interviewer, *“How high do you rate chances that he entered STEM-oriented field or profession? Like science, technology, engineering, mathematics.”*

Participant #1, *“Probably not. I mean, he's probably just like working either in a factory or like a grocery store.”*

Interviewer, *“Why don't you think that he would go into a STEM profession?”*

Participant #1, *“Because he didn't go to college and he just ..., feel like ..., he didn't really have initiative to ..., to put forth the effort to be able to do something like that.”*

- Lack appropriate instruction.

For example,

Interviewer, *“Do you think this student might even, just in theory, pick up a STEM career in a professional field?”*

P2, *“No, I think he'll be a stand-up comedian, to be honest with you. [both laughed] Because, but ..., he could ..., he could ..., but I know he needs to find somebody who would nurture that in him.”*

- Hard to follow directions.
- Afraid of failures.
- Easy to give up.

For example,

P4, *“She would ..., she had difficulties following direction and then also being motivated to do things on her own.”*

Interviewer, *“Yeah.”*

P4, *“She struggled with accepting failure and learning from it and not giving up. She would ..., she often wanted to just give up and that was just it.”*

- Not confident enough.

For example,

P4, *“Anna does have an inquisitive mind. She does like thinking. She can be a thinker, one necessary. But she still needs a lot of confidence with that thinking.”*

- Bad relationship with the authority.

For example,

P5, *“I would say, you know, Mike probably does a pretty good job of relating with other students, but maybe has a little bit more difficult job of relating with authority. So, you know, sometimes, maybe it's just the relationship ...*

When asked what characteristics a successful STEM personnel should have, “Creativity”, “Learn from failures”, “Curiosity”, “Global perspective”, “Intrinsically motivated”, “Lifelong learner”, and “Persistence” are most frequently mentioned by all six participants. Details can be found in Table 4 and Table 5.

Teaching Differences between Today and When Participants Started to Teach

Most participants admitted that they had experienced many changes through their years of teaching experience.

For example, Participant #1 admitted that,

“They're totally different. I would say I definitely do a lot more hands-on and engaging type of things now.” and *“[When I was a beginner,] I probably did more like lecturing and worksheets.”*

P2 provided a lot of changes throughout her 23 years’ teaching experience,

“Well, I think there is more data collection than ever. There is, there's been a loss of respect for the teaching profession, and from students in general. There's more testing than we've ever done. And that kind of thing.”

“Well, I would say that we have more behavior issues than ever. As far as students arguing or talking back or that kind of thing, and then also violent outbursts behavior type.”

“We have schools that are ..., well, how do I put it ..., schools that are afraid of the parents.”

“When I first started teaching, it was whatever the teacher said, you know. But now it's [that] people are constantly questioning motives, teachers' motives and things like that.”

P3 described her changes in being more patient:

“I would say I'm still beginner but never, never ..., new things every year, but I would say I'm still ..., I progress to say that.”

“... and probably my struggles are more on being patient and waiting.”

P4 perceived drastic changes in technology but not in the content:

“When I first started teaching, they [students] did not have the technology; they did not have the capability of the pros of technology; and then they also did not have the distractions of technology.”

“Technology has changed drastically. The content hasn't changed drastically. The content is very ..., you know, there's different ways to present it, but the content itself has not changed.”

P5 shared his perception in both a rural school when he started to teach and a suburban school where he teaches now.

“I see kids, when I first started teaching in rural districts, [the students did] not really think too much about the next step, going to college, to stuff like that, a lot of logistics. [They thought about] still working on the farm or stuff like that. Whereas here [a

suburban school], I see a lot more kids thinking about colleges, like that, going that next level.”

“From what I started to present-day the last few years especially just overall kids, students, whatever you call them, kid students that their behavior has changed quite a bit. And I don't know if that really relates to rural, suburban, or dis-relate to the kids in general.”

P6 described technology changes throughout the past years and how she perceived that students became more anxious than those in the past:

“Technology obviously has changed a lot. You know, I'm in a school right now that we are one to one. And so, the kids all have their own device, which is a big change from ..., you know, going to a computer lab and, and using that.”

“I think the problem is that they [students] get off tasks and will want to play games or do something they're not supposed to do. That could be one of the things.”

“What other differences there are between kids when I first started teaching to now? Definitely, they're more anxious and wanting to know exactly what they have to do and if they don't get it done, they get very stressed, versus kids I first started teaching. I don't remember them being like that. And I mean, maybe they were. I don't recall, but they weren't like that.”

Table 6 summarizes how the participants experienced and perceived these changes.

Participants' Understanding of Typical Troublemaking Behaviors

We asked the participants about their observations of typical troublemaking behaviors from troublemaking students. The most frequently mentioned troublemaking behaviors include:

- Being defiant (6)
- Hate to learn (5)
- Being a distraction (3)
- Being impulsive (2)
- Being impolite (2)
- Other (4)

All six participants identified “being defiant” as the most typical troublemaking behavior. A troublemaking student may show disrespect to a teacher by using bad words or through challenging a teacher. More often, a defiant behavior is mixed with several different behaviors or intentions. For example, Participant #1 described a troublemaking student like this:

“He was a bright student. But he ..., the school was not his thing. He would argue about everything constantly, speak out, be a distraction, try to get other people off topic ..., I guess this is very defiant.”

P2 described troublemaking students as follows:

“Angry, defiant. They have ..., they challenge authority. And I have had some that just do it because they like being the class clown. But that most more often than not they

do it for the attention, whether they can get the positive attention or the negative attention, or they do it to avoid doing something they don't want to do.”

P5 described defiant troublemaking students as follows:

“You know, back when I first started ..., you know, they might have not wanted to do stuff but they weren't as vocal about it. They didn't ..., you know, come out and say, you know, in words it is this ..., there's kind of short matches, but you know, nowadays they definitely vocalize what they heard.”

“Hate to learn” is the second most identified troublemaking behavior (five identifications). Specific behaviors included “come to class late”, “do not want to do homework”, “not interested in any topic”, etc. For example,

P4 described troublemaking students who hate learning:

“They don't have higher-level thinking. They do like to be given information there for them, not to seek the information on themselves.”

P5 described:

“Um ..., I see a lot less attention span, a lot less wanting to work on classes and work on getting better grades and more defiant, more vocal in their defiance.”

Other troublemaking behaviors including “being a distraction” (identified by three), “being impulsive” (identified by two), “being impolite” (identified by two), and some other

behaviors identified by individual participants such as “being tardy”, “frequently go to the bathroom in a class”, “always on the defense to others”, etc.

Participants’ Beliefs about Reasons or Causes behind Troublemaking Behaviors

Participants had various beliefs about why students engaged in troublemaking behaviors. (See Table 7)

Participant #1 believed that the family environment is an important factor that caused some students’ troublemaking behaviors. She said,

“I think his family life wasn't the greatest. That might have contributed a little bit to how he acted at school. So, if he's no longer in that situation with this family, like if he's on his own or living with friends or whatever, then I can see that he is different.”

P2 concluded the factors that caused students to be troublemaking in her classes:

- to get attention

For example,

“I have had some [students] that just do it [troublemaking behaviors] because they like being the class clown. But that most more often than not they do it for the attention, whether they can get the positive attention or the negative attention, or they do it to avoid doing something they don't want to do.”

- to avoid doing something unwanted

For example,

“Well, um ..., like ..., I've had students didn't like to write. So, whenever got to writing time, or they knew writing time was coming, we'd have some kind of ..., an outburst,

yelling, throwing things that ..., you know, we have some sort of ..., it's an avoidance tactic."

- mental issues

For example,

"I have had some [students] that had mental issues, you know, caused them not to be able to control their behavior."

- lack of hands-on activity

For example,

"A lot of time those are the kids that need to get their hands-on thing. And I've had ..., I can think of one student in particular that I had this year. He was a class clown. He always wanted the attention. He was ..., he was never quiet. He interrupted me all the time. But [if] you put him on the computer and he ..., or a STEM activity, and you get him started and give him the job of going around and helping the other students, he was perfect. He couldn't have been better behaved."

P4 provided her point of view from the perspectives of students' self-efficacy and their mindset.

- low self-esteem

For example,

"They [troublemaking students] have usually a low self-respect for themselves or low self-esteem. So, they don't find the value and how valuable they are."

- low trust to anyone

For example,

“A student to ..., cannot ..., they can't let their guard down. They always have to have their guard up. They always think someone after them. They're always wanting to be on the defense. They automatically think they are always doing the wrong thing when they don't realize that the right things that they do. They can't self-evaluate themselves. They struggle with that.”

“You know, they're not open enough to allow you to teach them so much as that trust in that relationship.”

- unwilling to think

For example,

“We do STEM activities for students who struggle with STEM. [They] are students who don't necessarily think outside the box. I call it. They don't have higher-level thinking. They do like to be given information there for them, not to seek the information on themselves.”

- afraid of making errors

For example,

“Students also don't like to make errors. They don't like to be wrong. You have to learn. You learn from your mistakes. You learn from doing things incorrectly. And some of the kids who have trouble with decision making and who do things poorly, things that they failed again, they're not seeing that failure as part of their learnings.”

P5 argued that when a troublemaking student heard too much negative feedback from his/her teachers during a day, he/she might behave more negatively instead of more positively as the teachers expected.

For example,

“Sometimes I think it's just ..., they get ..., they get it from teacher to teacher to teacher, hour to hour to hour, and they kind of ..., just ..., they get fed up with it and blow up. You know, earlier in the day, they just sit back, and they take it. But as the day goes on, and they get more and more ..., um ..., feedback from teachers that they don't like to hear or don't want to hear. They kind of get fed up with it.”

P6 also mentioned mental issues and family factors as causes leading to troublemaking behaviors. For example,

“I see sometimes medical issues, you know, medical diagnosis like ADD, ADHD. I see things like that. I see just like depression and things like that kind of might bring some of that [troublemaking behaviors] along students. Definitely, I see lower class, lower-income, kind of students ..., or students from broken homes. Definitely, definitely those, those type.”

P3 claimed that she did not see many troublemaking behaviors in her classes and thus did not talk much about the causes of troublemaking behaviors. Considering that she has only three-year teaching experience in a quality high school, we believe that it might be possible that she has not yet encountered many troublemaking behaviors.

Participants' Indication of Reasons for Troublemakers' Success, Failure, or Troublemaking Behaviors in STEM Fields

To understand how participants perceived a STEM student's success, unsuccess or troublemaking behaviors, we designed a survey-like section by providing three statements and a seven-reason list, followed by interview questions.

The three statements were:

- Please think of the most successful STEM student in your class. Please pick the major reason for his/her success from the list.
- Please think of the most unsuccessful STEM student in your class. Please pick the major reason for his/her failure from the list.
- Please think of the most troublemaking STEM student in your class. Please pick the major reason for his/her behaviors from the list.

The seven-reason list included:

- student's ability
- student's effort
- student's intrinsic motivation
- luck
- ease of task
- help from teachers
- help from others, like parents or peers

Table 8 shows the participants' selection, and Table 9 shows the frequency count for each reason.

From Table 9, “student’s effort” is the most selected reason (8 selections in total) by participants, followed by “student’s intrinsic motivation” (5 in total), “student’s ability” (3 in total), “ease of task” (1 in total), and “help from others” (1 in total).

Specifically, when identifying students’ reasons to succeed in STEM fields, “students’ intrinsic motivation” is the most frequently selected reason. When it came to students’ failure and their troublemaking behaviors in STEM fields, “student’s effort” was believed by participants to be the main reason.

It is interesting to find that none of the participants attributed their students’ success, failure, or troublemaking behaviors in STEM fields as “luck” or “help from teachers”.

Discussion

General findings

Teachers showed positive and negative expectations of “troublemaker” success in STEM. The variation may be explained by their pedagogical attitudes, humanistic values and attribution of success. The attribution of success also seems to correlate with the stability of being a “troublemaker” as a stable and trait-like characteristic they assigned to their students.

If one wants to identify a “troublemaker”, it seems promising to look for the defiant child that hates to learn and distracts others from learning. There were no indicators for independent differential variables like ethnicity or gender. Besides some general disrespect of communication rules (e.g. politeness), it is interesting that teachers mainly determine “trouble” with reference to learning processes and not with reference to teaching or the teacher in person. In our small-sample exploration study, it is speculative if teachers just cover their pedagogical challenges and reframe it on the student level, or if “troublemaking” is a contextual phenomenon on the student level. If the latter would apply, it could indicate a unique difference to misbehavior, because misbehavior is primarily addressed to the teaching process or teacher emotions and well-being/stress (c. f. Aldrup et al., 2018; Rafsanjani et al., 2019). Yet, it needs further and more extensive studies to evaluate this difference.

RQ1: What are teacher beliefs about “troublemaker” students’ potential achievement in STEM fields?

P3 and P6 believed that troublemaking students would be successful in STEM fields while P1, P2, P4, and P5 believed not. Although P6 indicated some extent of optimism in troublemakers' success in STEM field, she had prerequisites for their success, including only if they learn more initiatively, actively, and meaningfully. Among the participants, P3 seemed to be the only teacher who completely believed that her students (even if they were troublemakers) would be successful in STEM fields in the future.

Based on what we found, we believe that teachers' beliefs in student success might be connected to their length of teaching experience. P3 had only three years of teaching experience in a high school. Comparatively, P1 and P6 had been teaching for 14 and 18 years respectively, and P2, P4, and P5 had more than 20 years' teaching experience. The longer teachers teach, the more troublemakers or troublemaking behaviors they might encounter. This may explain why P3 had a relatively positive attitude towards her students' success in STEM fields, while the other participants had negative attitudes.

A second finding is that the better a school is, the more a teacher would believe in the success of troublemaking students' (if there is any) in STEM fields in the future. During our interview, P3 mentioned more than one time that the school where she was teaching had relatively demanding admission requirements. For example, "*Those students are ..., they have to apply to our school. They have to have a certain GPA; they have to have a certain attendance at their home schools, in order to come to us.*" and "*Like I said, most of my students, our students had to apply to come to us, so most of them want to be there.*" These examples indicate a higher student quality and a greater teaching quality in P3's school. The high quality of the school and its students may explain why P3 did not come across many troublemaking students and why she maintained an optimistic attitude towards

her students' future. Similar emphasis on students' or the school's quality was not found from other participants' interview records.

Besides, P1, P2, P4, and P5 indicated the reasons for troublemaking students' failure in STEM fields as (including but not limited to): the lack of creativity, curiosity, global perspective, intrinsic motivation, persistence, critical thinking, and a good family environment. These reasons, to a great extent, have overlapped with 21st-century skills (Bell, 2010; Trilling & Fadel, 2009). Our results seem to indicate that as well and are aligned with previous researchers' findings that, a good mastery of 21st-century skills is important to promote the advancement of STEM education and learners' success in this field (Bybee, 2010; Eguchi, 2016). In other words, if a teacher can develop students' 21st-century skills, the students are more likely to be successful in STEM fields in the future.

RQ2: How situational are teachers' subjective theories of troublemaking behavior and troublemakers?

According to participants, "being defiant" is an all-agreed troublemaking behavior. This indication was supported by P2's perceptions that students now have more behavior issues, and that teachers are losing respect from students or parents. Previous researchers also pointed out that disobedience was the most unacceptable student behaviors for teachers (Sun & Shek, 2012). Other typical troublemaking behaviors identified by participants included "hate to learn", "being a distraction", "being impulsive", "being impolite", etc.

From the results, we found that the longer a teacher teaches, the more drastic changes the teacher will perceive in teaching. Of the six participants, five have 14 or more years of

teaching experience. They perceived drastic changes throughout their teaching career. Their perceptions ranged from the influence of technology to instructional methods in class, students' behaviors and mental status, and then the loss of respect for teachers. In contrast, P3's perception is more on herself rather than on students, probably because her three years of teaching experience may not support her to discover a wide range of changes in either technology advancement in schools or students' behaviors or mental status. Our finding is aligned with that of a previous study arguing that teachers' perceptions of student misbehaviors may vary by their length of career and the school context where they teach (Kulinna et al., 2006).

We also found that as the technologies in schools advance, teachers perceive that students were becoming more distracted and more anxious. This finding may explain why some teachers (e.g., P2 and P6 in this study) have seen more "troublemakers" or troublemaking behaviors. Compared with the classrooms 15 or 20 years ago, students in today's classrooms more easily get distracted by technology. They may not do what they are supposed to do in the class (e.g., listen to the lecture, or focus on completing a task). Other students might be affected by these students and their behaviors.

Meanwhile, according to our teachers, students today are stressful from various sources such as home, school, or workplace (Armacost, 1990), or even from a teacher's age, that is, the older a teacher is (which could be considered as the longer a teacher teaches), the more stressful a student may feel (Meijer, 2007). The increased stress may affect mental status or produce misbehaviors. Consequently, teachers may consider the behaviors of these students as "troublemaking".

RQ3: What is the teachers' existing range of interpreting troublemaking behavior?

P2, P4, and P5, the three participants who have had more than 20 years of teaching experience, believed that the current students with troublemaking behaviors would most probably continue to be “troublemakers” as they grow older. They believed that it took a lot of time, patience, and consistency, through the effort from students, parents, and teachers, to change the troublemaking students.

P1 and P6, although they also admitted the toughness to change troublemaking students, are relatively more optimistic. According to P1, if the environment (e.g., family) becomes good, a troublemaking student might be less troublemaking. P6 believed that troublemaking students could be successful in STEM fields as long as they not only sit and write or type but also learn with more initiative.

P3 is the most optimistic about her students. Consistent with findings from a previous study (Woolfolk et al., 1990), she believed that her students even those with potential troublemaking behaviors could be successful in STEM fields and therefore, she had a more inclusive understanding of her students behaviors in class, though she also believed that troublemaking behaviors, if there are any, should be nipped at an early stage.

Through the comparison of the beliefs of these participants, we may find that the length of teaching experience plays an important role in differentiating teachers' interpretation of troublemaking behaviors. It seems that as the years of teaching increases, a teacher's viewpoint toward troublemaking students and their behaviors becomes more fixed. This finding may imply that, while experienced teachers might be important to maintain the teaching quality of a school, the school may also consider having more young teachers who might be more tolerant or patient to “troublemakers” or students with troublemaking

behaviors. In this way, the school may provide these students with more support and opportunities for their success in STEM fields in the future.

RQ4: What are situational factors that shape the view of teacher on a student's behavior in STEM instruction?

Situational factors that we found that may shape the view of teacher on a student's behavior in STEM instruction include:

- Technology advancement
- Students' maturity
- Students' quality
- Students' willingness to learn
- Students' self-discipline
- Students' mental issues
- School location
- Year of teaching experience

Technology advancement is an influential factor that may shape teachers' views on a student's behavior in STEM instruction. With the fast development, an increasing number of technologies (e.g., laptop, mobile phone, tablet, VR headset, etc.) have been introduced into the classroom. As P4 and P6 said, though technology may promote learning experience and outcomes in classes, it may also distract learners and thus harm their learning. As a result, teachers may consider students who easily get distracted by technology and get other students distracted as troublemakers in class.

Students' maturity is another situational factor that may shape teachers' views. P6 commented that her troublemaking students were not mature enough to realize their responsibilities. P2, even if she strongly held that many troublemaking behaviors would continue as students grow older, did not deny the possibility that these students might change as they grow more mature. Because P2 and P6's students were respectively from a middle school and an elementary school, we have the reason to believe that these teachers deem that, as students become more mature, their troublemaking behaviors may diminish or disappear.

More situational factors are students' quality and their willingness to learn. All six participants considered "being defiant," and five of them deemed "hate to learn", as two major troublemaking behaviors. A student who is impolite, less respectful to a teacher, unwilling to learning, or not intrinsically motivated is considered as a troublemaker by the participants. Reversely, a student who is polite, hardworking, initiative, and intrinsically driven is traditionally a good student in many teachers' eyes.

Besides, self-discipline and mental issues could be factors. According to P4, self-disciplined students are less likely to have troublemaking behaviors. Additionally, as P2 and P5 commented, mental issues such as ADD or ADHD may reduce some students' capability of emotion control, and thus produce more troublemaking behaviors.

The area where a school is located could also be a factor that shapes teachers' views on students' behaviors. P2 teaches in a rural school, and she had a more pessimistic view on students' troublemaking behaviors than other participants did. P6 worked in a rural school when he started to teach, and now he teaches in a suburban school. According to

him, compared to students in rural schools, those in suburban schools think more about their future and thus behave more initiatively in learning.

Finally, teachers' years of teaching experience is also an important factor. As the years of teaching increase, teachers are more likely to meet different generations of students and find the discrepancies among different generations. This experience will shape their view on students' behaviors.

Implication

A good balance between young and experienced teachers might be important to a school. Experienced teachers with decades of teaching experience are indeed valuable to a school, but throughout their prolonged teaching career, some of them may have gradually formed a negative or pessimistic attitude toward the future of troublemaking students. This type of negative attitude may lead to teacher burnout, which is positively correlated with students' misbehaviors (Abel & Sewell, 1999). To keep students from such negative attitudes and keep experienced teachers from burnout, a school needs to import an appropriate proportion of young teachers who have more positive expectations of students. With the addition of young teachers, the atmosphere of a school might become more positive, and students may have a more healthy and supportive learning environment.

Teachers may use theories or new technologies to help with their teaching. As P2 mentioned, some students would better engage themselves in activities instead of lectures. Therefore, it is recommended that teachers adopt theories from the field of education or learning science to guide their teaching. For experienced teachers with decades of teaching experience, it might be helpful to incorporate student-centered teaching methods,

meaningful learning design, and new digital instructional media or technologies into their classrooms to engage their students. For young teachers, theories could be their guidelines in designing and implementing instruction and dealing with troublemaking issues in the classroom. They may verify the effectiveness of the theories and adjust their teaching accordingly.

Except for teachers' effort, schools should help manage both the student stress in learning and the teacher burnout in the job. Students' stress may come from both families or schools (Matheny et al., 1993). Some schools' policies or rules may raise students' stress and thus cause more misbehavior on students (Hyman & Perone, 1998). On the other hand, an appropriate level of stress in learning might be good for students' academic achievement (Shanahan & Walberg, 1985). Therefore, schools should adjust some rules or practices (if necessary) to eliminate students' negative feelings such as anxiety, depression, or fear of the school, and foster students' self-discipline and help them regain confidence and interest in learning.

Additionally, schools should also care about teachers' stress in the workplace. Teachers' report of stress is always connected to students' misbehaviors (S.Yoon, 2002). Schools should provide support for teachers to release their stress from students' misbehaviors. This type of support might be more important for experienced teachers who have been long in their careers. For example, schools may have teachers discuss and exchange perceptions of and solutions to students' misbehaviors in the classroom. This kind of group effort may reduce teachers' stress from troublemaking students (Klassen, 2010), and in turn, benefit these students.

In summary, to help troublemaking students succeed in STEM fields, schools and teachers should take various measures to create a great learning environment and a healthy interpersonal relationship for these students at school.

Limitations and Future Work

In this study, we only interviewed six participants. Only one of them was from a rural school, and the others were from suburban schools. None of them were from an urban school. The sample size and the lack of teachers from urban schools may have limited the scope of our results and the potential implication of our findings to teachers from urban schools.

For future research, not only could there be more participants, but also more involvement of teachers from urban schools, to get a more comprehensive view of teachers on troublemaking students' success and behaviors in STEM fields. In terms of data acquisition, we will include more questions on the class composition (ethnicity and gender).

The students' opinions might also be meaningful. Questions such as how students perceive troublemaking students and their behaviors, how students believe in the success of troublemaking students in STEM fields in the long run, and how peers' beliefs or pressure affect troublemaking-students' self-efficacy are worth research.

Another research direction might be longitudinal studies on troublemaking students and their success (or failure) in STEM fields. Researchers may review how troublemaking students performed when they were at schools and then examine whether they take STEM as a career and how well they do it as a career.

Conclusion

In this study, we interviewed six STEM teachers to understand how they perceived troublemaking students and their troublemaking behaviors, what their beliefs about these students' success in STEM fields are, and what factors shaped their points of view.

We found many typical troublemaking behaviors identified by teachers and many factors causing the behaviors. These behaviors might be related to the negative impact of technology advancement, student stress, a general loss of respect for teachers, or some other student characteristics. Among all these factors, we found teachers' length of career very influential on their perceptions and understanding of students' troublemaking behaviors and their foreseeing of these students' success in STEM fields. It seems that as a teacher's years of teaching increases, the teacher may have less confidence in students' success in STEM fields.

As this study provides perceptions of troublemaking students' success in STEM fields from a teachers' perspective, future researchers may conduct more empirical studies on how troublemaking students perform if they take STEM as a career. In practice, schools and teachers should work together, both instructionally and mentally, to provide more support for students who might have troublemaking behaviors and help them become successful in STEM fields.

Crawshaw (2015) stated that teachers from different countries have a consistent perception of student misbehaviors in the classroom. Though this study interviewed STEM teachers in the United States, we believe that our findings are meaningful to teachers from other countries and subjects not limited to STEM.

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Tables

Table 1. Demographic information of participants – part 1

Participant	Gender	School Level	Years of Teaching	School Location	Title 1 School
P1	Female	High	14	Suburban	No
P2	Female	Elementary	23	Rural	Yes
P3	Female	High	3	Suburban	No
P4	Female	Middle	26	Suburban	No
P5	Male	High	27	Suburban	No
P6	Female	Middle	18	Suburban	No

Table 2. Demographic information of participants – part 2

Demographic Item	Frequency	Participant
Gender		
Female	5	P1, P2, P3, P4, P6
Male	1	P5
School Level		
Elementary	1	P2

Middle	2	P4, P6
High	3	P1, P3, P5
Years of Teaching		
≤ 10	1	P3
11-15	1	P1
16-20	1	P6
21-25	1	P2
≥ 25	2	P4, P5
School Location		
Urban	0	
Suburban	5	P1, P3, P4, P5, P6
Rural	1	P2
Title 1 School		
Yes	1	P2
No	5	P1, P3, P4, P5, P6

Table 3. Participants' beliefs about troublemaking students' success in STEM fields

P	Success in STEM	Reasons for Success or Unsuccess	Students' Behavior Characteristics
1	No	<ul style="list-style-type: none"> ● Didn't go to college. ● Not initiative work hard. 	<ul style="list-style-type: none"> ● Intrinsic motivation ● Work hard at what they like
3	No	<ul style="list-style-type: none"> ● Lack appropriate instruction. 	<ul style="list-style-type: none"> ● Think outside the box ● Not afraid of failures ● Willing to try different things ● Intuitiveness ● Persistence
6	Yes	<ul style="list-style-type: none"> ● Inquisitive; wanted to understand things. 	<ul style="list-style-type: none"> ● To be inquisitive. ● To be a lifelong learner.

		<ul style="list-style-type: none"> ● Wanted to learn problem-solving. ● Can collaborate with other people. 	<ul style="list-style-type: none"> ● Always to change. ● To be a giving person. ● To be a resourceful person. ● Want to help everyone. ● Have a global perspective
8	No	<ul style="list-style-type: none"> ● Hard to follow directions. ● Not initiative work hard. ● Afraid of failures. ● Easy to give up. ● Not confident enough. 	<ul style="list-style-type: none"> ● Perseverant ● Willing to have failures ● Willing to learn from failures ● Willing to take risk ● Think outside the box
9	No	<ul style="list-style-type: none"> ● Bad relationship with the authority. 	<ul style="list-style-type: none"> ● Good relationship with the authority and colleagues ● A good mind ● Some good basic skills ● Tech-savvy
10	Yes	<ul style="list-style-type: none"> ● Only if they do not just sit and write on a piece of paper or type on a computer. ● Only if they want to get up and move around. ● Only if they are building or designing. 	<ul style="list-style-type: none"> ● Think out of the box ● Critical thinking

Table 4. Themed students’ behavior characteristics – part 1

Students’ Behavior Characteristics	Themed Behavior Characteristics
Willing to take risk	Bravery
Think outside the box	Creativity
Think outside the box	Creativity
Think out of the box	Creativity
Critical thinking	Critical thinking
Willing to try different things	Curiosity

To be inquisitive.	Curiosity
Want to help everyone.	Global perspective
Have a global perspective	Global perspective
A good mind	Good mind
Good relationship with the authority and colleagues	Good relationship
Work hard at what they like	Hard-working
Intrinsic motivation	Intrinsically motivated
Intuitiveness	Intrinsically motivated
Not afraid of failures	Learn from failures
Willing to have failures	Learn from failures
Willing to learn from failures	Learn from failures
To be a lifelong learner.	Lifelong learner
Always to change.	Lifelong learner
Persistence	Persistence
Perseverant	Persistence
To be a resourceful person.	Resourceful
Tech-savvy	Tech-savvy
To be a giving person.	Willing to give

Table 5. Themed students' behavior characteristics – part 2

Themed Behavior Characteristics	Frequency
Creativity	3
Learn from failures	3
Curiosity	2
Global perspective	2
Intrinsically motivated	2

Lifelong learner	2
Persistence	2
Bravery	1
Critical thinking	1
Good mind	1
Good relationship	1
Hard-working	1
Resourceful	1
Tech savvy	1
Willing to give	1

Table 6. Participants’ teaching differences between today and when they started to teach

P	Years of Teaching	When Started to Teach	Today
1	14	<ul style="list-style-type: none"> ● More lecturing and worksheets 	<ul style="list-style-type: none"> ● More hand-on and engaging activities
3	23	<ul style="list-style-type: none"> ● Students respected their teachers. ● Whatever the teacher said, parents agreed. 	<ul style="list-style-type: none"> ● More data collection ● More testing ● A loss of respect for the teaching profession and from students in general ● Students have more behavior issues. ● Schools are afraid of parents.
6	3	<ul style="list-style-type: none"> ● I might not be patient enough. 	<ul style="list-style-type: none"> ● I am more patient now.
8	26	<ul style="list-style-type: none"> ● Schools did not have much technology. ● Students were not distracted by technology. 	<ul style="list-style-type: none"> ● Technology has changed a lot. ● The content did not change much.

9	27	<ul style="list-style-type: none"> ● Rural students did not think much about going to college. 	<ul style="list-style-type: none"> ● Suburban think more about going to college. ● Students' behaviors have changed a lot.
10	18	<ul style="list-style-type: none"> ● Students did not have their own devices. ● Students were not as anxious as they are now. 	<ul style="list-style-type: none"> ● Technology has changed a lot. ● Students have their own devices. ● Students may more easily get off tasks than they did in the past. ● Students are more anxious about what they should do.

Table 7. Participants' identifications of troublemaking behaviors and reasons or causes behind

P	Typical Behaviors	Potential Causes
1	<ul style="list-style-type: none"> ● Being lazy. ● Do not want to do homework. ● Being defiant. ● Get others distracted in the classroom. ● Not interested in any topic. 	<ul style="list-style-type: none"> ● Affected by a bad family environment.
3	<ul style="list-style-type: none"> ● Being angry. ● Being defiant. Challenge authority. 	<ul style="list-style-type: none"> ● Mental issues (unable to control their behaviors). ● Lack of engagement (e.g., hands-on activities) ● Try to get attention. ● Avoid doing something unwanted.
6	<ul style="list-style-type: none"> ● Being tardy. ● Being loud. ● Cognitively challenge the teacher. ● Disrupt other students. 	
8	<ul style="list-style-type: none"> ● Do not respect authority. ● Do not trust others. ● Very impulsive. ● Not open enough. 	<ul style="list-style-type: none"> ● They have low self-esteem and cannot self-evaluate themselves. They do not realize the right things that they do.

		<ul style="list-style-type: none"> ● They always think someone is after them and are always on the defense. ● They think that they are always right, and others are unfair to them. ● They do not think outside the box. They like to be given information instead of seeking information on their own. They are afraid of making errors.
9	<ul style="list-style-type: none"> ● Do not want to work or learn. ● Being defiant and vocalize it. ● Come to class late. ● Go to the bathroom or get a drink during a class. ● Throw hands up in the air or throw books out of the desks. 	<ul style="list-style-type: none"> ● They hear too much feedback from the teachers, get fed up with it, and do not want to cooperate.
10	<ul style="list-style-type: none"> ● Being disrespectful. Use bad words. ● Interfering other students who want to learn. 	

Table 8. Participants' selections for the three statements

P	Statement 1 (Most successful)	Statement 2 (Most unsuccessful)	Statement 3 (Most troublemaking)
1	student's ability	student's effort	help from others
3	student's intrinsic motivation	student's intrinsic motivation	ease of task
6	student's intrinsic motivation	student's effort	student's effort
8	student's intrinsic motivation	student's effort	student's effort
9	student's effort	student's ability	student's effort
10	student's intrinsic motivation	student's ability	student's effort

Table 9. Reason frequency count

Reasons	Statement 1	Statement 2	Statement 3	Total
student's ability	1	2	0	3
student's effort	1	3	4	8
student's intrinsic motivation	4	1	0	5
luck	0	0	0	0
ease of task	0	0	1	1
help from teacher	0	0	0	0
help from others	0	0	1	1

