Investigating Teachers' Role in Shaping Student Engagement: A case study

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Table of Contents

0.0 Abstract 6

1.0 Introduction 7

1.1 Knowledge Gap 13

1.2 Research Questions 15

2.0 Theoretical Framework 16

2.1 Context 17

2.1.1 Pedagogy 18

2.1.2 Measuring Pedagogy 20

2.2 Self 22

2.2.1 Self-Determination Theory 22

2.2.2 Cognitive Evaluation Theory 25

2.3 Action 27

2.3.1 Engagement 28

2.3.2 Measuring Engagement 29

2.4 Hypotheses 31

3.0 Methods 32

3.1 Phases 33

3.2 Sample and Contexts 34

3.3 Procedure Overview 35

3.3.1 Classroom Observations 35

3.3.2 Student Questionnaires 37

3.3.3 Student Focus Groups 39

3.3.4 Teacher Interviews 41

4.0 Results and Findings 43

4.1 Classroom Observations 43

4.1.1 Teacher Expectations 43

4.1.2 Choice of Pedagogy 44

4.1.3 Student Engagement 45

4.2 Student Questionnaires 46

4.3 Student Focus Groups 47

4.4 Teacher Interviews 50

5.0 Conclusions 54

5.1 Research Sub-Question 1 54

5.2 Research Sub-Question 2 56

5.3 Beyond the Research Questions 59

6.0 Discussion 61

6.1 Implications 61

6.2 Limitations 62

6.3 Future Research 63

6.3.1 The Scope 63

6.3.2 The Constructs 64

6.3.3 The Focus 64

6.3.4 Triangulation 65

6.4 The Final Word 66

7.0 References 67

8.0 Appendices 80

Appendix I: Classroom Observations 81

Appendix II: Student Questionnaires 86

Appendix III: Student Focus Groups 96

Appendix IV: Teacher Interviews 103

Appendix V: Miscellaneous 115

9.0 Figures 121

10.0 Tables 124

11.0 Addendum: Clinical Education 126

Abstract

This case study investigated engagement as a function of psychosocially supportive pedagogy. To examine how teachers enacted their expectations of student performance in their pedagogical actions, 12 days of observations (3.5 hrs per day) were conducted in two physics classes in an institute for remedial learning in the Netherlands (N = 30 students). The study surveyed the availability, accessibility, and quality of learning opportunities and their effects on engagement. Teacher interviews explicated the reasons behind the choice of pedagogy. Furthermore, student questionnaires and focus groups elucidated how the pedagogical actions impacted engagement. The results show that the teachers promoted engagement to a similar extent albeit by different means. According to students' self-reported accounts, both classes experienced a comparable degree of overall engagement. However, there was a dissimilarity in observed behavioral engagement. The social composition, group dynamics, and students' psychosocial needs played a role in teachers' choices of pedagogy and the degree of observed behavioral engagement. The findings from the study suggest an assortment of psychosocially supportive pedagogical actions that can positively mediate student engagement and/or mitigate the effects of extrinsically-driven motivations.

Keywords: expectations, learning contexts, instructional core, psychosocially supportive pedagogy, engagement, self-determination theory, cognitive evaluation theory

Investigating Teachers' Role in Shaping Student Engagement: A case study

Pedagogy in the 21st century is characterized by an increased focus on educational efficacy and accountability for student learning (Maxwell, 2009; see also Elmore, 2000). A 21st-century classroom is an inclusive environment where teachers shift from unidirectional dissemination of processed knowledge to creating intellectually stimulating learning opportunities (Wiggins & McTighe, 2006; Shor, 1992; see also "democratic education" in Falk & Darling-Hammond, 2010). Transformative learning is negotiated, requiring non-authoritarian leadership by the teacher and mutually reinforced teacher-student authority on knowledge (see "interactive pedagogy" in Shor, 1992). Such equitable school contexts empower students and, in the process, promote participatory democratic values by raising entire generations of critical thinkers, skilled workers, and responsible citizens (Shor, 1992; cf. "sanctions-focused education" in Ravitch, 2010). This study investigated teachers' role in shaping such classroom environments and subsequent effects on student engagement.

Every child is born a learner (Shor, 1992, p. 12), and in fact, the brain's pattern-seeking proclivity and its built-in reward system predispose children to curiosity, exploration, and spontaneous interests (e.g., Ryan & Deci, 2017; 2000b; Bernstein et al., 1997, pp. 59–79, pp. 340–343; Cordova & Lepper, 1996). Children's inquisitive nature is essential in their cognitive and social development and epitomizes a principal source of enjoyment and vitality (Ryan & Deci, 2000b). As children's linguistic and cognitive abilities grow throughout school years (see "cognitive and linguistic development" in Ormrod, 2011, pp. 26–38, pp. 49–57; Bernstein et al., 1997, pp. 397–398, pp. 292–293), one would expect their inquisitiveness to flourish as well (see also Paley, 2007; 2009). Favorable learning environments have a capacity to foster the

development of students' intellectual powers and condition them to become autonomous knowledge builders and critical thinkers; nonetheless, environments can also inhibit learners' cognitive growth and socialize them into dependence on processed knowledge (Shor, 1992, pp. 11–30).

Figure 1

Conflicting Degrees of Cognitive Stimulation

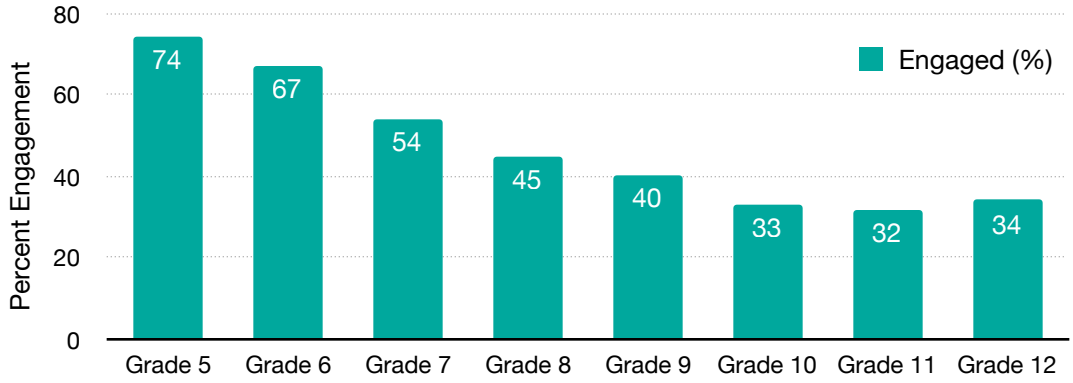
In the 21st century, students live a digital childhood (Maloy et al., 2011) hence in supportive conditions for curiosity and intellectual stimulation (see Figure 1). Indeed, students' free time involves accessing and navigating through multiple sources, several types of technology, and various forms of media (Rideout et al., 2006). The archetype 21st-century student interacts with information—literally, at their fingertips—and actively synthesizes new knowledge (Maloy et al., 2011). In contrast, schools subject students to learning activities that generally require cognitive processes less complex than those in students' downtime. Traditional-style teaching involves teacher-directed, memory-focused instruction, where knowledge is limited to factual trivia from authoritative sources (see also "twin sins" in Wiggins & McTighe, 2006; "assign and tell" in Vacca et al., 2011). Maloy et al. (2011) further assert that practices,

such as lecturing, often fail to engage students "who are experiencing active, engaging learning environments in other parts of their lives" (p. 5; see also Lawson, 2010; "learning by osmosis" in Wiggins & McTighe, 2006). In sum, the literature argues that students' leisure activities condition them to be active learners, but schools continue to be passive learning environments.

Inapt pedagogy relegates students to the role of spectators (Wiggins & McTighe, 2006), which engenders passivity, disengagement, or even behavioral issues (e.g., Shor, 1992). Indeed, the Gallup poll (2016) reports that student engagement decreases by about 40% from fifth through tenth grade and reaches its lowest point around grades ten to twelve (see Figure 2).

Figure 2

Percent Student Engagement

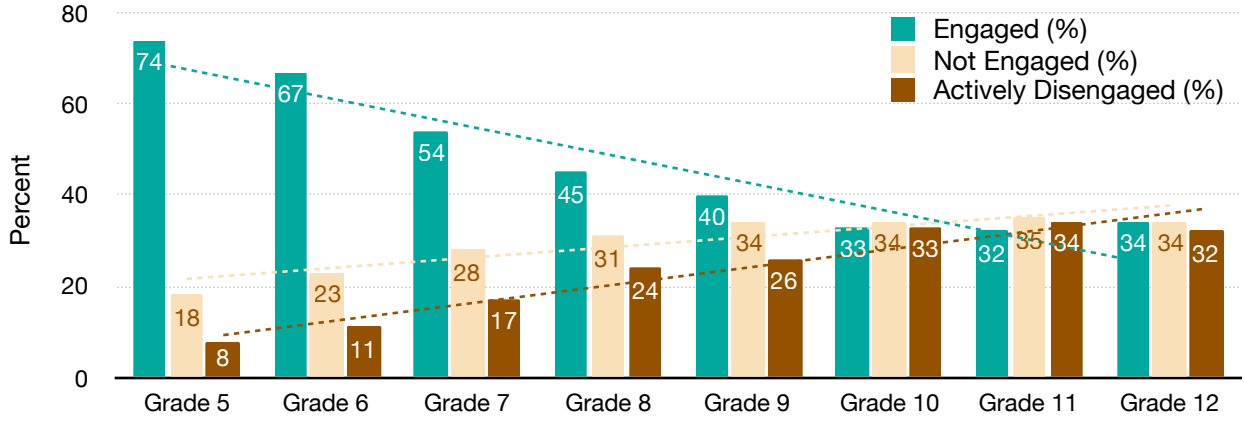


Note. Source Gallup (2016).

Furthermore, active disengagement rises steadily between grades five and twelve (see Figure 3). Actively disengaged or discouraged students are three times more likely to miss school than their engaged counterparts (Gallup, 2016). However, absenteeism is antithetical to the participatory democratic values that schools aim to inculcate (see also "performance strike" in Shor, 1992; "academic deterioration" in Dembo & Eaton, 2000, pp. 473–474).

Figure 3

Percent Engagement, Non-Engagement, and Active Disengagement



Note. Source Gallup (2016).

The literature affirms the pervasiveness of the inclination to blame students or their families (e.g., Milner, 2010; Bartolomé, 2008). According to Elliott (2008), people often "locate the problem within the student and [do] not consider the circumstances surrounding the student as a significant factor" (p. 214). Moreover, research challenges the cogency of these blame-shifting conjectures. For example, a study by Vedder-Weiss and Fortus (2010), $N = 1{,}181$, compared fifth- through eighth-graders' self-reported objectives, engagement, and their continuing motivation to learn. The results indicate that students' sustained motivation and engagement are related to a higher degree to the school culture and a lesser degree to students' home cultures. The evidence implies that schools are a greater influential factor in engagement than students' home cultures; therefore, the study focused on investigating the effects of school contexts, *viz.* classroom interactions between teachers and students.

Findings from the research on motivation have shown that favorable learning contexts positively affect student engagement and academic performance. Students benefit socially and

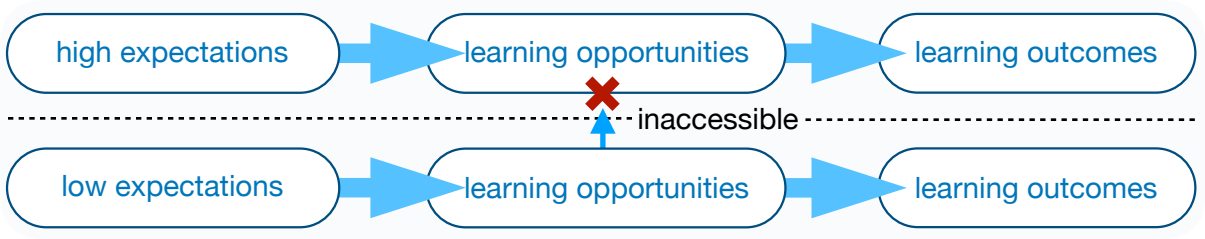
academically when they experience supportive relationships with their teachers (Resnick et al., 1997; see also Davis et al., 2003; Davis, 2006). Affective classroom climates are a contributing factor to students' emotional health thus consequential to their academic performance (Matsumura et al., 2008, p. 294; see also "emotional competence vs. outcomes" in Jennings & Greenberg, 2009). Furthermore, teachers who operate as socializing agents positively affect students' intellectual experiences and strengthen their motivation to learn (Davis, 2006, p. 193). For example, teachers can enhance motivation to learn by addressing students' need to belong (Davis, 2006; see also "relatedness" in Ryan & Deci, 2017; cf. "school alienation" in Morinaj et al., 2020). Additionally, the results of a study by Matsumura et al. (2008) demonstrate that affective classroom climates where the teacher models prosocial behaviors significantly predict students' interactions toward one another; furthermore, the teacher's choice of pedagogy predicts the quality of students' participation in class discussion. In brief, the research suggests that favorable learning contexts positively affect student engagement and achievement; however, the literature underscores also the teacher's role in defining classroom environments.

Teacher expectations are a contributing factor in shaping learning contexts (e.g., Rubie-Davies et al., 2020). Since the initial study by Rosenthal and Jacobson (1968; cited in Rubie-Davies, 2007) and the subsequent research on expectancy theory, the literature has provided the impetus to further investigations of the dyadic teacher-student interplay and unraveled the consequences of teacher expectations for student learning (pp. 289–290). For example, relatively recent studies have shown that the instructional practices of teachers with high class-level expectations promote student learning by creating learning opportunities that are generally inaccessible to students in low-expectation classes (see Figure 4; Li & Rubie-Davies, 2015;

Rubie-Davies, 2007; Wang et al., 2019; cited in Rubie-Davies et al., 2020). A study by Flanagan et al. (2020) examined teacher expectations and differential influences across demographic lines. The results indicate discrepancies between teacher expectations and their reported behaviors toward students. Therefore, the authors suggest that future research should include exploring if reported pedagogic actions can be observed in the classroom.

Figure 4

Effects of Expectations



Furthermore, a study by Rubie-Davies et al. (2020) investigated links between teachers' class-level expectations and students' beliefs, *viz.* perceptions of expectations and class climate. The findings demonstrate practical implications in showing "positive benefits for students when teachers have high class-level expectations" (p. 1173). Moreover, the authors assert that

> gaining additional understandings about the relations between teacher expectations, instructional practices, and interaction patterns with students may assist teachers to develop further understandings about the important role that they play in influencing not just student academic outcomes but also their psychological well-being (p. 1174).

Indeed, school contexts can either elevate or stifle learners' natural penchant to be inquisitive and strive to learn (e.g., Shor, 1992; Ryan & Deci, 2017). The research on motivation

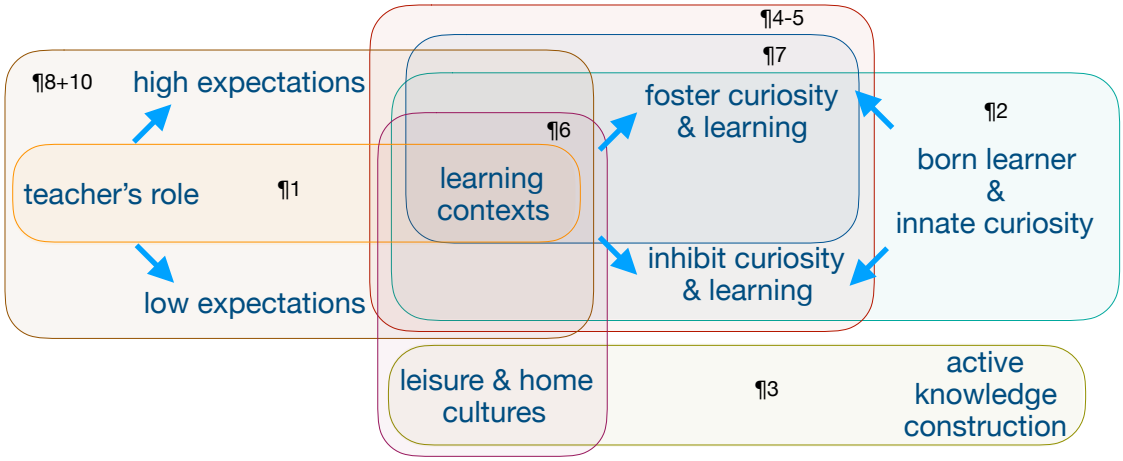
has shown that teachers' belief systems often affect their instructional decisions (Davis, 2006, p. 196; see also "ideology" in Bartolomé, 2008; Elliott, 2008). Teacher expectations create self-fulfilling prophecies by a perceptual bias, thus they predict student performance without influencing the outcome (Jussim, 1989; Jussim & Eccles, 1992; Rubie-Davies, 2007; Flanagan et al., 2020; see also "low expectations" in Fortus & Daphna, 2020; "self-fulfilling prophecies" in Rist, 2003; "opportunity gap" in Milner, 2010). Furthermore, Rubie-Davies et al. (2020) draw on the literature and assert that teacher expectations are of critical importance because they often determine the accessibility and quality of learning opportunities available to students (p. 1176). Hence, this study centered around the teacher's role in establishing and maintaining intellectually stimulating classroom contexts.

1.1 Knowledge Gap

This subsection summarizes previously stated arguments (see Figure 5), and elucidates the knowledge gap of interest (see Figure 7).

Figure 5

Introduction Summary

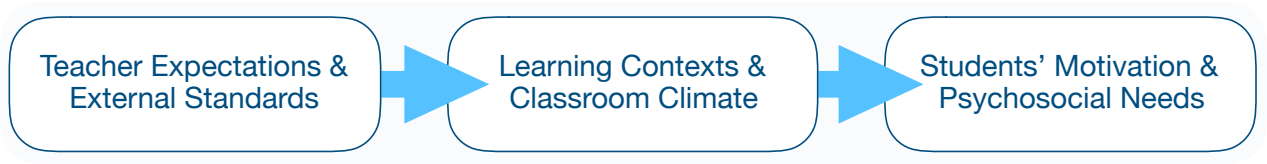


Note. The figure represents a simplified summary of the assertions presented in the introduction and the corresponding paragraph numbers (¶).

As depicted in Figure 5, this paper has argued that children are born inquisitive and motivated to learn; moreover, their lives are immersed in stimuli-rich contexts. Students' proclivity for curiosity can be either enhanced or abated by contextual factors: intellectual, affective, and social facets. Furthermore, learning environments are shaped by teachers' expectations, so the study focused on teachers' role in shaping favorable learning climates (see Figure 6).

Figure 6

Teacher Expectations Shaping Learning Contexts, and Contexts Affecting Students' Psychosocial Needs



The knowledge gap of interest: Cerasoli et al. (2014) invoke a lack of meta-analysis along the boundary lines and raise a question if the link between intrinsic motivation and performance differs across various demographic or contextual lines (p. 2). Similarly, Stroet et al. (2015) recommend a further investigation of "how effects of need-supportive teaching are shaped by their context" (p. 138). Also, Thapa et al. (2013) point out in their review of school climate research that many other studies advocate for the inclusion of a wide range of factors, such as pedagogical processes, when examining school outcomes (p. 365). According to a review by Wang et al. (2018), there are only few studies that have investigated the degree to which the correlation between pedagogic actions and student outcomes is mediated by social psychological constructs in the students' minds. And finally, Rubie-Davies et al. (2020) argue that expectations

are likely to affect student psychosocial needs, but the authors have also noted that psychosocial effects of expectations have been studied less frequently than expectations' effects on academic outcomes (p. 1173).

In sum, the knowledge gap of interest includes the inter-related topics listed in Figure 7.

Figure 7

The Knowledge Gap

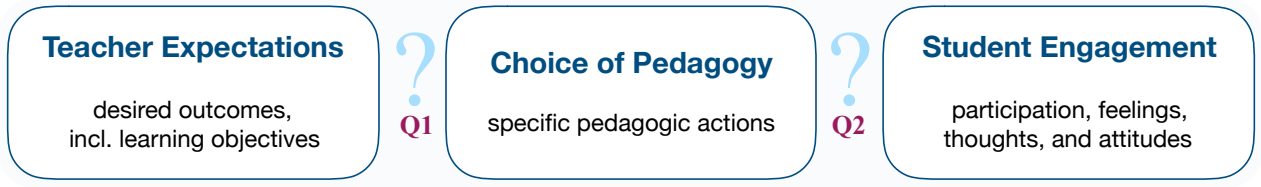
- motivation-to-performance link → demographic and contextual factors (Cerasoli et al., 2014),
- effects of teaching → shaped by contexts (Stroet et al., 2015),
- pedagogic processes → outcomes (Thapa et al., 2013),
- pedagogic actions → students' psychosocial needs (Wang et al., 2018), and
- teachers' expectations → students' psychosocial needs (Rubie-Davies et al., 2020).

1.2 Research Questions

This study examined the interplay among three sets of variables (see Figure 8).

Figure 8

Two Research Sub-Questions vs. Three Sets of Variables



The following main research question guided the inquiry: *How are teachers' expectations of students' academic performance reflected in students' engagement, as manifested (a) by the rate and quality of students' participation? and (b) in their self-reported accounts?*

The sub-questions were:

Q1. How are teachers' expectations of students' academic performance enacted in teachers' pedagogical choices?

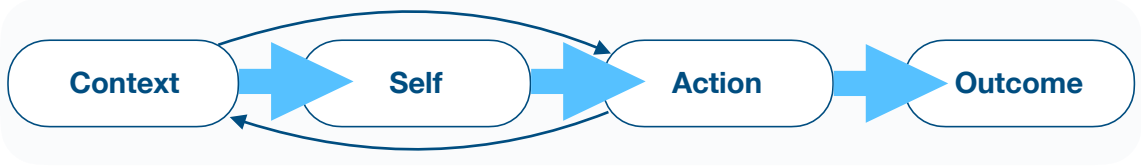
Q2. How do teachers' explicit pedagogical choices foster students' behavioral manifestations of their innate psychosocial needs; i.e., competence, autonomy, and relatedness?

2.0 Theoretical Framework

The study focused on the educational process—*viz*. social interactions within—and theorized that learning environments were a predicting factor in student engagement. The literature suggests a reciprocal interaction with contextual variables thus malleability of engagement (Appleton et al., 2008; see also Ryan & Deci, 2000b). To indicate the correlation, Connell & Wellborn (1991) proposed a model—context ⇾ self ⇾ action ⇾ outcome (see Figure 9)—to explain the cyclical relations between the degree of engagement and the quality of support students received from their contexts en route to expected outcomes (p. 54; see also Appleton et al., 2008, p. 380; Skinner & Belmont, 1993, p. 574).

Figure 9

The Context-Self-Action-Outcome Model



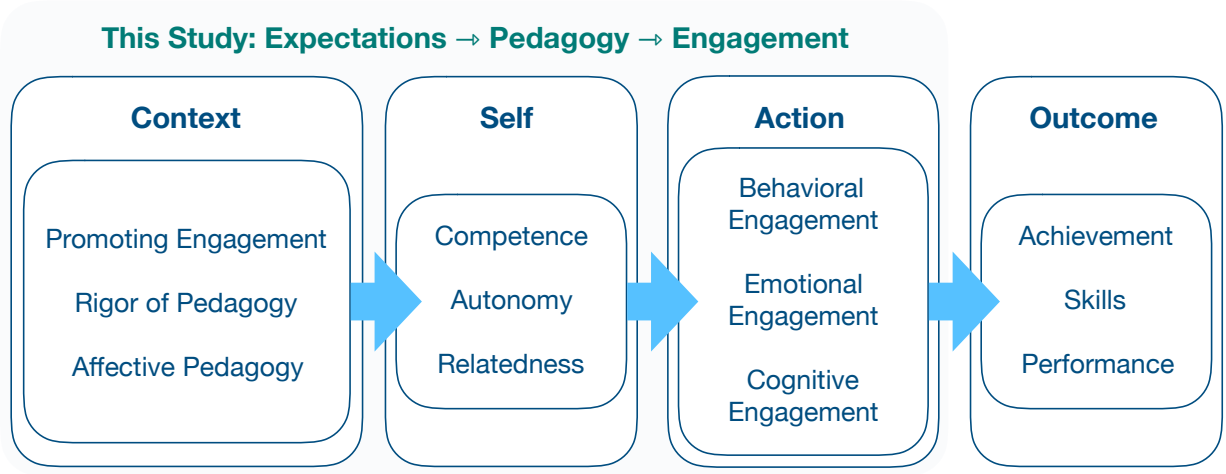
Note. Connell & Wellborn, 1991, p. 54; Appleton et al., 2008, p. 380; Skinner & Belmont, 1993, p. 574.

Applying the model in Figure 9, this study hypothesized that teachers' expectations enacted through their pedagogical actions would define the disposition of the particular learning

context. In turn, the context would affect the regulation of students' basic psychosocial needs. Finally, the resulting engagement would be a function of the fulfillment of students' psychosocial needs. This study did not examine etiologic effects on academic outcomes. Figure 10 adumbrates the theoretical framework.

Figure 10

An Overview of the Theoretical Framework



Note. (see also and cf. Appleton et al., 2008, p. 380).

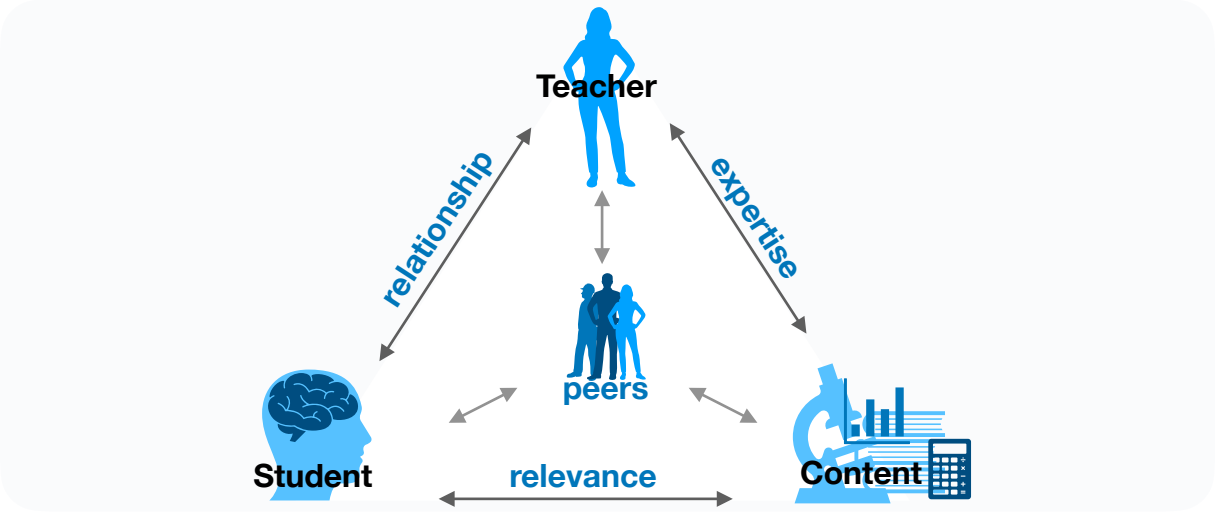
2.1 Context

Much of social interactions in schools center around pedagogy; and in fact, teaching and learning represent one of the most influential dimensions of school climate (Thapa et al., 2013, p. 365; see also "psychosocial functioning" in Wertsch, 2008). *Classroom climate* is the degree to which students feel connected and supported (Matsumura et al., 2008). Additionally, Thapa et al. (2013) assert that a school climate is characterized by patterns of norms, goals, values, and social interactions (p. 363) and reflects students' academic, emotional, and social experiences in school

(p. 369). As depicted in Figure 11, the process of teaching and learning is fundamentally relational (Thapa et al., 2013; see "instructional core" in Corso et al., 2013; City et al., 2009).

Figure 11

The Pedagogic Triangle: Teacher-Student-Content Interactions



Note. The pedagogic triangle is also called the instructional core (Corso et al., 2013; City et al., 2009).

According to Guthrie and Anderson (1999), "social interaction patterns in the classroom can amplify or constrict students' intrinsic motivations, their use of self-regulated strategies, and their attainment of deep conceptual knowledge" (p. 20; see also "teacher-student relationships" in Wubbels & Brekelman, 2005). Therefore, under the assumption that teachers have a crucial role in shaping interaction patterns and that a majority of classroom interactions is pedagogical, this study investigated pedagogic actions that are pivotal in shaping student engagement.

2.1.1 Pedagogy

Studies have shown that effective pedagogy stimulates and sustains student engagement (e.g., Skinner & Bellmont, 1993), and engagement fosters learning (Carini et al., 2006; Parsons

et al., 2014). In fact, the degree of student engagement plays a critical role in their chances for academic success (Cerasoli et al., 2014; see also Corso et al., 2013), so the paramount of practice is teachers' ability to foster students' innate curiosity and desire to learn. Figure 12 summarizes examples of efficacious pedagogical actions (cf. Figure 13).

Figure 12

Effective Pedagogic Actions

Effective Pedagogic Actions

- promoting a collaborative environment, as opposed to competitive (e.g., Parsons et al., 2014),
- promoting a deeper understanding of underlying principles, as opposed to memorization and recall (Wiggins & McTighe, 2006),
- explicitly defining and communicating what constitutes satisfying academic performance (Ormrod, 2011, p. 444; see also p. 511; Skinner & Belmont, 1993),
- pressing for accurate knowledge and rigorous thinking (Matsumura et al., 2008),
- providing different representations for abstract concepts; e.g., sketches, mathematical equations, graphs, animations, etc. (e.g., Ormrod, 2011),
- pedagogical link-making (Scott et al., 2011),
- teacher restating students' contributions thus extending these ideas to the rest of the class (Matsumura et al., 2008; Tuckman, 1995),
- pressing students to provide evidence for their assertions (e.g., Tharp & Gallimore, 1988a).

(see also "assisted performance" in Tharp & Gallimore, 1988b; "effective lectures and discussions" in Lawson, 2010; "the Standard Performance Continuum" in Doherty et al., 2002; Doherty & Hilberg, 2008; Maloy et al., 2010; Peregoy & Boyle, 2008; Vacca et al., 2011; Simon, 1995; 2017; etc.)

Figure 13 represents the lower extreme on the spectrum of classroom interactions. To some extent, all pedagogical interactions consist of a unidirectional teacher-to-class monolog (see T2C in Figure 13) albeit in different ratios to other interactions. Although, lectures are still a useful teaching convention, the age of information has redefined the manner in which learners nowadays interact with information and synthesize new knowledge (see Figures 52–53 in Appendix V; see also Maloy et al., 2011; Wiggins & McTighe, 2006; Lawson, 2010).

Figure 13

Less Effective Pedagogic Actions

The Anti-Measure to Effective Pedagogic Actions

- The teacher presents the content to the class verbally (T2C); i.e., to no one in particular, uses no visual aids, no other forms of representation (Edlich, 1993; McIntosh, 1996; cf. Lawson, 2010).
- collaboration dimension → absence of collaborative activities
- language use → the teacher dominates the discourse
- contextualization → decontextualized learning, lack of integration
- cognitive complexity → over-reliance on memorization and recall
- student-teacher dialog → script recitation

} based on the Standard Performance Continuum (Doherty et al., 2002)

(see also "interactive pedagogy" in Shor, 1992; "assign and tell" in Vacca et al., 2011; "teaching by mentioning" in Wiggins & McTighe, 2006; "passive vs. active learning" in Anthony, 1996; "philosophical continuums" in Maloy et al., 2010; Tharp et al., 2000; Doherty & Hilberg, 2008).

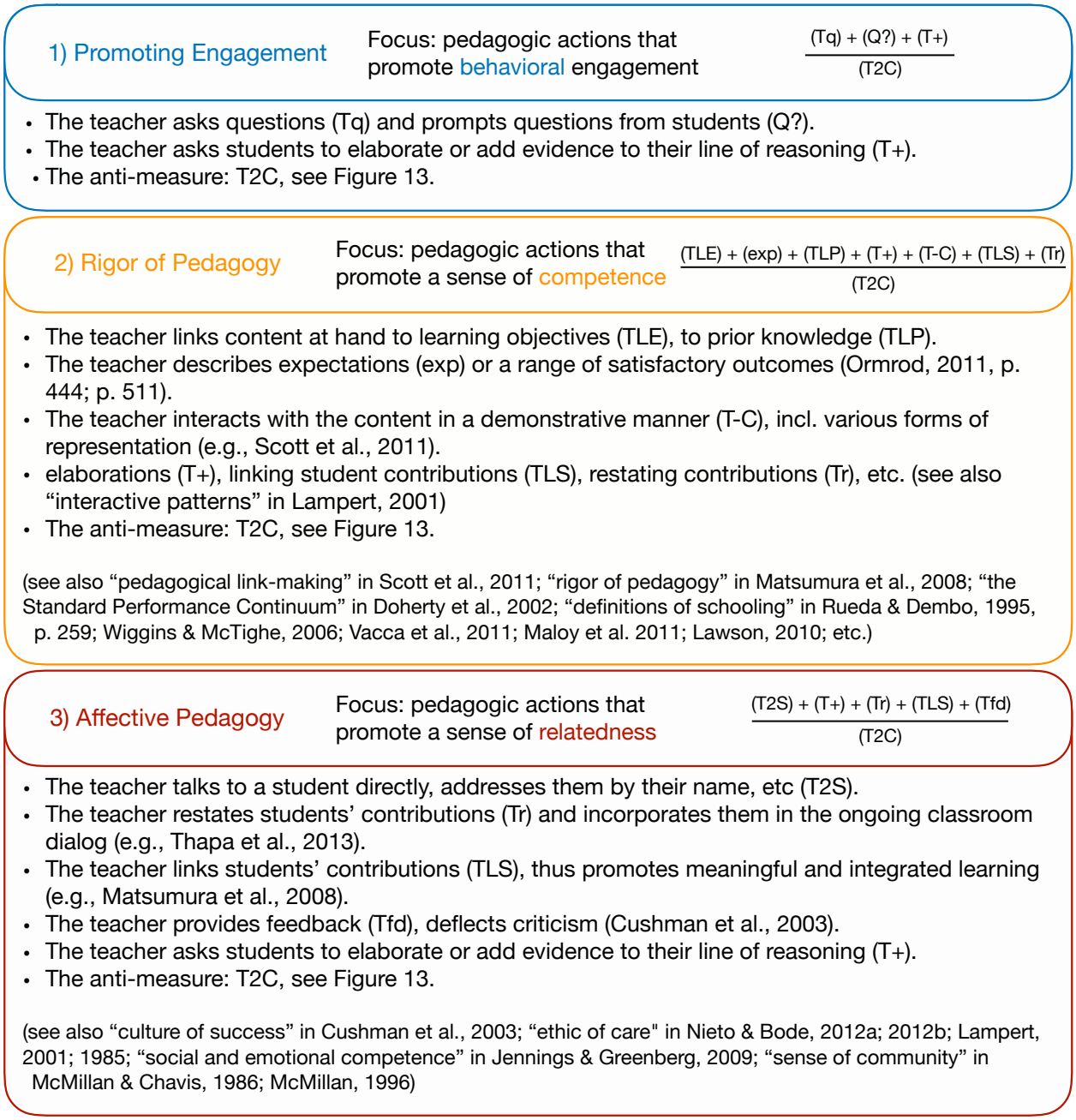
2.1.2 Measuring Pedagogy

So far, this study has argued that social interactions within pedagogy engender classroom contexts which, in turn, are consequential to student engagement. To quantify classroom interactions, the literature served as a guide in constructing three measures of pedagogy: 1) promoting engagement, 2) rigor of pedagogy, and 3) affective pedagogy. For consistency, this paper refers to combinations of different classroom interactions as constructs.

First, the construct *promoting engagement* incorporates pedagogical actions with the sole intent to promote behavioral engagement, *viz.* participation and interaction (see Figure 14.1). Second, *rigor of pedagogy* is a more general measure. It expands on 'promoting engagement' and includes pedagogic actions that are not intended exclusively to promote engagement but support students' sense of competence (see Figure 14.2). Third and final, *affective pedagogy* focuses on the affective dimension of pedagogy that provides a sense of relatedness (see Figure 14.3). The main goal is to juxtapose the results rather than to attain mathematical exactness.

Figure 14

The Constructs Measuring Pedagogy



Note. The main goal is to juxtapose the results rather than to attain mathematical exactness.

In sum, this section drew on the literature to quantify social interactions within pedagogical actions. Pedagogy and social interactions in the classroom socialize students, and

these contextual factors are consequential to students' self-regulation—to be discussed next.

2.2 Self

The previous section argued that classroom social interactions embedded within pedagogical actions create contexts affecting students' feelings and attitudes, thus are a contributing factor to their decision-making and engagement. This section shifts focus from contexts to students' psychosocial needs (see "self" in Figures 9 and 10) and draws on self-determination theory to postulate that contexts affect motivation; therefore, they are instrumental to student engagement (e.g., Ryan & Deci, 2017).

Motivation is the drive that "energizes, directs, and sustains behavior" (Ormrod, 2011, p. 362) or, simply put, "what moves people to action" (Ryan & Deci, 2017, p. 13). Additionally, motivation is reflected in students' investment and their behavioral, emotional, and cognitive engagement in academic activities. Ormrod (2011) further argues that the fulfillment of learners' basic needs—that are critical to their psychological functioning—are key ingredients to studying motivation. Engagement is the outcome of motivation and a predictor of performance (Cerasoli, 2014). A four-decade meta-analysis by Cerasoli et al. (2014), $k = 183$, $N = 212{,}468$, shows that intrinsic motivation is a medium to strong predictor of performance ($\rho = .21–.45$); furthermore, "intrinsic motivation predicted more unique variance in quality of performance, whereas incentives were a better predictor of quantity of performance" (p. 1). Next, self-determination theory further clarifies the link between motivation and performance.

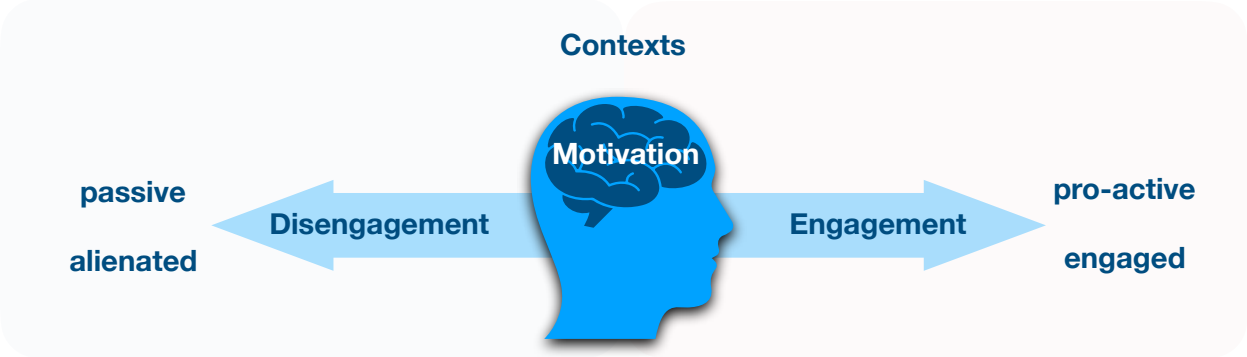
2.2.1 Self-Determination Theory

Self-determination theory (SDT) is a macro theory concerning human motivation, inherent proclivity for growth, and satisfaction of innate psychological needs (Ryan & Deci,

2017). SDT conceptualizes motivation as a function of social contexts, with the engagement outcomes falling on a spectrum, having a binary set of mutually exclusive extremes: proactive and engaged or passive and alienated (Ryan & Deci, 2000b, p. 68; see Figure 15). Internal motivating factors— each with highly varied experiences and ramifications—propel people to act upon their motivation, and the resulting behavioral outcomes can be self-authored or externally controlled.

Figure 15

Motivation → Engagement



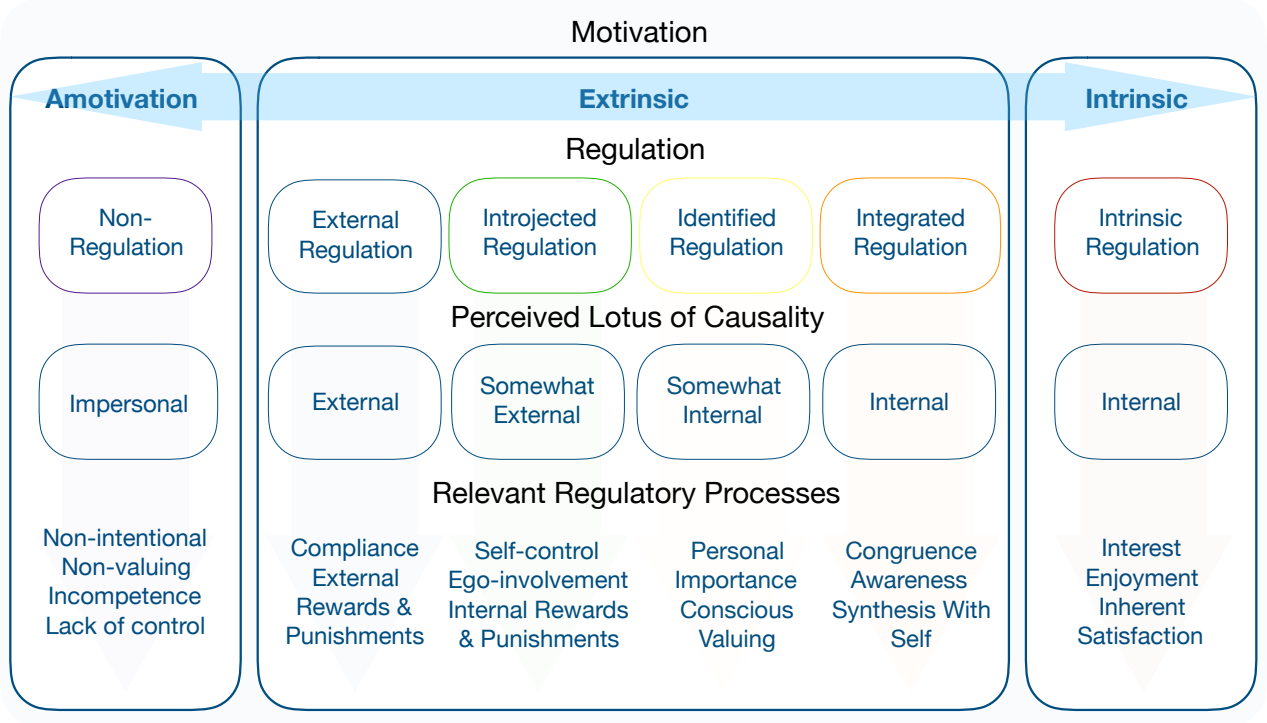
Note. Motivation as a function of contexts, engagement as an outcome.

According to Ryan and Deci (2000b), *intrinsic motivation* is "the prototypic manifestation of the human tendency toward learning and creativity" (p. 69). The innate drive is characterized by the inherent self-directed persistence to seek learning opportunities and intellectual challenges, to exercise and extend on one's abilities (Ryan & Deci, 2000b; Cerasoli et al., 2014, p. 3; see also "flow" in Ormrod, 2011). However, this innate proclivity requires supportive conditions. In fact, social contextual variables can either facilitate or forestall an individual's natural propensity for self-motivation and development (e.g., Ryan & Deci, 2017).

Extrinsic motivation, on the other hand, is co-authored by influential external factors in order to attain separable results or rewards (Ryan & Deci, 2000b; Deci, 1971). SDT identifies several distinct types of extrinsic motivation (see Figure 16), each with a corresponding set of specifiable consequences for learning, performance, personal experience, and well-being (Ryan & Deci, 2000b; see also "organismic integration theory" in Ryan & Deci, 2017, pp. 179–215).

Figure 16

The Self-Determination Continuum



Note. based on Ryan & Deci, 2000b; see also Ryan & Deci, 2017.

The most fundamental distinction between intrinsic and extrinsic motivation is that intrinsic motivation refers to engaging in tasks that are inherently interesting and enjoyable. On the other hand, extrinsic motivation refers to undertaking an activity because it yields a separable

outcome or a reward made contingent on task performance (Ryan & Deci, 2000a, p. 55; 2017, pp. 123–157; see also "external rewards" in Deci, 1971; see and cf. "cognitive and sociocultural perspectives on motivation" in Rueda & Dembo, 1995).

SDT underscores the importance of self-regulation. According to the theory, different types of motivation correspond to "differing degrees to which the value and regulation of the [performance task] have been internalized and integrated" (Ryan & Deci, 2000b, p. 71). Internalization and integration are outcomes of socialization (p. 71); moreover, contexts supportive of one's psychosocial needs foster a greater degree of internalization and integration than those that thwart satisfaction of these needs (p. 76). Therefore, this study examined how teachers' pedagogical actions affect the satisfaction of students' psychosocial needs thus mediate internalization. The variability in motivation-to-engagement transfer can be explained by cognitive evaluation theory.

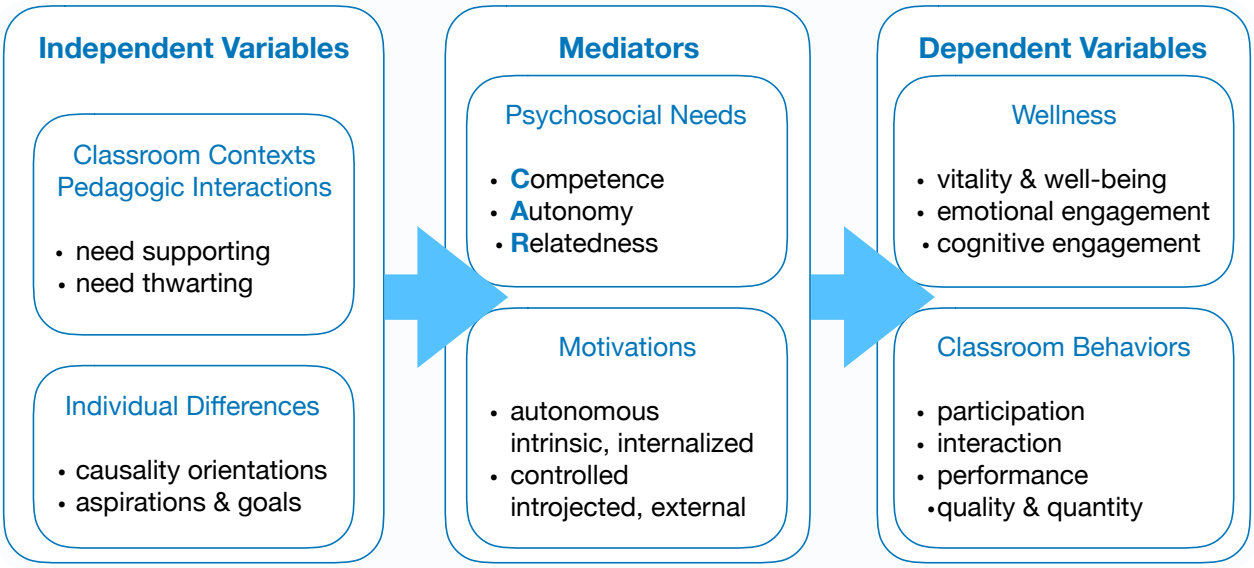
2.2.2 Cognitive Evaluation Theory

Cognitive evaluation theory (CET), a sub-theory of SDT, was developed inductively and explains variability in intrinsic motivation, by examining the satisfaction of three innate psychological needs: competence, autonomy, and relatedness (Ryan & Deci, 2000b; 2017). Fulfillment of these needs contributes to and enhances an individual's optimal functioning, intrinsic motivation, self-regulation, and well-being. For example, events that promote a greater degree of perceived competence enhance intrinsic motivation (Ryan & Deci, 2017, p. 130; see also p. 513). Furthermore, autonomy-supportive social contexts—in which teachers "minimize the salience of external incentives and threats, avoid controlling language, and acknowledge the learners' frame of reference—have been found to enhance autonomous motivation" and lead to

higher academic performance (Vansteenkiste et al., 2004, p. 247). In other words, tasks that are consistent with the satisfaction of basic psychological needs lead to positive learning-related outcomes (p. 259). Ergo, this study hypothesized that students' psychosocial needs—*viz*. competence, autonomy, and relatedness—would function as mediators between independent contextual variables and dependent variables (see Figure 17; see also Deci et al., 2017, p. 23).

Figure 17

Application of CET to Classroom Contexts



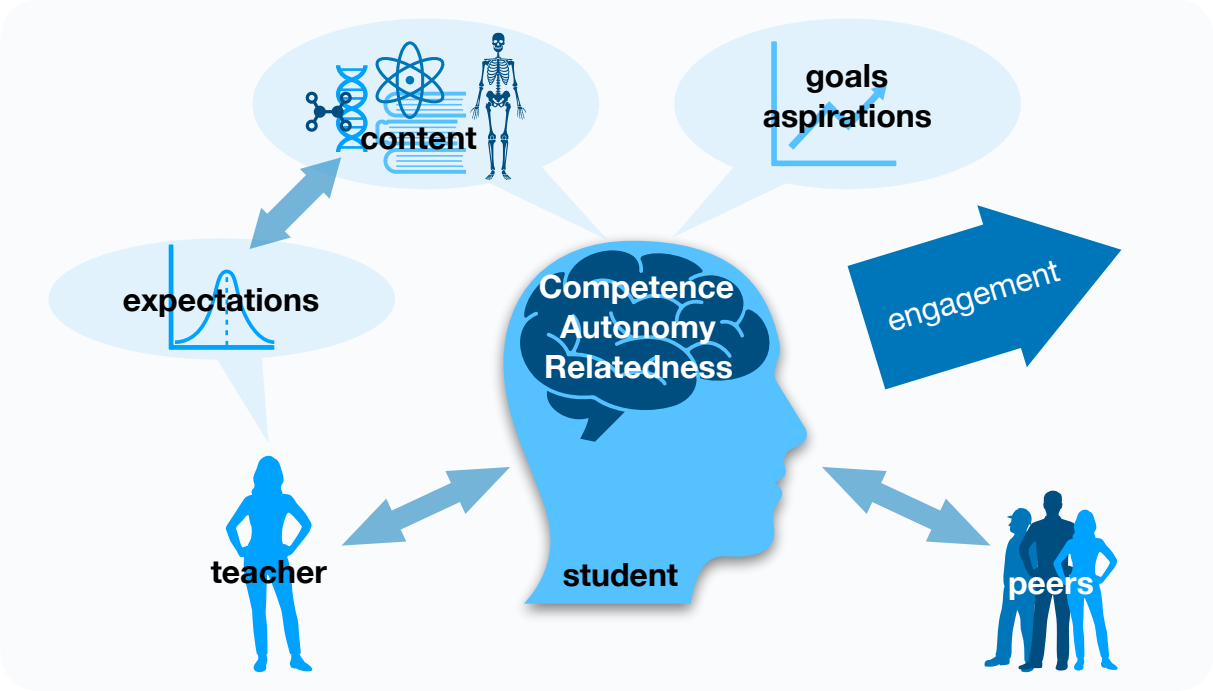
Note. (Deci et al., 2017) The figure has been adjusted for use in educational contexts.

Feedback, social dialog, or other classroom-communication factors can generate feelings of competence and belonging; therefore, they can enhance intrinsic motivation for engagement in academic tasks (see Figure 18). The research supports the notion that social contexts are a predictor of performance because they catalyze intra- and inter-person differences in motivation and personal propensity for growth (e.g., Vansteenkiste et al., 2006; 2004). In fact, CET argues

that intrinsic motivation is likely to flourish in environments characterized by a sense of psychosocial safety and relatedness (Ryan & Deci, 2017; see also Nolen et al., 2015).

Figure 18

Student in Complex Multi-Variable Contexts



However, CET further argues that feelings of competence do not enhance intrinsic motivation unless they are accompanied by a sense of autonomy (Ryan & Deci, 2000a; 2000b). Studies have shown that autonomy-supportive teachers conduce greater intrinsic motivation in their students, enhance curiosity and desire for challenges (Ryan & Deci, 2000b, pp. 70–71; see also Vansteenkiste et al., 2006).

2.3 Action

To review, the first section of the theoretical framing established that pedagogical interactions engender a particular disposition of learning contexts. The second section postulated

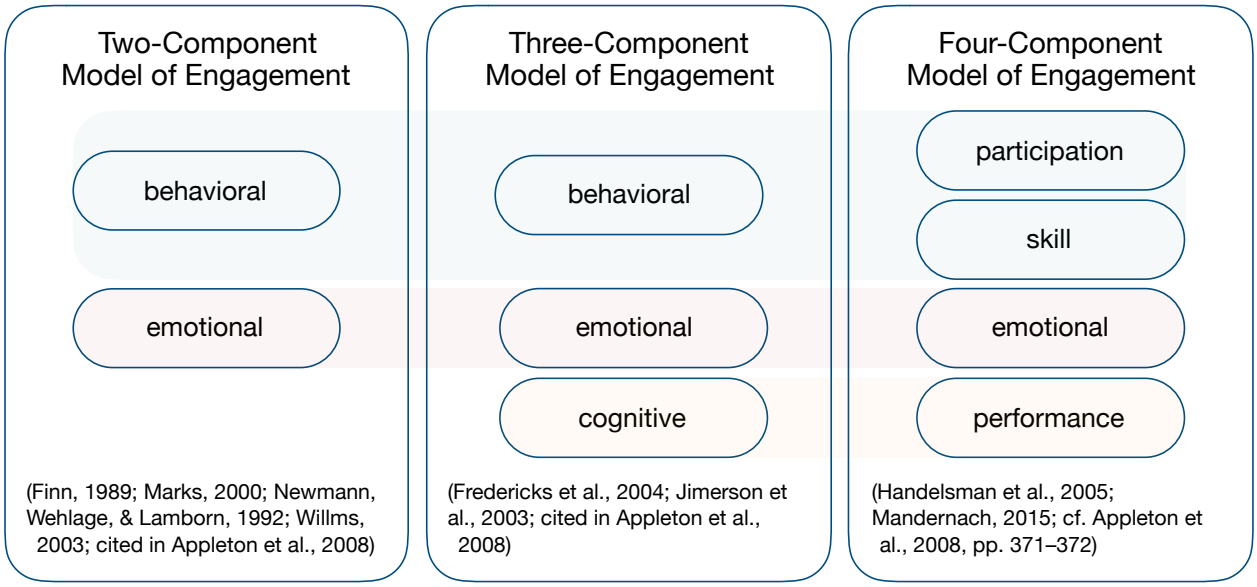
that students' psychosocial needs operate as mediators between motivation and engagement. This section describes engagement as the outcome of motivation and a function of contextual variables and psychosocially supportive pedagogy (Ryan & Deci, 2000b).

2.3.1 Engagement

As depicted in Figure 19, the literature generally conceptualizes engagement as having two or three (Appleton et al., 2008), or even four components (Handelsman et al., 2005).

Figure 19

Examples of Two-, Three-, and Four-Component Models of Engagement



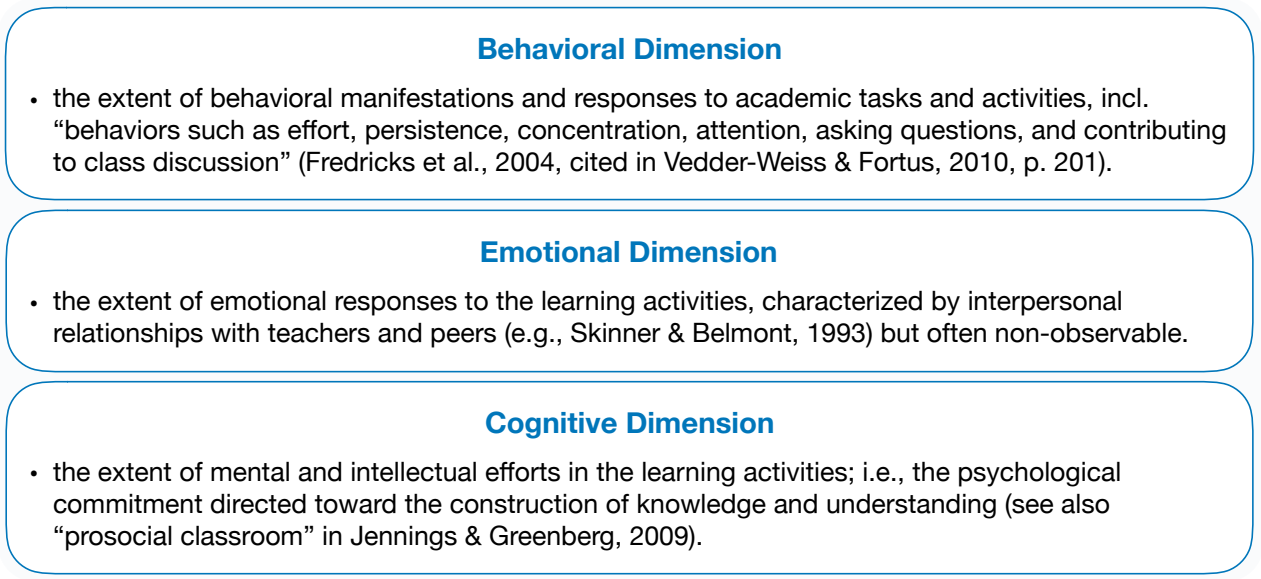
Note. The figure is not intended to be exhaustive.

The literature on engagement offers only a minimal consensus on its definition and contains substantial discrepancies in how engagement is operationalized and quantified (Appleton et al., 2008) but generally agrees that engagement is a complex multidimensional phenomenon (e.g., Butler, 2011; Handelsman et al., 2005; Skinner & Belmont, 1993). The notion

of engagement has evolved from comprising solely observable behaviors to including cognitive and affective dimensions (e.g., Appleton et al., 2008; Rueda & Dembo, 1995; Mandernach, 2015). Figure 20 depicts an example of a tripartite conceptualization of engagement, consisting of three nonorthogonal interrelated dimensions (Chapman, 2003; cited in Mandernach, 2015).

Figure 20

The Tripartite Conceptualization of Engagement



2.3.2 Measuring Engagement

For the purpose of this study, *engagement* is defined as the quality of effort; i.e., the breadth and depth of student initiatives that contribute to learning and development (Pace, 1984, pp. 96–97). Furthermore, engagement is "the time and energy students devote to educationally sound activities [in] . . . the classroom" (Kuh, 2003, p. 25), and in a reciprocally interactive dialogue; i.e., "the antithesis of separateness" (Barnett, 2003; p. 23). In short, classroom engagement is students' investment in an ongoing content-related discourse.

2.3.2.1 Observed Engagement. This study argued that social interactions in the classroom engender a particular classroom context (see Figure 11). *Behavioral engagement* consists of students' involvement in learning activities; i.e., an investment of attention, intellectual energy, and social interactions (e.g., Mandernach, 2015; Garrett, 2011). This dimension of engagement includes participation, interaction, and other actions, but it is often limited to observable behaviors. Figure 21 depicts how the study quantified this particular measure of engagement.

Figure 21

Measuring Observed Student Engagement

Observed Engagement — Participation/interaction: behavioral manifestations of engagement

$$\frac{(S2Tq) + (Sini) + (S2S) + (S+) + (S\text{-}C)}{\sum (N/C)}$$

- the frequency of students asking questions (S2Tq) (Butler, 2011),
- frequency of initiating content-related contributions (Sini) (see "initiation and execution of leaning activities" in Skinner & Belmont, 1993, p. 575),
- frequency of collaborative work with peers characterized by students building upon one another's ideas (S2S) (e.g., Kuh, 2003; Mandernach, 2015; see also Ghaith, 2003; Wentzel & Watkins, 2002; cited in Thapa et al., 2013),
- the rigor of discussion; i.e., the frequency of students elaborating or adding evidence to their line of reasoning (S+) (Matsumura et al., 2008, p. 299; cf. "task completion" in Doyle, 1983),
- frequency of interacting with the content in a demonstrative manner (S-C), etc.
- the anti-measure of engagement: sum of non-content interactions or distractions, such as walk out, eating food, talking, unrelated use of digital devices, etc.

Note. The construct measures only observable behavioral manifestations of engagement.

The main goal is to juxtapose the results rather than to attain mathematical exactness.

2.3.2.2 Spectrum of Engagement. Measures of observed behavioral manifestations do not necessarily communicate the utter extent of engagement (Mandernach, 2015; Handelsman et al., 2005). In fact, participation and interaction are only a subset of engagement. Students' self-

reported perspectives on engagement offer additional insights that are unattainable from observations; however, Mandernach (2015) points out that any assessment of these measures "should be careful to differentiate between satisfaction and engagement" (p. 6). Furthermore, Handelsman et al. (2005) found that many studies rate engagement at the macro level. In response, the researchers constructed and validated a measure of engagement that focuses on the micro level. The questionnaire centers around "what happens in and immediately surrounding class" and takes into account the teacher's role as a major influence on student behaviors (p. 185). The measure has four dimensions: skills, emotional, participation/interaction, and performance engagement (for more details, see Methods).

In sum, this case study investigated classroom contexts, situations, and interactions that have a capacity to facilitate or hinder students' innate psychological needs: competence, autonomy, and relatedness. It could be hypothesized that satisfaction of these needs would positively affect engagement.

2.4 Hypotheses

Based on the presented theoretical arguments, the following hypotheses guided the study:

H1. Teachers explicitly promoting engagement would lead to higher frequencies and quality of observed behavioral manifestations of engagement.

H2. Learning environments that are supportive of competence, autonomy, and relatedness would result in higher engagement.

3.0 Methods

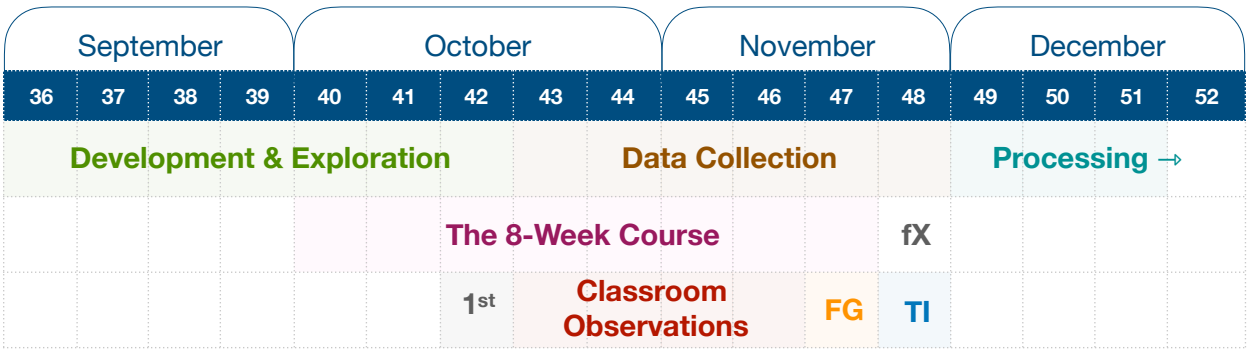
The study was conceived in the interpretative research tradition (e.g., Denscombe, 2010; Guba, 1981) but deliberately crossed the boundaries of conventional paradigms to descriptive quantitative. The choice of mixed-methods case-study approach allowed to focus on and study a paired instance of a particular phenomenon. The reasons include but are not limited to:

- a detailed and holistic approach to studying the classroom climate, social interactions within, and resulting engagement (Denscombe, 2010, pp. 51–64),
- to "clarify and explain relationship found to exist between [sets of] variables" and identify particular pedagogic actions that foster engagement (Fraenkel & Wallen, 2008, p. 558–560),
- to cross-validate findings from various studies and theoretical didactics, with the objective to converge on a single interpretation of a phenomenon (Guba, 1981; Fraenkel & Wallen, 2008).

Figure 22 depicts the project timeline.

Figure 22

The Project Timeline



Note. Abbreviations:

1st	first visit at the location	fX	final examination
FG	student focus groups, incl. questionnaires	TI	teacher interviews

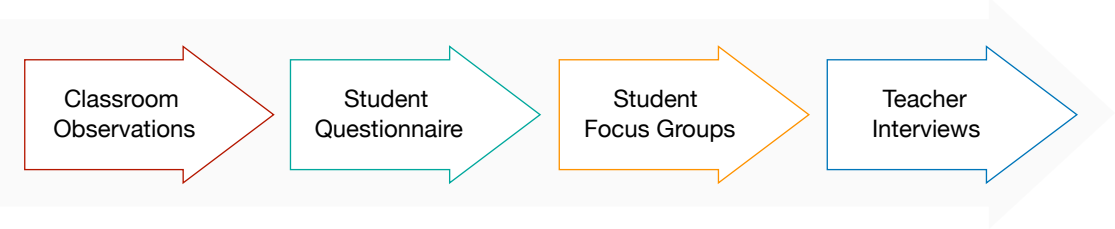
3.1 Phases

During the development phase, a literature search aided the inception of an observation rubric (see Table 3 in Appendix I). The rubric was developed by watching teaching videos with an intention to capture and generalize a wide spectrum of classroom interactions (e.g., Annenberg Media, 1999; Bank Street, n.d; Haynes, n.d; Hancock Productions, 1998; WestEd, 2001; WGBH Media, 1996; etc.). The resulting rubric essentially deconstructs classroom reality along the pedagogic triangle into its constituent interaction components (see Figure 11). The coding scheme underwent several versions and was tested on non-sample classes.

During the exploration phase, several secondary bilingual schools (TTO) throughout the Netherlands were approached. The school of choice was a convenience sample scouted at the recommendation of the researcher's supervisor. After initial observations in each class, the rubric was adjusted for use at the particular location. The data from the first observations were disregarded from the analysis. Next, de facto data collection generated four types of data (see Figure 23): 1) from classroom observations, 2) student questionnaires, 3) student focus groups, and 4) teacher interviews. Finally, data processing was the final phase and included additional literature search.

Figure 23

The Data Collection Phase: The Methods



3.2 Sample and Contexts

The study was conducted in the Netherlands, at an institute specializing in access education. The school offers condensed courses in secondary-level physics, chemistry, biology, and mathematics for students who intend to enter higher education. Upon successful completion of the exam, students fulfill a prerequisite to enter a university in the Netherlands. The courses are on pass/non-pass basis, offered several times throughout the year, and conducted in Dutch and English. The classes vary in length and intensity to serve a range of ability groups.

One of the main benefits of choosing this particular school emerged from its limits on the ranges of possible variables and outcomes. First, having a binary set of outcomes, teacher expectations were presumed to be limited by the preferred outcome, *viz.* to pass the exam. Second, the institute serves a particular group of students; i.e., university-bound students. Thus, the motivation to learn was expected to be somewhat invariable across the population sample. The nature of motivation was not under investigation; however, the study theorized that students were predominantly extrinsically motivated; i.e., wanted to pass the exam. Because many schools frame their academic goals similarly, the extrinsically framed motivation presupposed ecological generalizability of the findings. However, this conjecture does not obviate a critical assessment of the external validity (see Limitations).

The study observed two highly condensed physics courses ($n = 2$). For consistency, the study refers to the teachers, students, and classes as X and Y. 16 students were enrolled in class X, and 14 students in class Y ($N = 30$). The average age was 20.1 in class X and 19.6 in class Y, students' ages in both classes ranged between 18 and 29. The participants were from Africa, Asia, Europe, and the Americas. The language of instruction was English, and the classes met

five times a week for 3.5 hours, over eight weeks in total. The final examination occurred one week after the completion of the course.

The sample was a convenience sample; however, the rater had previously had no prior history with the participants and maintained a casual but minimal interaction (see "optimal distance" in Guba, 1981, p. 77). The participants were ensured of confidentiality and were given a general and intentionally vague idea about the aims of the study: an investigation of classroom practice and approaches to measuring practice. Both teachers agreed to a combination of scheduled and unscheduled visits.

3.3 Procedure Overview

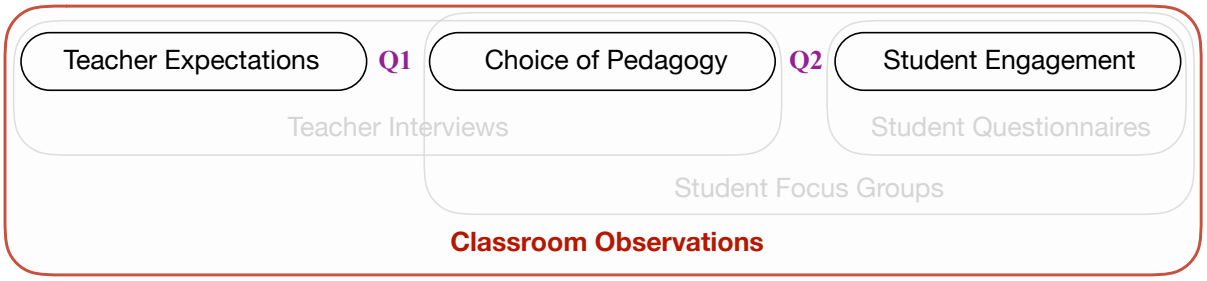
The mixed-methods inquiry employed the methodological tools previously outlined in Figure 23. The relations among the methods, types of data, and research questions are depicted in Figures 24–27 (see also Figure 28).

3.3.1 Classroom Observations

3.3.1.1 Types of Data. Figure 24 depicts the general intent of classroom observations.

Figure 24

The Focus of Classroom Observations



Note. The data generated from classroom observations: expectations, pedagogy, and engagement.

The observations were to collect the following types of data in situ (a) teachers explicitly voicing their expectations; i.e., desired outcomes or learning objectives, (b) observed choices of pedagogic actions, and (c) resulting behavioral manifestations of student engagement. Thus, the observations yielded data to partially inform both research sub-questions, Q1: expectations vs. pedagogy, and Q2: pedagogy vs. engagement.

3.3.1.2 Data Collection. The coder visited six non-consecutive 3.5-hour-long lessons in each of the two classes, a total of 42 hours. The total hours of classroom observations constituted 15% of the entire course.

By the time of first observations, the coder had practiced the coding scheme for six weeks thus had it memorized. The coder recorded all teacher-student-content and non-content interactions in real time and logged these interactions in a spreadsheet in Numbers (MacOS), each code in a new column. The lessons were timed with a stopwatch from the time the teacher first addressed the class. The coder closely monitored the time and started a new line of codes in 5.0-minute intervals (see Sample Log in Table 4 in Appendix I).

The empirical data generated during whole-class discussions were coded and recorded in its entirety to hamper potential biases and prevent disregarding data without justification (Denscombe, 2010, p. 178). During group or individual work, the rater took descriptive notes and recorded contextual factors.

Because rigor in data collection is a critical criterion of quality (Guba, 1981, p. 78; see also Denscombe, 2010, p. 199), it was imperative to allow for sufficient data saturation until no new themes emerged. The number of observation days per teacher was increased from two to six, so if needed, the measure of variance and the degree of internal consistency could be assessed

conclusively (for shifts in interaction patterns see Discussion).

3.3.1.3 Data Processing. Numbers (MacOS) calculated the sums of codes per 5.0-minute intervals and total instances per lesson. Per each interval, the individual codes were summed according to the formulas representing three pedagogy-centered constructs: 1) promoting engagement (see Figure 14.1), 2) rigor of pedagogy (see Figure 14.2), 3) affective pedagogy (see Figure 14.3), and one student-centered construct 4) observed student engagement (see Figure 21) These values represent rough approximations of lesson progression and variations in pedagogy and engagement throughout each lesson.

The final sums from each individual lesson were normalized; i.e., scaled to represent frequencies per 3.5-hour lesson rather than counts per varied time lengths. These values per each code were also summed according to the constructs' formulas. The ratios are dimensionless.

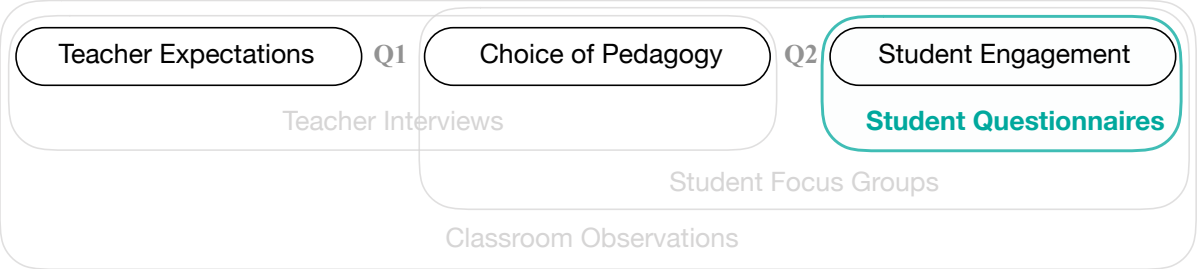
3.3.1.4 Percent Agreement. Inter-rater agreement was assessed by two coders observing a 90-minute segment of a lesson and simultaneously recording codes. After a discussion with the second coder, the resulting agreement was determined to be moderate .58, or satisfactory .83 with a code omission (see Limitations). To assess Cohen's kappa, lesson videotaping was arranged for the last week of classes; however, it was cancelled due to privacy concerns. Plans to observe additional lessons with a second coder were abandoned due to the COVID-19 preventative measures.

3.3.2 Student Questionnaires

3.3.2.1 Types of Data. The intent of student questionnaires was to (a) assess students' perspectives on their engagement, and (b) supplement the behavioral data from classroom observations with a more comprehensive measure of engagement (see Figure 25).

Figure 25

The Focus of Student Questionnaires



Note. The data generated from class from questionnaires: a fuller spectrum of student engagement.

Use of questionnaires partly disentangled some of the interlocking factors typically associated with the naturalistic paradigm. The additional statistical data arising from questionnaires were to supplement and to confirm or disconfirm the validity of measurements procured by the observation rubric.

The Student Course Engagement Questionnaire (SCEQ; see Appendix II) was devised and validated by Handelsman et al. (2005) and consists of 23 questions on a 5-point Likert scale. The authors reported conclusive "evidence of the convergent and discriminant validity of the [SCEQ]" (p. 184). According to Mandernach (2015), "the SCEQ provides a more comprehensive understanding of student engagement and fosters insight beyond what is visible in behavioral observations of classroom engagement" (p. 10). An advantage of using the SCEQ is its focus on class-level influences, as opposed to school-level. The SCEQ has four sub-scales: i) skills engagement, ii) emotional engagement, iii) participation/interaction engagement (behavioral), and iv) performance engagement. The participation/interaction sub-scale was of a particular interest and was compared with the observed student engagement. The other sub-scales enriched the perspective to a more extensive spectrum of engagement (see "measuring engagement" in

Theoretical Framing).

3.3.2.2 Data Collection. On separate days during the final week of the course, students from both classes were asked to voluntarily fill out the SCEQ (see Appendix II) and consented to having the data processed for the purpose of the study. At the time of administering the questionnaires, 15 students from class X and 12 students from class Y were present ($N = 27$). It is crucial to mention that the sample pool consisted of only 27 respondents. Next, the data from the SCEQ were digitized in both SPSS (Windows) and Numbers (MacOS).

3.3.2.3 Data Processing. From the data, SPSS generated the following measures: basic descriptive statistics, Chronbach's alphas (incl. per each sub-scale), Pearson's correlations and *p*-values, point-biserial correlations (according to class and gender), and independent-samples *t*-tests (see Tables 13–16 in Appendix II).

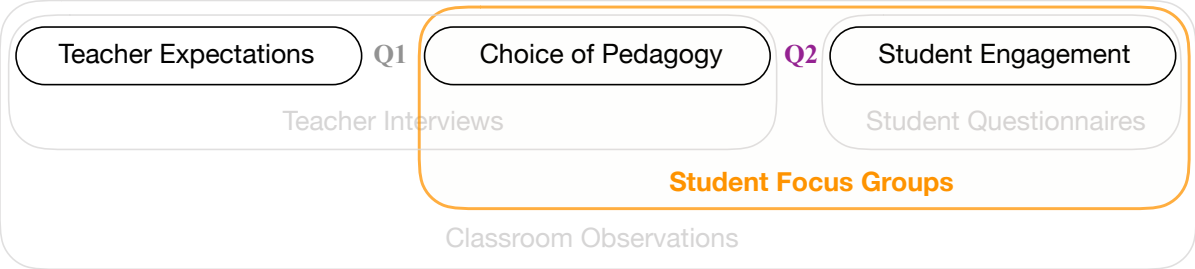
3.3.2.4 Chronbach's Alpha. Assessed by the SPSS, the SCEQ yielded an average coefficient alpha of .81, corresponding to a good measure of internal consistency. The coefficients for individual sub-scales ranged from .75 to .90, from acceptable to excellent (see Tables 11–12 in Appendix II).

3.3.3 Student Focus Groups

3.3.3.1 Types of Data. The intent of student focus groups was to collect students' perspectives on (a) the teachers' choice of pedagogy and intermediate learning objectives, and (b) students' accounts on their engagement; i.e., their feelings, thoughts, and attitudes. In other words, it was to fathom etiologic factors between the choice of pedagogy and engagement and to generalize trends in how students responded to specific pedagogical choices. Thus, the student focus groups yielded data to answer sub-question Q2: pedagogy vs. engagement (see Figure 26).

Figure 26

The Focus of Student Focus Groups



Note. The data from focus groups: students' perspectives on pedagogy and engagement.

3.3.3.2 Data Collection. After the students filled out the SCEQ, they were asked to volunteer in the focus groups. Six students were randomly selected from each class for their respective focus groups, but all of the selected agreed to participate. The students consented to being audio recorded twice: once prior to the session and then again at the beginning of the recording. The sessions were approximately 15 minutes long and semi-structured. The participants were asked similar and intentionally vague questions. For example, "How was it?" "And the teaching style?" "Last remarks?" (see Figure 47 in Appendix III).

3.3.3.3 Data Processing. The recordings from the focus groups were transcribed verbatim. The data on engagement were initially coded top-down in agreement with the cognitive evaluation theory's three innate psychological needs: competence, autonomy, and relatedness. Two additional codes were intended to assess engagement: Eng+ (a generally positive) and Eng– (generally negative). Next, the transcript was re-coded to assess the teacher's choice of pedagogy, using the bottom-up coding scheme from teacher interviews. However, the coding allowed for the emergence of additional themes (see Coding Scheme in Table 24 in Appendix IV and Flowchart in Figure 48 in Appendix III).

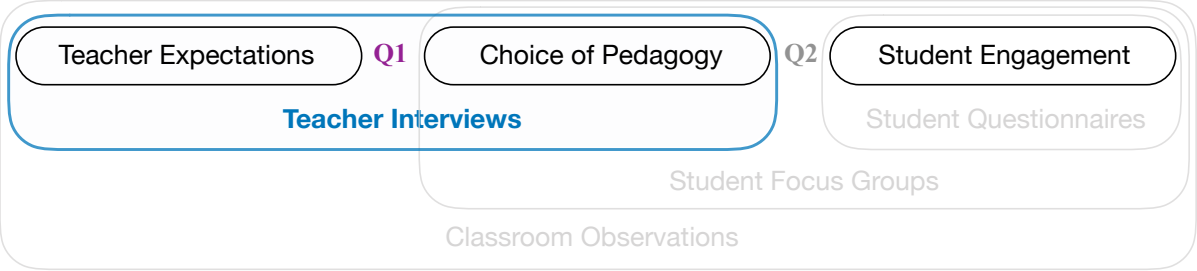
3.3.3.4 Cohen's Kappa. A second rater independently coded a set of 30 randomly selected student quotes. After a consultation with the second rater, an inter-rater matrix was constructed, and the average inter-rater agreement was calculated to be .83, or substantial to almost perfect (Landis & Koch, 1977; see also Regier et al., 2012).

3.3.4 Teacher Interviews

3.3.4.1 Types of Data. The intent of teacher interviews is depicted in Figure 27.

Figure 27

The Focus of Teacher Interviews



Note. The data generated from interviews: teachers' perspectives on expectations and pedagogy.

The interviews were to collect teachers' perspectives on (a) their explicit and implicit expectations of student performance; incl. intermediate learning objectives or desired outcomes, (b) their choice of pedagogic actions to achieve these expectations, (c) other contextual aspects that might have affected their choice of pedagogical actions, and (d) to ascertain any conjectures that might have emerged from classroom observations. Thus, the teacher interviews yielded data to answer sub-question Q1: expectations vs. engagement (see Figure 27).

3.3.4.2 Data Collection. The participating teachers were interviewed in the week following the final class meetings but before students' final examination. The same set of general

open-ended questions and follow-up questions guided each interview (see Figure 49 in Appendix IV), but unscripted follow-up questions based on participants' responses yielded unique trajectories for each interview. The teachers were asked the same question in different ways as to approach topics from a different angle or address situations in different contexts. Throughout the process, the interviewer deliberately varied who controls the flow of communication alternating between the interviewee and self (Fraenkel & Wallen, 2008).

3.3.4.3 Data Processing. Thereafter, the interview recordings were manually transcribed verbatim. The transcripts were coded alternating between top-down and bottom-up (Boeije, 2009). The inductive coding procedure allowed the emergence of themes from the data and consisted of labeling phenomena and creating categories according to properties and dimensions. Recursive reading led further fine-tuning of each teacher's individual coding scheme according to emerging patterns and their hierarchies. Next, the two parallel coding schemes were compared to identify overlapping themes, modified and merged into a single, final set of categories. Finally, both transcripts were re-coded again deductively (see Coding Scheme in Table 24 and Flowchart in Figure 50 in Appendix IV). The coding scheme was used predominantly to reference the data in a more thematically oriented manner but also to provide categories for further abstraction.

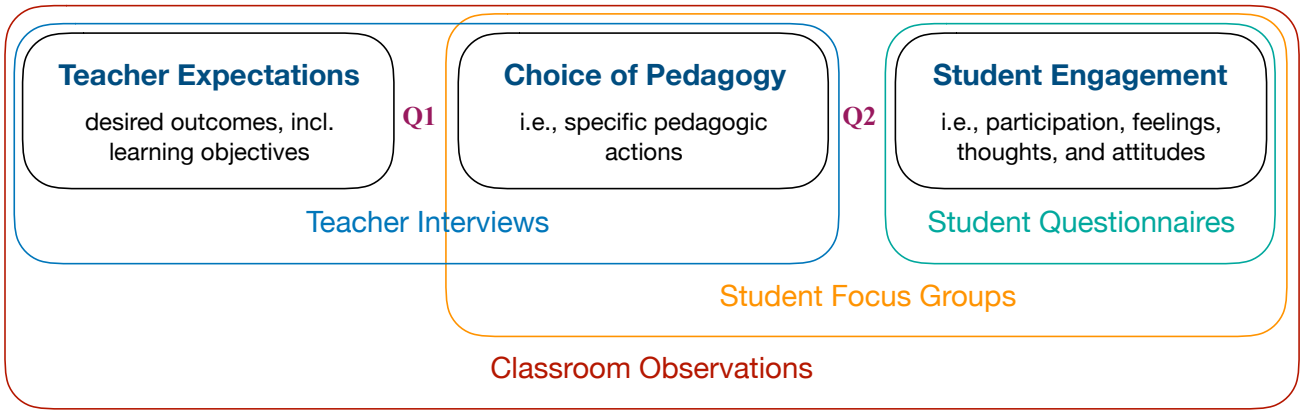
3.3.4.4 Cohen's Kappa. A second rater independently coded a set of 30 randomly selected quotes. After a consultation with the second rater, an inter-rater matrix was constructed, and the average inter-rater agreement was calculated to be .76, or substantial (Landis & Koch, 1977; see also Regier et al., 2012).

4.0 Results and Findings

Figure 28 graphically summarizes the inter-relationships between the research questions, sets of variables, and methods. To review, the study utilized the following methods: 1) classroom observations, 2) student questionnaires, 3) student focus groups, and 4) teacher interviews.

Figure 28

A Review: Research Questions vs. Sets of Variables vs. Methods



4.1 Classroom Observations

Classroom observation generated a total of 42 hours of data. Teacher X and Y devoted on average 58% and 56% of a lesson to whole-class discussions, respectively. Observations yielded data on: (a) teachers' references to expectations, (b) teachers actively promoting engagement and their choice of pedagogy, and (c) behavioral manifestations of students' engagement

4.1.1 Teacher Expectations

Teacher expectations were framed by external norms, *viz*. the examination standards. The teachers explicitly voiced their expectations in two ways. First, they described performance expectations, or possible ranges of satisfactory outcomes; i.e., how the exam designers wanted students to answer the problems. Second, the teachers linked the content at hand to expectations.

For example, while solving a problem, performing an experiment, or showing an animation, etc.

Table 1 summarizes average frequencies of teachers voicing their expectations.

Table 1

Classroom Observations: Teacher Expectations

		average frequencies (per lesson)	
Teacher-Student-Content Interaction	code	Teacher X	Teacher Y
The teacher explicitly describes expectations.	exp	3	4
The teacher links the content at hand to expectations.	TLE	19	20
Total		22	24

Note. Summary of empirical data on teacher expectations, per 3.5-hr lesson.

4.1.2 Choice of Pedagogy

To meet expectations, teachers employed intermediate learning objectives and a range of pedagogical actions. Figure 29 summarizes the teacher-modeled interactions with the content.

Figure 29

Modeled Interactions With the Content

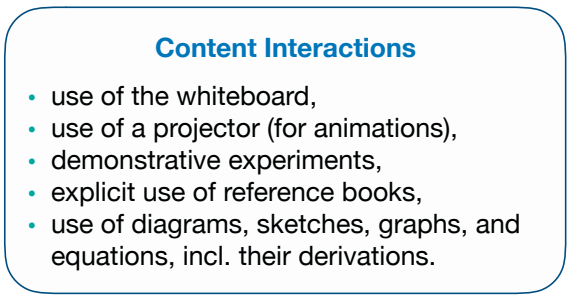
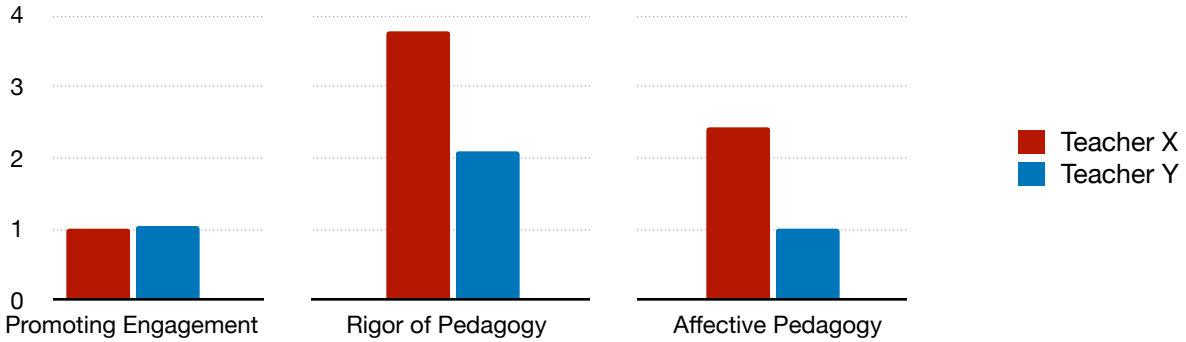


Figure 30 depicts the results of three measures of pedagogy: 1) promoting engagement, 2) rigor of pedagogy, and 3) affective pedagogy (see also Table 5 in Appendix I).

Figure 30

Three Constructs Measuring Pedagogy



Note. The values are ratios thus dimensionless.

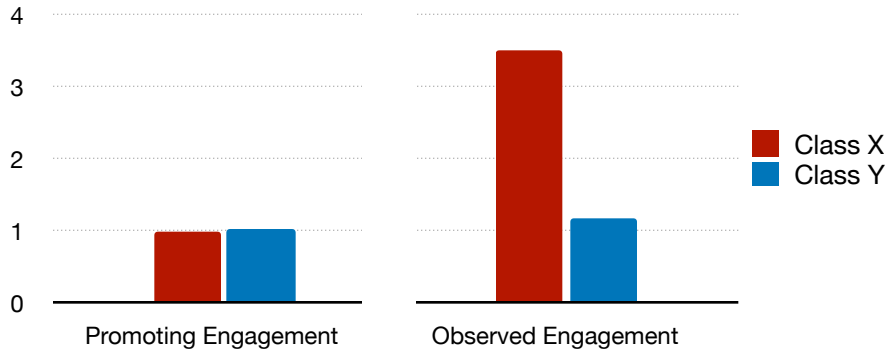
The x-axis and gridlines are interrupted to denote that the values are reciprocally incommensurate.

4.1.3 Student Engagement

Figure 31 depicts the construct of observed engagement in juxtaposition with previously addressed construct of promoting engagement (see also Table 6 in Appendix I).

Figure 31

Classroom Observations: Promoting Engagement vs. Observed Engagement



Note. The values are ratios thus dimensionless.

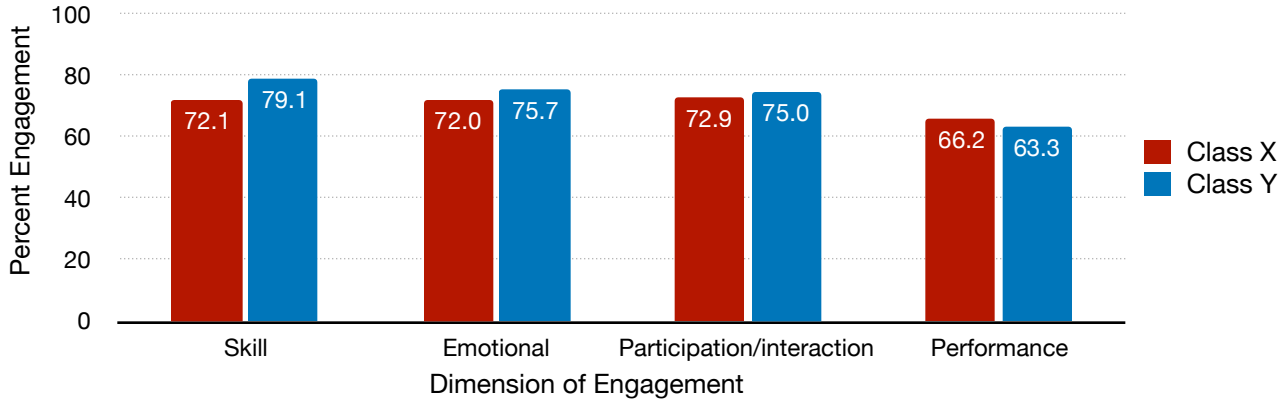
The x-axis and gridlines are interrupted to denote that the values are reciprocally incommensurate.

4.2 Student Questionnaires

In class X, 15 out of 16 students submitted the questionnaire (7 female, 8 male), and in class Y, 12 out of 14 students (8 female, 4 male). Figure 32 depicts the average scores corresponding to four dimensions of engagement (for Descriptives, see Table 8 in Appendix II). Furthermore, Table 9 in Appendix II breaks down the results according to respondents' gender.

Figure 32

The Student Course Engagement Questionnaire: the Results



Note. For the results of individual students, see Figure 46 in Appendix II.

Table 2 summarizes Pearson's *r* bivariate and point-serial correlations. Three outcomes marked by asterisks deserve an explicit mention. At the .05-level, the results indicate a positive correlation between skill and emotional engagement. Additionally, male students self-reported a higher degree of performance engagement. On the other hand, at the .01-level, female students reported higher skill engagement. It should be noted that correlation does not insinuate causation (see Discussion). The respondents' age was not distributed normally; and indeed, additional statistical tests suggest no correlation between age and engagement. For independent-samples t-tests, see Tables 13–16 in Appendix II.

Table 2

SCEQ: Bivariate and Point-Serial Correlations

Variable	1	2	3	4	5	6
1. Skill engagement	—	.463*	.342	−.002	−.551**	.313
2. Emotional engagement		—	-.014	.156	−.174	.215
3. Participation/Interaction engagement			—	.193	.096	.000
4. Performance engagement				—	.477*	−.086
5. Gender					—	#
6. Class						—

Note. $^{*}p \leq .05$, $^{**}p \leq .01$, #comparison is meaningless.

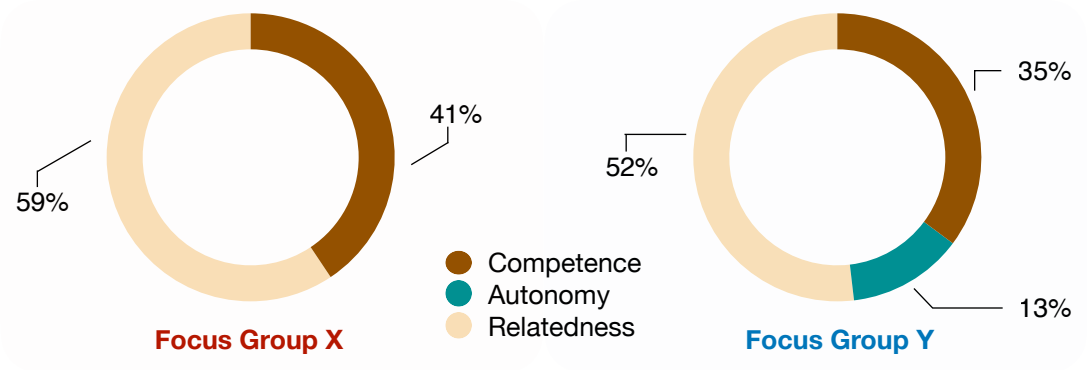
The data pool consisted of only 27 respondents.

4.3 Student Focus Groups

Student focus groups generated data on: i) choice of pedagogic choices, ii) students' feelings, thoughts, and attitudes about the class, the teacher, and peers, incl. links between pedagogy and engagement. Figure 33 compares students' self-reported perspectives on their engagement in terms of competence, autonomy, and relatedness (for quotes, see Figure 34).

Figure 33

Student Engagement According to Focus Group X and Y



Note. The Figure Represents Student Engagement Expressed in Terms of Their Psychosocial Needs.

Figure 34

Student Focus Groups X and Y: Students' Statements

Focus Group X

"[The class] was interactive."

"Sometimes education isn't always about learning the material, like you have… yes, the whole interaction, so counts a lot. [It] makes the whole course more vibrant."

"I was really worried about not being able [to] pick up this much physics in a span of two months. But I feel like it's pretty comprehensible, and it's ehmm… yeah. I feel like I'm learning everything quickly and thoroughly."

"But [Teacher X] has made it interactive. Like, he is… [silence] the learning is not, you know, completely passive. It's not just, you know, we read the information, receive information, that's it."

"Also, I like it's not really hierarchical. He like, like… he's just… interacting with us as if we are on the same level. . ."

"[I learned] to not be afraid to ask questions. [silence] Because in university, I would never ask questions. Because probably no one asks. No one has a question. But what I noticed in our class is the more people ask questions, the more questions arise."

"Even if. . . even for just curious… if we have a stupid question, he'll like totally entertain it, and like, you know… If we have any interest, he'll totally try to answer it no matter how out-of-the-way or unrelated it is. . ."

Focus Group Y

"He is also very energized. And he uses real world like experiments and, let's say, he would… bring like a vacuum pump and he would show us how…"

"and also what I realized, what he did is when we have a question from… from… from the booklet… we would have a question, we would ask him to help us, he would answer us in questions to make us think, instead of… just…giving us the answer."

"Because I've had [inaudible] can ask [Teacher Y] for anything. Always end up like… again, like, oh, I just answered my own question, okay, thanks anyway, though."

"All good teachers that I've known have a good sense of humor. And he keeps the class interesting."

"He… he also learns words for us. Because we don't know what it's called in English, the [a foreign language word], and then… Now, when he's helping us, he knows, yeah, you have to do the [a foreign language word]. It's something in math."

"Personally, I like . . . [to] work individually, you know, give me tasks, and then ehm… if I need help, then . . . I ask the teacher, obviously."

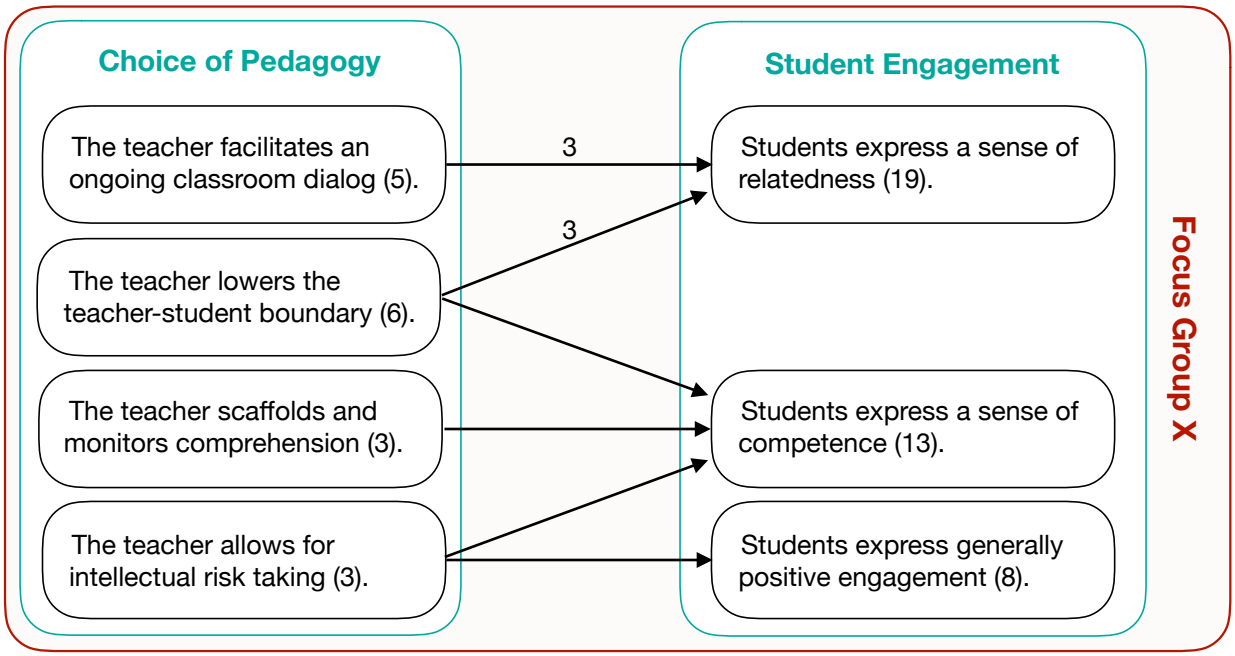
"When he explains it, some people have like… certain questions and he answers those individually. That's clear… you know, when… when he explains stuff, and then… some people [do] not understand point A, some people [do] not understand point B, so then we can. After he explains it, we can ask individually. So it's the mixture."

Note. A selection of statements from students (see also Tables 19–23 in Appendix III).

Figure 33 describes student engagement in terms of students' psychosocial needs—competence, autonomy, and relatedness—albeit in isolation from pedagogy. On the other hand, Figures 35 and 36 generalize students' perspectives on engaging pedagogical actions in their respective focus groups.

Figure 35

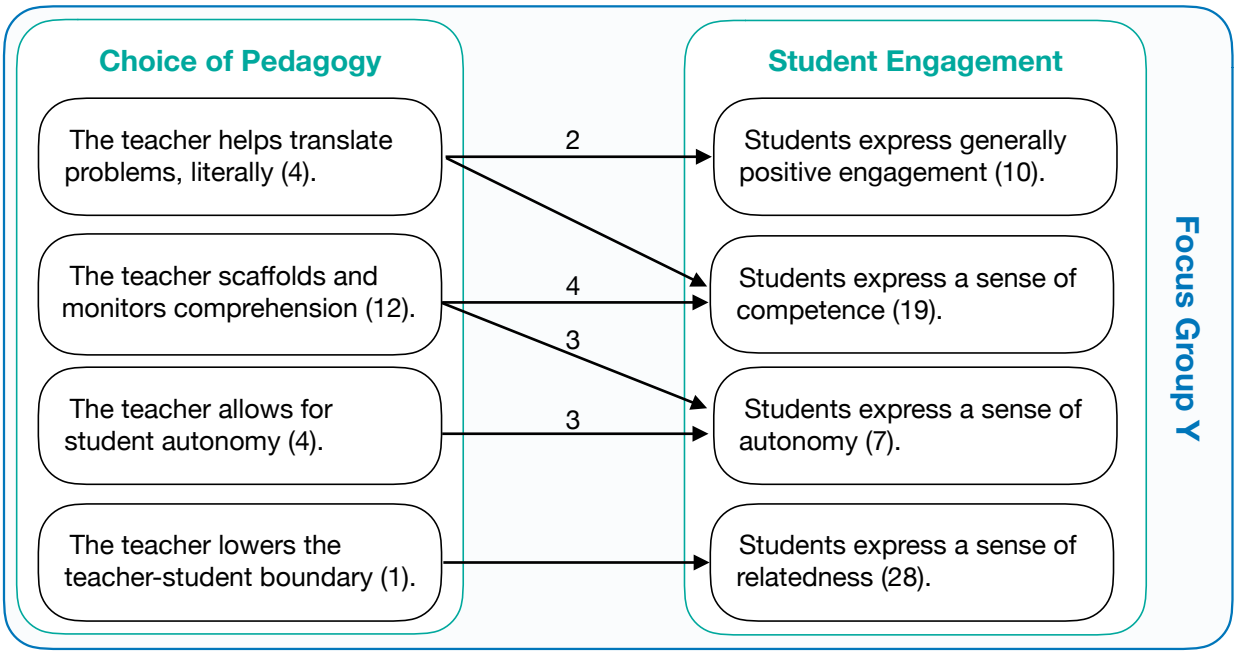
Student Focus Group X: Explicit Links Between Pedagogy and Engagement.



Notes. The numbers in parentheses enumerate the frequency of a statement expressed in isolation. The arrows represent students making explicit links between the teachers' pedagogical action and engagement. Unless stated otherwise, each arrow illustrates one explicit link.

Figure 36

Student Focus Group Y: Explicit Links Between Pedagogy and Engagement



Notes. The numbers in parentheses enumerate the frequency of a statement expressed in isolation. The arrows represent students making explicit links between the teachers' pedagogical action and engagement. Unless stated otherwise, each arrow illustrates one explicit link.

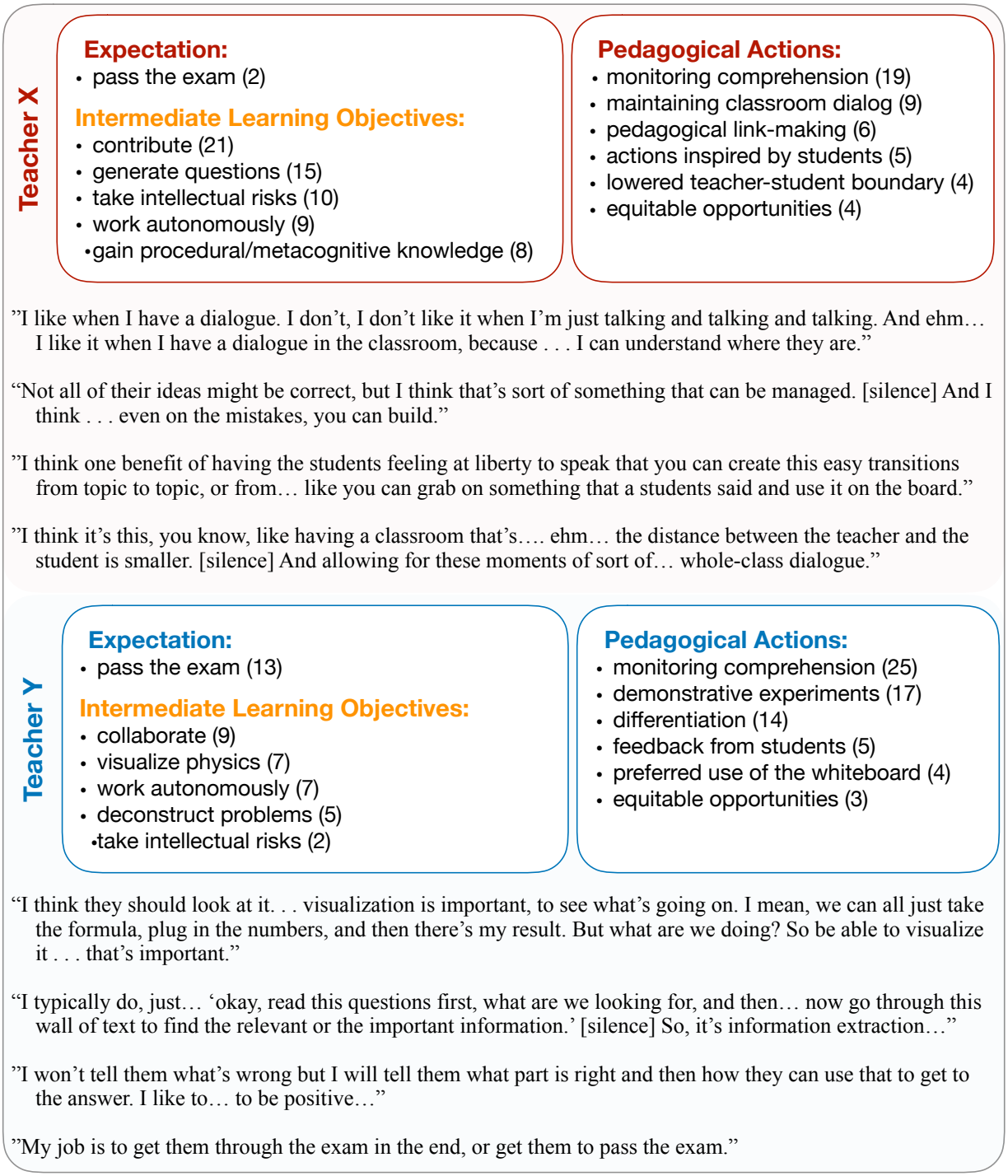
4.4 Teacher Interviews

Teacher interviews generated data on: i) teachers' expectations of student performance, ii) choice of pedagogic actions, and reasoning or links between expectations and pedagogy (see Figures 37–39; see also Tables 25–29 in Appendix IV).

The choice of school limited the range of teacher expectations to a single desired outcome: to pass the exam. To meet this expectation, the teachers employed intermediate learning objectives. In turn, the objectives in combination with pedagogic actions constituted particular pedagogical emphases. Figure 37 delineates general trends in pedagogic emphases; on the other hand, Figures 38 and 39 offer more comprehensive teacher profiles.

Figure 37

Pedagogical Emphases

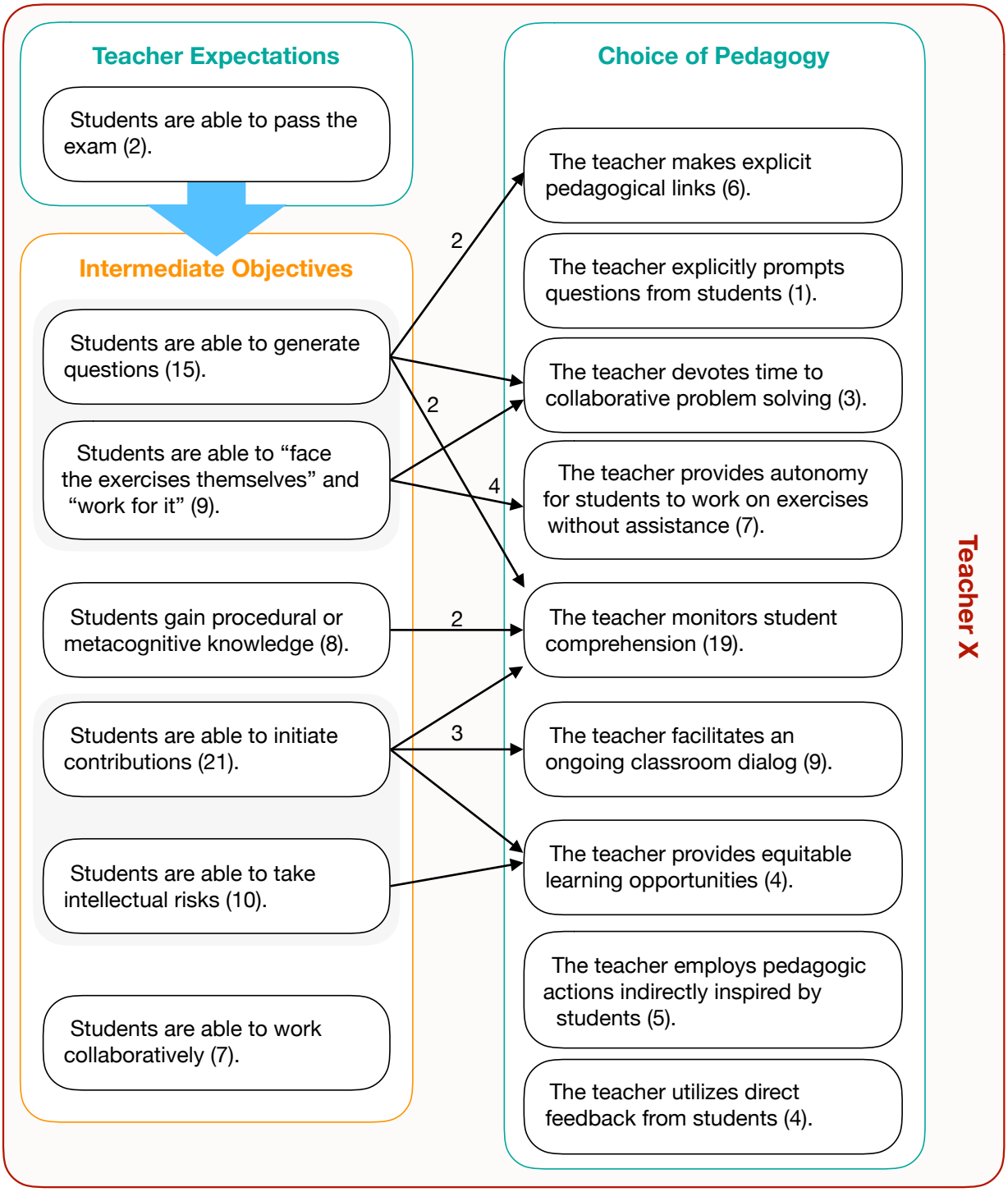


Note. The numbers in parentheses enumerate the frequency of a statement expressed in isolation.

For additional details, see Figures 38–39 and Tables 25–29 in Appendix IV.

Figure 38

Teacher X Interview: Expectations and Pedagogic Actions

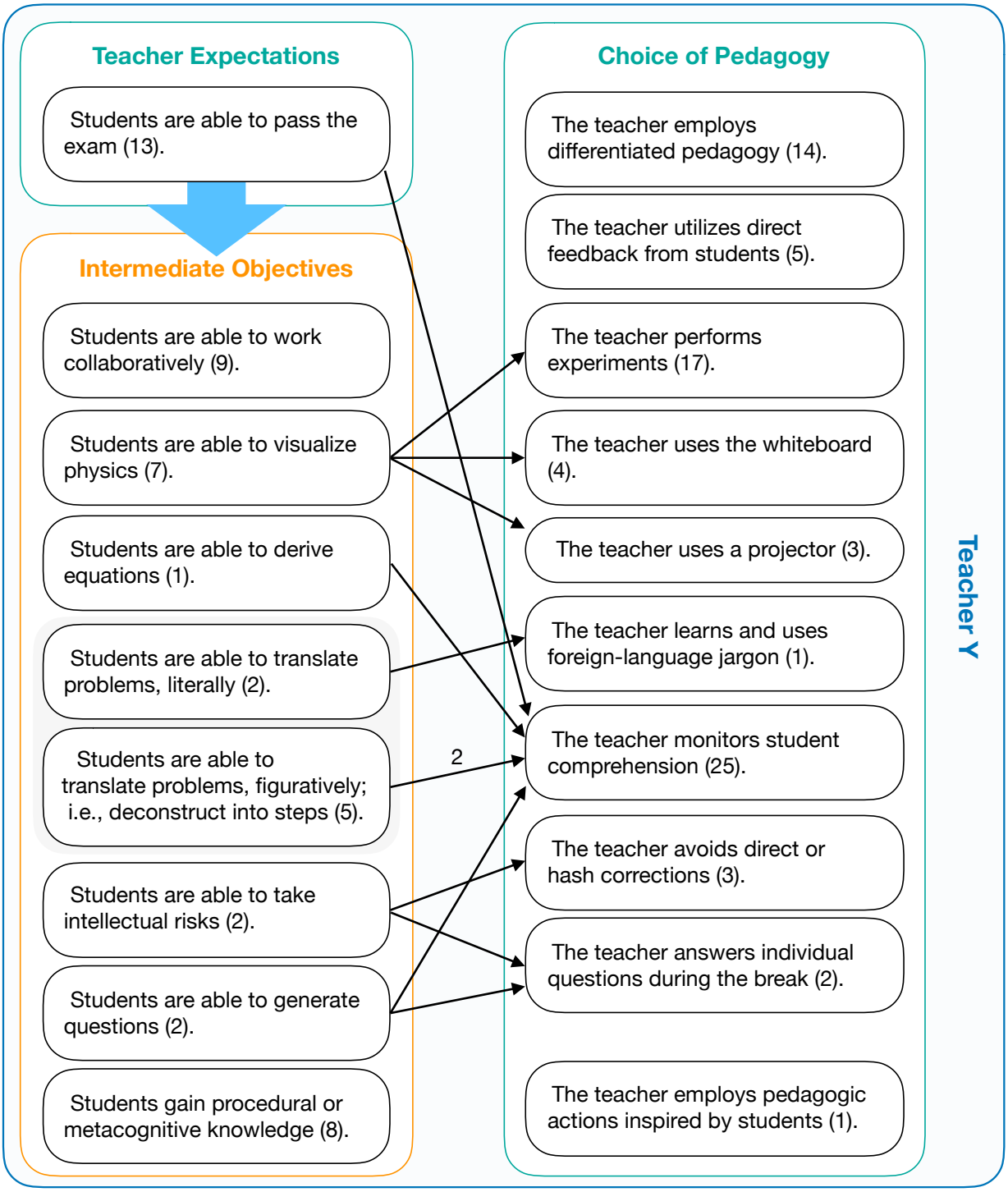


Note. The numbers in parentheses enumerate the frequency of a statement expressed in isolation.

Unless stated otherwise, each arrow illustrates one explicit link.

Figure 39

Teacher Y Interview: Expectations and Pedagogic Actions



Note. The numbers in parentheses enumerate the frequency of a statement expressed in isolation.

Unless stated otherwise, each arrow illustrates one explicit link.

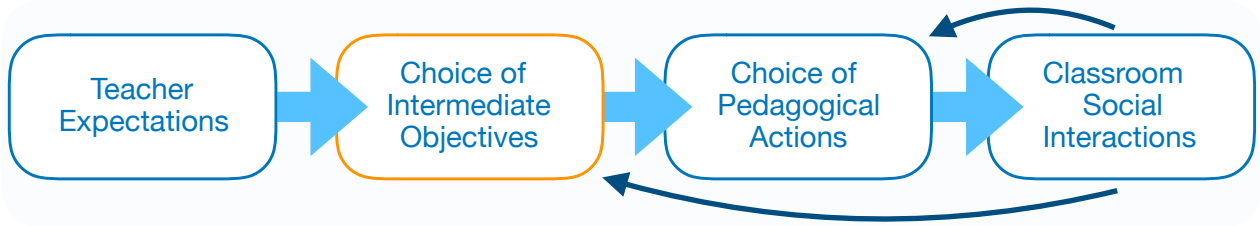
5.0 Conclusions

5.1 Research Sub-Question 1

Q1: *How are teachers' expectations of students' academic performance enacted in teachers' pedagogical choices?*

Figure 40

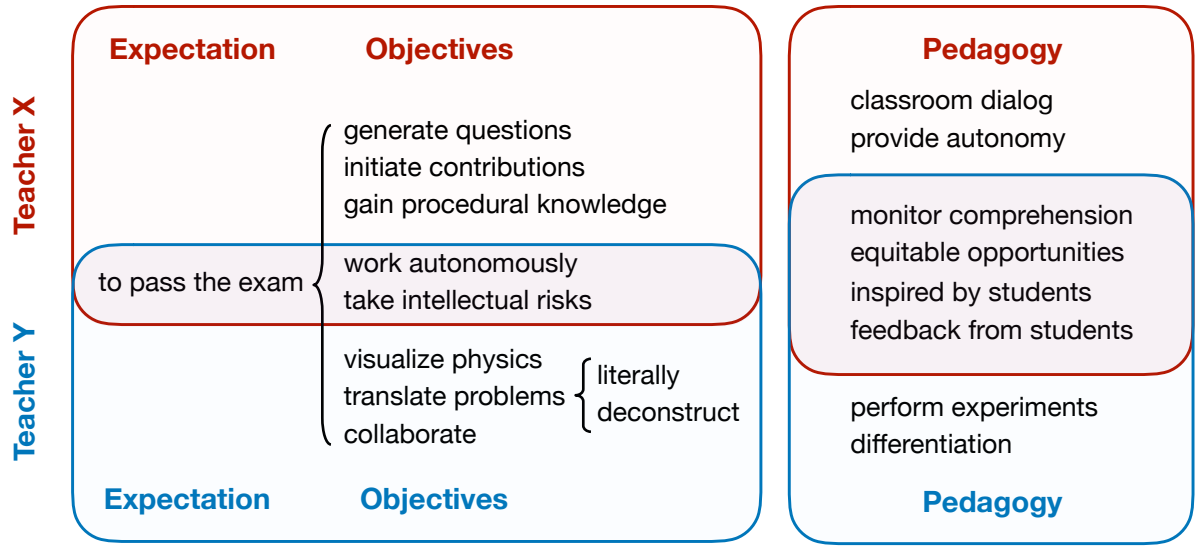
Expectations → Intermediate Objectives → Pedagogical Actions → Social Interactions



Access examination standards undergirded teachers' expectations. To help students pass the exam thus accomplish the expectations, the teachers defined their respective sets of intermediate learning objectives (see Figure 40) and employed arrays of pedagogic actions albeit with different emphases (see Figures 37–39 and 41). More importantly, direct and indirect feedback from students further informed teachers' pedagogical choices (see arrows in Figure 40). Figure 41 generalizes the mechanisms between teachers' expectations, intermediate objectives, and the dominant choices of pedagogy.

Figure 41

Pedagogical Emphases: a Generalized Scheme



Note. Expectations in the figure include intermediate learning objectives.

To accomplish the objectives (see Figure 41, red), teacher X assigned a set of homework problems. Students "face[d] the exercises by themselves" and generated questions for the next class meeting. The next day, the teacher devoted more discussion time to collaborative problem solving and eschewed lecturing. In an ongoing classroom dialog, the teacher restated students' assertions or questions thus extended these contributions to the rest of the class. Furthermore, he immediately implemented these contributions in the ongoing discourse. Students shared their problem-solving strategies, justified their reasoning, or asked additional questions. Additionally, the teacher linked students' contributions to their prior knowledge, to one another's contributions, and to exam expectations. The teacher used different forms of content representation to help students gain a deeper understanding of the underlying principles of science. For example, graphs, figures, animations, equations, etc.

To attain the objectives (see Figure 41, blue), teacher Y performed demonstrative experiments during which students generated assertions about the ongoing process or made predictions about the phenomena. The teacher restated these contributions, asked additional questions, and linked the content to exam expectations. To deconstruct physics problems into steps, the teacher used the whiteboard. The preference for the whiteboard over using PowerPoint was to allow an optimal time for student-content interaction, as opposed to speeding up or skipping the process in favor of merely showing the outcome.

Both teachers monitored students comprehension and scaffolded their procedural knowledge by guiding questions. Students broke information into smaller constituent parts and identified interrelationships among these parts. Students made critical judgments about information using scientific and mathematical criteria. Lastly, students put together knowledge from various sources to form coherent and scientifically sound answers. Generally, students were able to answer their own questions.

The teachers informed and adjusted their pedagogy based on direct and indirect feedback from students. During whole-class discussions, teacher X often asked his student to elaborate; however, teacher Y opted for a more indirect approach. He stated that he did not want his students to feel uncomfortable; therefore, he did not force participation during whole-class discussions. In class Y, students collaborated in pairs or worked independently during discussions and asked questions privately during individual or group work or during breaks. Students in both focus groups appreciated that the teachers allowed intellectual risk-taking.

5.2 Research Sub-Question 2

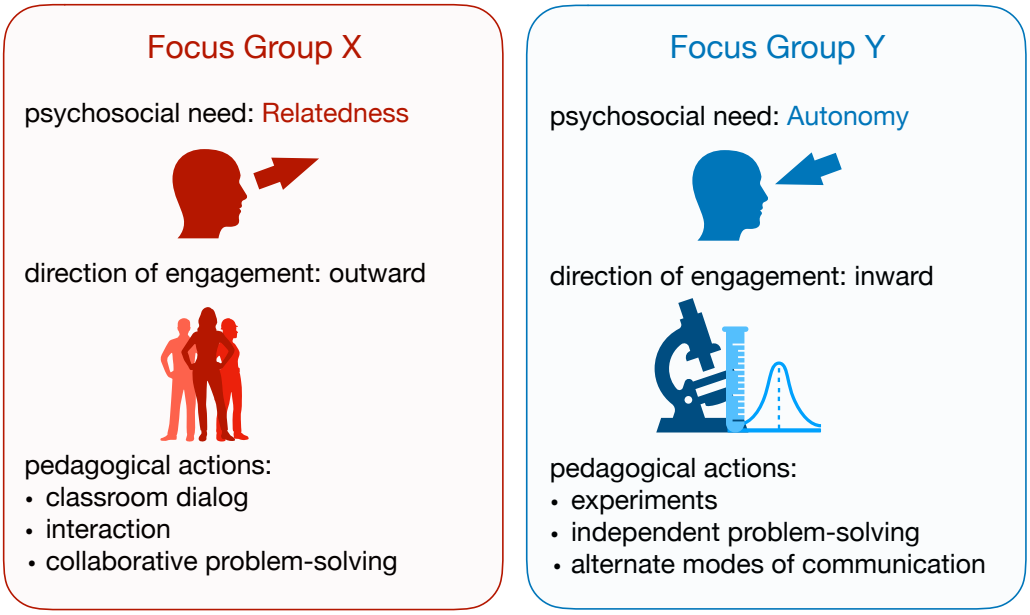
Q2: *How do teachers' explicit pedagogical choices foster students' engagement?* i) in

terms of behavioral manifestations of their innate psychological needs; i.e., competence, autonomy, and relatedness? and ii) in terms of a multi-dimensional construct of student engagement?

The results show that both teachers promoted engagement by different means but to a similar extent (see Table 1 and Figure 30; Table 5 in Appendix I). The results from questionnaires indicate that students in both classes felt engaged to a proportionally comparable degree, incl. non-behavioral dimensions of engagement (see Figure 32 and Appendix II). Students' psychosocial needs explain the dissimilarity in observed behavioral engagement (see Figure 31).

Figure 42

Focus Groups' Dominant Psychosocial Needs and Favored Pedagogy



Note. Apposite pedagogical actions based on students' dominant psychosocial need.

The social composition of each class and individual students' needs affected social interactions and engagement. Figure 42 depicts the focus groups' dominant psychosocial needs

expressed explicitly in connection to their favored pedagogical actions. Generalizations from focus group X demonstrate that the students responded well to pedagogic actions which underscore feelings of relatedness (see Figure 42, red). On the other hand, focus group Y manifested an inclination towards pedagogic actions which highlight a sense of autonomy (see Figure 42, blue). Consequently, the teachers' pedagogic efforts were not necessarily met with a commensurate degree of observable manifestations of student engagement; i.e., the behavioral dimension of engagement (see Figure 31; Table 6 in Appendix I).

In regards to engagement linked to specific pedagogic actions (see Figure 35), focus group X expressed a relatively higher degree of need for relatedness. Teacher X's choice of pedagogy directed student engagement towards externalized engagement through social interactions. Similarly, the measure of observed engagement was higher in class X than in class Y (see Figure 31; see also Table 6 in Appendix I). Teacher X's pedagogy emphasized classroom dialog and contributions (see Figure 42). Based on the values calculated from the constructs (see Figures 14 and 30), higher degrees of pedagogical rigor and affective pedagogy may have positively affected the frequencies and the quality of observed engagement. It can be theorized that the group's relatively heightened need for relatedness may have been why class X responded well to affective pedagogy.

Focus group Y, on the other hand, explicitly expressed a relatively higher degree of need for autonomy (see Figure 36). These needs were reflected in teacher Y's choice of pedagogy; thus, the resulting student engagement was directed towards internalized engagement; e.g., cognitive dimension of engagement. Teacher Y's pedagogy emphasized visualization and experimentation (see Figure 42). The students responded well to demonstrative experiments and

working independently even during whole-class discussions. Neither of these pedagogic actions required any behavioral responses from students. Furthermore, focus group Y explicitly praised the use of experiments in the class; i.e., evidence of cognitive engagement; and they appreciated the teacher's response to their need for autonomy.

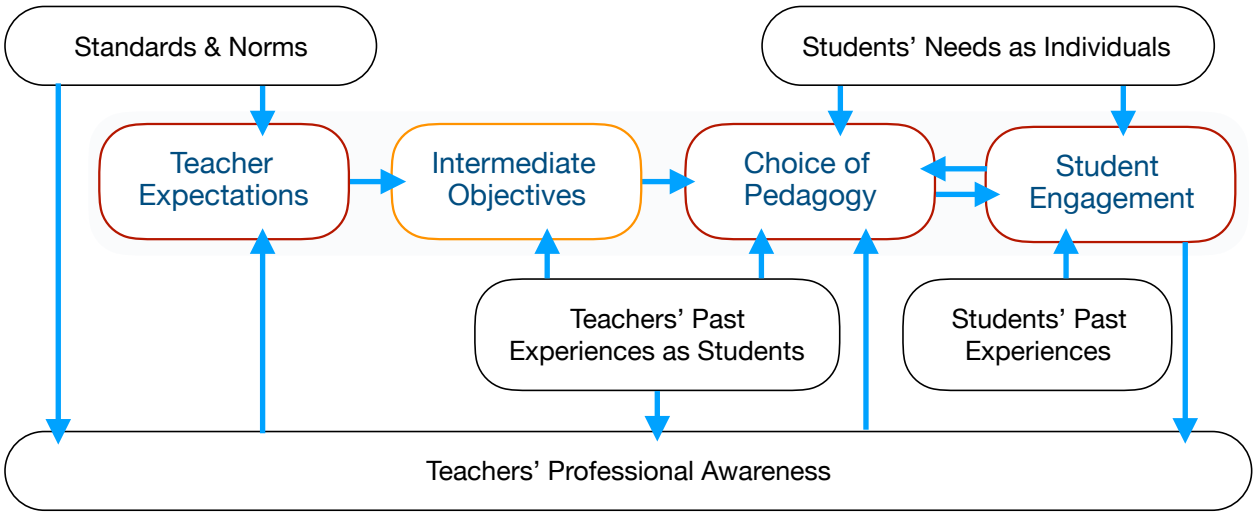
5.3 Beyond the Research Questions

RQ: *How are teachers' expectations of students' academic performance reflected in students' observed engagement, as manifested by the rate and quality of students' participation?*

Based on the data from interviews and focus groups, Figure 43 summarizes the contextual factors that affected the expectations, choice of pedagogy, and student engagement.

Figure 43

Contextual Factors Affecting Expectations, Pedagogy, and Engagement



Note. Based on teacher interviews and student focus groups.

Teachers' critical reflection on their practice is paramount and one of its core elements (e.g., Rodgers, 2002; Yost et al., 2000; Falk & Darling-Hammond, 2010). Both teachers

recursively questioned their assumptions about students' interactions with the content and strived to examine how their expectations might have affected their students' performance (see also Ormrod, 2011, p. 524). Teachers' past experiences as students created a sense of empathy for students and an ability to see beyond their expert blindspot. Teachers' choices of pedagogic actions were not individualistic but were informed by their professional awareness and congruent with the demographic composition of the class and individual students' psychosocial needs.

To answer the hypotheses, the findings suggest that i) pedagogic actions with the sole intent to promote engagement did not perforce have a behavioral response, and ii) other pedagogic actions not explicitly intended to promote behavioral engagement may have had an effect on the overall engagement. Moreover, the data suggest that when teachers voiced their expectations, these actions did not necessarily affect students' behavioral engagement, unless the expectations were accompanied by other pedagogical actions that either i) modeled these expectations or ii) created opportunities for students' behavioral responses.

Also, it can be further hypothesized that the constructs rigor of pedagogy and affective pedagogy are better predictors of behavioral engagement due to their capacity to positively affect students' psychosocial needs; competence and relatedness, respectively. More importantly, due to the limited scope of the study, the finding may be situated and the generalizability inconclusive (see Limitations).

In sum, student engagement is a fluid and dynamic phenomenon, it is reciprocal and synergistic. The social contextual conditions can support intrinsic motivation and facilitate internalization and integration of extrinsically motivated tasks. Informed choices of pedagogy can attenuate extrinsic standard-driven performance goals and create psychosocially supportive

learning environments.

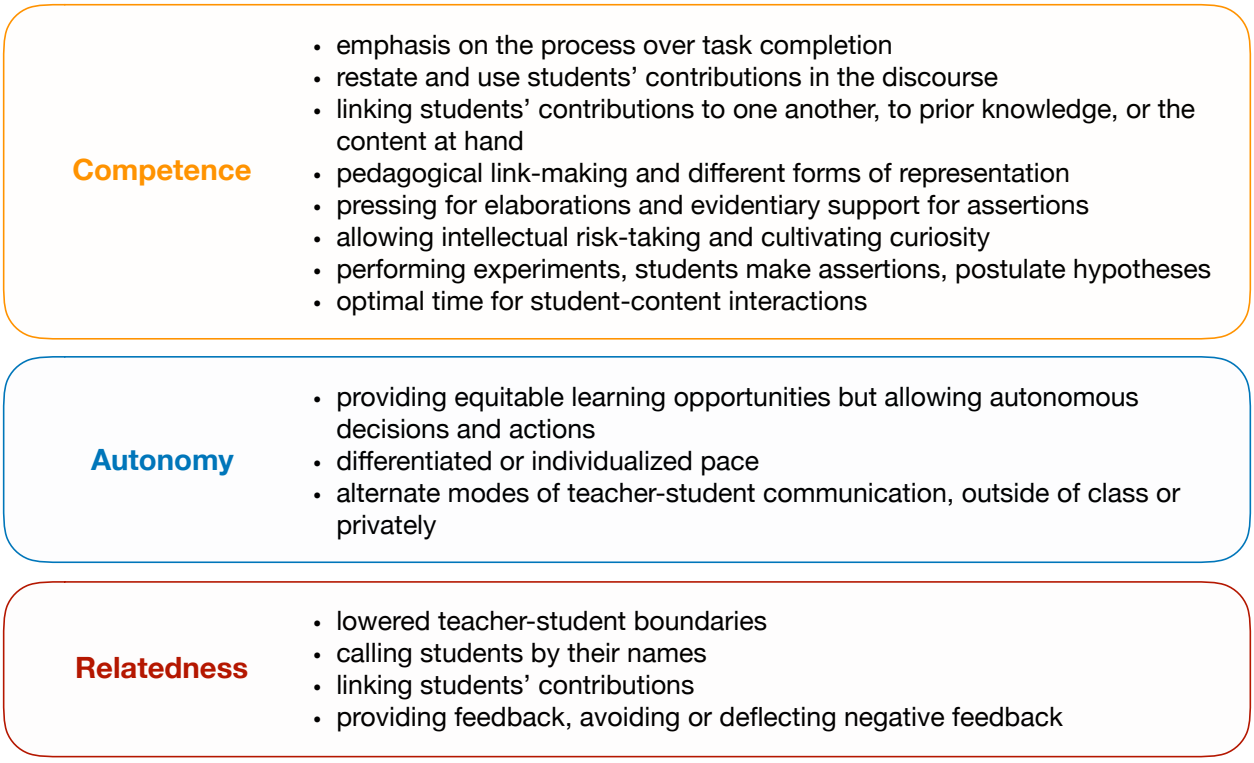
6.0 Discussion

6.1 Implications

Student engagement is a complex phenomenon with interlocking aspects of behavioral, affective, and cognitive components. A prudent choice of pedagogy can mitigate the effects of extrinsic motivators—such as examination standards, which are not inherently engaging. Figure 44 inventories a gamut of pedagogical actions that have been found to i) enhance students' sense of competence, autonomy, and relatedness, and ii) actively stimulate student engagement.

Figure 44

Pedagogic Actions Enhancing Engagement



Note. Students' psychosocial needs (CAR) mediate the effects of the listed pedagogical actions.

6.2 Limitations

Several limitations attenuated the ecological generalizability of this study. To define the observational horizon, the study considered only two classes, 30 students total. Also, the data from classroom observations entailed only 15% of the eight-week course. Thus, the empirical data comprised a series of snapshots rather than a cohesive spectrum. Additionally, the data from the student focus groups assumed a degree of general representativeness.

The choice of school deliberately limited the ambit of variables; however, this choice inadvertently skewed the results. Therefore, the results and findings are situated. Also, smaller school have been found to engage students more effectively (Kuh, 2003) and lead to better academic performance (Thapa et al., 2013).

The choice of school preselected the demographic group. First, the students in both classes were international students, hence the heightened need for relatedness. Second, the students were university-bound, thus a specific demographic subjected to a limited range of expectations. Third and final, the language of instruction was English, and most of the students were non-native English speakers. The study did not account for linguistic effects on students' cognitive interactions with the content and their psychosocial needs in interactions with the teachers and peers.

Elimination of grades and the restricted demographic spectrum imposed another limitation to the study. According to McDermott et al. (2009), schools operate under an illusion of meritocracy, but in reality, run on risk and competition. Competitiveness has its deleterious effects: "As long as schools pit everyone against everyone else, and as long as success is defined at the expense of others being called failures, massive inequalities follow" (pp. 109–110; see also

Bartolomé, 2008; Elliot, 2008; Milner, 2010). Thus, elimination of grades alleviated some of the competitiveness generally associated with school cultures; this, in turn, limits the generalizability of the study.

The choice of paradigm imposed limits on the reconciliation of conflicting perspectives and perceptual biases. In regards to student self-reports, Mandernach (2015) raises concerns about "honesty and/or accuracy of responses" (p. 4), and the generalized nature of items may limit the value of responses. On the other hand, the reliability of classroom observations "may be impacted by observer bias [and is] limited to observable behaviors" (p. 5).

The study was conceived within the constraints of master research, which imposed a limit on the availability of human resources. Particularly in regards to classroom observations, the overall low degree of inter-rater agreement points at some oversights in coder training (see "second coding remarks" in Appendix I).

Lastly, the study does not account for *intentionality*, or the ever-elusive discrepancy between the ontologically objective states of affairs and the epistemically subjective experiences of them (Searle, 2015).

6.3 Future Research

6.3.1 The Scope

To assess the generalizability of the study, one would recommend expanding the study to more diverse settings and approach the study longitudinally. In a cohesive team of well-trained and well-synched researchers, the study would include:

- schools in rural and urban areas
- monolingual and bilingual schools

- schools or classes serving other specified types of students
- schools or classes with a diverse student population: socio-economic groups, different linguistic minorities, learning abilities, etc.

6.3.2 The Constructs

Future studies should revisit the coding scheme based on the pedagogic triangle and critically re-evaluate the constructs for measuring pedagogy. The constructs were devised according to definitions in the literature; however, the study experienced some issues in how these definitions could be operationalized.

For example, the literature is critical of students' non-content interactions and often calls for eliminating or minimizing distractions to the learning process. Thus, such interactions were considered the anti-measure of engagement and placed in the denominator of observed engagement (see formula in Figure 21). First, the empirical data suggest that students were able to self-regulate these distractions. Second, classroom observations were unable to efficiently trace all student-student interactions, *viz.* whether or not they were content-related. And finally, the results from the student focus groups indicate that, regardless of their relation to the content, student-student interactions enhance students' sense of relatedness, thus they positively contribute to engagement.

6.3.3 The Focus

The current study did not explicitly track individual students; however, the size of its sample pool ($N = 30$) allowed the coder to supplement the data from classroom observations with additional qualitative data on some students. Learning is central to teaching (e.g., Rodgers, 2002). If learning is defined as a cognitive shift or a change in behavior, these supplemental

notes suggest that several students manifested learning. Additionally, each class as a whole also manifested such behavioral changes over time (see Figures 54–55 in Appendix V). These changes are:

- an increase in student-initiated contributions,
- elaborations without teacher's prompt to elaborate,
- elaborations from students who normally did not elaborate,
- students answering other students' questions without the teacher restating the question.

Are these the outcomes of behavioral conditioning or manifested engagement? And if the latter, did these shifts in behavioral engagement affect other dimensions of engagement?

Thus, rather than a longitudinal approach, a possible future study could narrow its focus on classroom interactions as a function of pedagogy. The richness of coded data generated during classroom observations engenders possible investigations of other measures:

- codes as sequences and patterns (see Table 30 in Appendix V)
- shifts in patterns (see Figures 54–55 in Appendix V).
- codes and code sequences as functions of time (see Figures 56–57 in Appendix V).

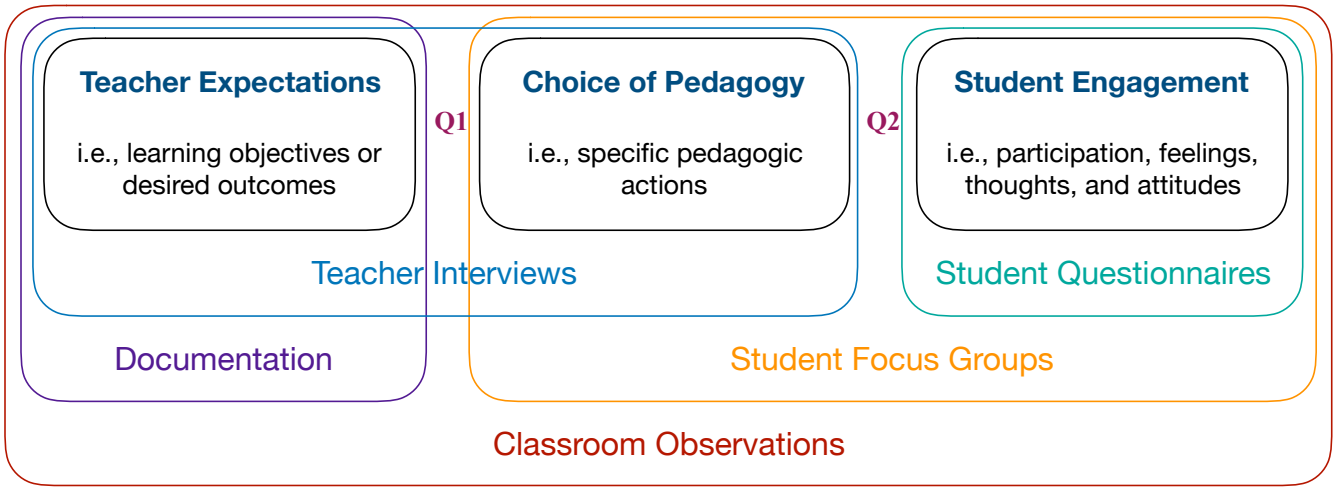
Therefore, one could reframe and refocus the study exclusively on pedagogy and concentrate on interactive patterns within the pedagogic triangle.

6.3.4 Triangulation

The study involved a limited range of teacher expectations, *viz.* to pass the exam; therefore, the coder did not collect any documentation, such as lesson plans. For future studies, a methodological rectification is imperative to fully triangulate the data (see Figure 45).

Figure 45

Research Questions, vs. Sets of Variables vs. Methods



6.4 The Final Word

Purposeful pedagogy capitalizes on the brain's inherent pattern-seeking and its proclivity for curiosity. With a befitting balance between structured guidance and autonomy, teachers effectuate an array of intellectually stimulating learning opportunities where students play an active role in knowledge construction and sense-making is shared by a community of learners. Student engagement is mediated by apposite pedagogical actions congruent with students' psychosocial needs. The findings from this study suggest a gamut of pedagogical actions that can motivate students by elevating their sense of competence, autonomy, and relatedness. Mitigating of extrinsic motivations and creating engaging learning environments promote participatory democratic values and raise critical thinkers, skilled workers, and responsible citizens.

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8.0 Appendices

I. Classroom Observations 81

Tables 3–6

II. Student Questionnaires 86

Student Course Engagement Questionnaire (SCEQ)

Figure 46

Tables 7–18

III. Student Focus Groups 96

Figures 47–48

Tables 19–23

IV. Teacher Interviews 103

Figures 49–51

Tables 24–29

V. Additional Data 115

Figures 52–55

Table 30

Appendix I: Classroom Observations

Table 3. *Observation Rubric (version 4.8)*

General Setup		
1. Classroom Physical Arrangement	R	The classroom is arranged in rows, lecture hall seating, all eyes towards a stationary front.
	U/O	The classroom is arranged in a U or an O where students can face one another.
	G	Students' desks are arranged in groups, the classroom may or may not have a stationary front.
2. The Sequence of Classroom Activities	ec	The lesson activity involves the teacher talking to the entire class.
	pr	The teacher asks students to work with their neighbor; i.e., the class into pairs.
	gr	The lesson activity splits the class into groups; possible differentiation.
	ind	Students work individually.
Teacher Expectations		
3. The Degree of Specificity in Expectations	aim	The teacher communicates specific or general learning objectives/aims for the lesson.
	cont	The teacher provides a list of contents or an agenda for the lesson.
	exp	The teacher expresses the expectations/intentions minimally; e.g. general task directions.
	diff	The teacher gives altered expectations/directions to a specific student or students.
	debr	The teacher offers a formal debriefing with explicit links to expectations/intentions.
4. Methods of Expectation Communication	ut	The teacher utters the expectations to the entire class or individually.
	vle	The expectations can be found in the virtual learning environment.
	ho	The expectations are presented on a physical handout distributed to the class.
	ppt/brd	The expectations are on a Powerpoint presentation or written on the board.
Non-Content Interactions		
5. S or S-S Incidental Behaviors (discruptions)	dig	Digital distractions, social media, phones, video games, etc.
	f	Excessive food consumption
	cht	Students chat, non-content
	wi/wo	Students walk in late or leave during the class.
6. T-S Non-Content Interactions	bc	The teacher corrects, addresses, or deals with behavioral issues (non-content).
	b+	The teacher praises a student for good behavior (non-content).
	log	Teacher-student logistical disruptions; e.g. The teacher asks a student to go to a copier
	pers	The teacher and students talk about non-content personal matters.
	[...]	Other non-content interruptions from the outside of the class; e.g., [blackout], [earthquake].

Table 3 (Continued). *Observation Rubric (version 4.8)*

Teacher-Student-Content Interactions		
7. T-S-C Interactions & Feedback	T2C	The teacher addresses the entire class, but no one in particular.
	T-C	The teacher interacts with the content, a visual aid, or ICT, in a demonstrative manner.
	C2T	Students respond to a prompt in unison or multiple students answer the prompt (behavioristic answer).
	Tq	The teacher asks a content-related question (thus invites a response from the class).
	Q?	The teacher explicitly invites questions from students; e.g. "Are there any questions?"
	T2S	The teacher talks to a particular student in a whole-class setting.
	S2T	A student replies to a prompt and talks to the teacher.
	Tr	The teachers reiterates or restates a student's contribution to the entire class.
	Sini	A student initiates a contribution to the discussion.
	S2Tq	A student poses a content-related question to the teacher.
	T+	The teacher asks a student to elaborate or add further evidence to the contribution.
	S+	A student elaborates or adds further evidence to the contribution.
	S2S	A student directly responds to a student's content-related contribution in a whole-class setting.
	S2Sq	A student poses a question to a student or students in a whole-class setting.
	SSS	Multiple students discuss in a group.
	S-C	A student or students interact with the content; e.g. read, fill out a form, work with visual aids, ICT, etc.
	TLS	The teacher explicitly links how a student's contribution relates to another student's contribution.
	SLS	A student explicitly links his or her contribution to another student's contribution.
	TLP	The teacher explicitly links the content to prior knowledge.
	SLP	A student explicitly link the content to prior knowledge.
	TLE	The teacher explicitly links the content or a student contribution to the learning aims or expectations.
	Tfd	The teacher provides immediate content-related feedback or constructive criticism.

Table 4. *Observation Log Sample*

T(y) — Thursday 11/12

Time	Setup		Remarks	Observation Notes (3-7)												
	1	2														
5	R	ec	Lecture	log	pers	Q?	cht	cht	S2Tq	T2S	TLE	T-C	T2S	S+	T2S	cht
10			balloons	cht	T-C	Tq	S2T	Tr	Tq	S2T	Tr	T-C	pers	cht	Tq	S2T
15			TLR → TLE	T2C	T-C	T2C	Tq	S2T	Tr	dig	cht	T2C	TLE	pers	cht	T2C
20				S2T	S2T	Tr	Tq	S2T	S2T	T-C	Sini	Sini	Tr	Tq	Tr	T-C
25			TLR → TLE	TLE	Q?	T2C	Tq	T2C	Tq	S2T	S2T	Tr	Tq	S2T	Tr	Tq
30				T2S	TLE	T2C	cht	Sini	Sini	S2S	T2C	cht	T2C	pers	dig	cht
35				Tq	T-C	dig	Tq	S2T	S+	T2C	Tq	Tq	S2T	Tr	T-C	T-C
40				Tq	S2T	Tr	T-C	Tq	S2T	Tr	T2C	Q?	T-C	cht	Tq	S2T
45			ec → ind	T2C	Tq	S2T	S2T	Tq	S2T	S+	Sini	T-C	T2C	cht	S2Tq	S+
5			log → old exam	log	cht	T2C	cht	dig	T2C	T-C	Sini	Tr	T-C	Tq	S2T	Tr
10			Lecture	T2C	cht	Sini	Tr	T2C	Tq	T2C	T-C	pers	Sini	Tr	T-C	T2C
15				TLE	T-C	T2C	T-C	S2Tq	T2C	T2C	T-C	S2Tq	S+	T2S	T2C	dig
20				Tq	S2T	Tr	T2C	T-C	T-C	cht	T2C	T-C	T2C	Tq	S2T	Tr
25				S-C	cht	Sini	Tr	Tq	S2T	S2T	T-C	TLE	cht	pers	Tq	S2T
30				Sini	S+	T2S	T-C	cht	T2C	Sini	Sini	S+	pers	T2C	cht	T2C
35				Sini	S+	S2S	Tr	T2C	T-C	TLE	cht	cht	dig	dig	Q?	T2C
40				dig	T2C	dig	T2C	S2Tq	T2S	cht	Q?	cht	T2C	Tq	S2T	Tr
45				T2C	Tq	S2T	S2T	Tr	S2Tq	T2S	TLE	dig	cht	Tq	dig	S2T
50				S2Tq	T2S	S+	T2S	T-C	dig	T2C	cht	S2Tq	T2S	pers	cht	T-C
55				S2Tq	Sini	S2S	S2S	S2S	S2S	Tr	pers	T2C	dig	dig	dig	T2C
60				pers	cht	T-C	Sini	Tr	S2Tq	T2S	T-C	S2Tq	T2S	Sini	Tr	T2C
65				Q?	T2C	Sini	T2C	Tq	T2C	Tq	T+	S+	T-C	Tq	S2T	Tr
70			ec → ind	T-C	cht	exp	T2C	Sini	Tr	exp	f	S2Tq	T-C	TLE	S2Tq	T2S
TOTAL																
AVG																

Note: This is only a sample, each 5.0-min interval in this log has been truncated to fit the page.

Second Coding Remarks

Based on the discrepancies in the logs, two pairs of codes need an explicit clarification. First, T2C and T-C both involve the teacher addressing the class, delivering the content. In T-C, there is a specific visual or mental connection to the content; i.e., the teacher interacts with a visual aid, an equation, a specific point on a graph or in an animation, etc. T2C does not entail any other forms of representation of the presented content but the teacher's utterances. Second, S2T and Sini both involve a student talking to the teacher (content-related). Sini is a student-initiated contribution without a prompt, whereas S2T is a response to the teacher's explicit prompt. More diligent coder training would have prevented such discrepancies.

Classroom Observations (Cont'd): Choice of Pedagogy

Table 5

Classroom Observations: Choice of Pedagogy (Deconstructed)

		average frequencies (per lesson)	
Teacher-Student-Content Interaction	code	Teacher X	Teacher Y
The teacher asks a question.	Tq	57	137
The teacher prompts questions from students.	Q?	37	30
The teacher restates a student's contributions.	Tr	120	118
The teachers asks a student to elaborate or add evidence.	T+	16	8
The teacher talks to the class, content-related.	T2C	112	168
The teacher interacts with a model, graph, experiment, etc.	T-C	227	193
Total (T2C + T-C)		340	361

Note. A summary of empirical data on a selection of pedagogic actions, per 3.5-hr lesson.

Table 6

Classroom Observations: Student Engagement (Behavioral, Deconstructed)

		average frequencies (per lesson)	
Teacher-Student-Content Interaction	code	Students X	Students Y
A student answers a question	S2T	53	143
A student asks a question	S2Tq	101	44
A student initiates a content-related contribution	Sini	94	57
A student elaborates or adds evidence to their reasoning	S+	106	42
A student interacts with a student, content-related	S2S	12	6
A student interacts with content in a demonstrative manner	S-C	3	2

Note. A summary of empirical data on student behavioral engagement, per 3.5-hr lesson.

Appendix II: Student Questionnaires

STUDENT COURSE ENGAGEMENT QUESTIONNAIRE

- By completing this questionnaire, you are consenting to take part of this study
- Your answers are anonymous.
- Think how each of the statements applies to **you.** There are no right or wrong answers.
- If the statement is **unlike you**, check the far **left** column.
- If the statement is **like you**, check the far **right** column.
- For neutral responses, check the center column.

	Not like me	Less like me	Neutral	More like me	Totally me
1. Raising my hand in class					
2. Participating actively in discussions					
3. Asking questions when I don't understand					
4. Doing all the homework problems					
5. Coming to class every day					
6. Asking the teacher to review assignment or tests					
7. Thinking about the course between class meetings					
8. Finding ways to make the course interesting to me					

Student Questionnaires (continued)

9. Taking good notes in class					
10. Looking over class notes between classes					
11. Really desiring to learn the material					
12. Being confident that I can learn and do well in the class					
13. Putting forth effort					
14. Being organized					
15. Getting good grades					
16. Doing well on each test					
17. Staying up on the readings					
18. Having fun in class					
19. Helping and collaborating with other students					
20. Making sure to study on a regular basis					
21. Finding ways to make the course material relevant to my life					
22. Seeing how the course material is relevant to my future academic plans					
23. Listening attentively in class					
Gender: Female / Male / decline to state	**Age**:				

Table 7. *Student Questionnaires Dimensions*

	Dimension of Engagement			
Item	Skill	Participation Interaction	Emotional	Performance
1		✓		
2		✓		
3		✓		
4	✓			
5	✓			
6		✓		
7			✓	
8			✓	
9	✓			
10	✓			
11			✓	
12				✓
13	✓			
14	✓			
15				✓
16				✓
17	✓			
18		✓		
19		✓		
20	✓			
21			✓	
22			✓	
23	✓			

Note. This table indicates each item's dimension: 1. skills engagement, 2. participation/interaction engagement, 3. emotional engagement, and 4. performance engagement.

Table 8

The Student Course Engagement Questionnaire (SCEQ), Descriptives

	Class X, *n* = 15		Class Y, *n* = 12	
Dimension of Engagement	*M* (%)	*SD* (%)	*M* (%)	*SD* (%)
Skill	72.1	10.9	79.1	9.7
Emotional	72.0	12.2	75.7	17.5
Participation/interaction	72.9	17.5	75.0	14.7
Performance	66.2	14.4	63.3	20.6
Total	71.5	8.1	75.2	8.8

Note: *N* = 27. Some participants were absent during the time of administering the questionnaires.

Table 9

The Student Course Engagement Questionnaire (SCEQ): by Class and Gender

	Class X, *n* = 15		Class Y, *n* = 12	
Dimension of Engagement	female, *n* = 7	male, *n* = 8	female, *n* = 8	male, *n* = 4
Skill	78.7 ± 10.1	66.4 ± 8.4	79.7 ± 10.0	77.8 ± 10.4
Emotional	72.0 ± 15.3	72.0 ± 9.8	77.5 ± 16.3	72.0 ± 21.9
Participation/interaction	78.1 ± 11.4	68.3 ± 21.3	70.0 ± 14.0	85.0 ± 11.4
Performance	63.8 ± 20.3	68.3 ± 6.9	52.5 ± 16.7	85.0 ± 6.4
Total	73.2 ± 14.3	68.8 ± 11.6	69.9 ± 14.0	79.9 ± 12.5

Note. Average percent scores by gender.

Table 10

Student Questionnaires Descriptive Statistics

Dimension of Engagement	*N*	Min	Max	*M*	*SD*
Skill	24	23	42	34.0	5.03
Emotional	25	12	25	18.6	3.59
Participation/Interaction	26	13	30	22.5	4.55
Performance	27	3	14	9.7	2.57
Total Score	23	62	109	84.3	10.32
Valid N (listwise)	23				

Note. Point-Scale scores, rather than percent scores.

Table 11

Chronbach's Alpha: Total Score

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.810	.809	23

Table 12

Chronbach's Alpha: Dimensions of Engagement

Dimension	Chronbach's Alpha
Skill	.763
Emotional	.751
Participation/Interaction	.758
Performance	.901
Total	.810

Note. Values extracted from SPSS.

Tables 13+14

Independent-Samples T-Tests: Class

Group Statistics

	Class	N	Mean	Std. Deviation	Std. Error Mean
Skill	Class X	12	32.5000	5.35130	1.54479
	Class Y	12	35.5833	4.37884	1.26406
Emotional	Class X	14	17.9286	3.07507	.82185
	Class Y	11	19.4545	4.15605	1.25310
Part_Int	Class X	14	22.5000	4.83179	1.29135
	Class Y	12	22.5000	4.40041	1.27029
Perform	Class X	15	9.9333	2.15362	.55606
	Class Y	12	9.5000	3.08957	.89188
Total_Score	Class X	12	82.5000	10.22919	2.95291
	Class Y	11	86.1818	10.56237	3.18467

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Skill	Equal variances assumed	.002	.968	3.095	22	.005	5.44755	1.76021	1.79710	9.09800
	Equal variances not assumed			3.047	19.608	.006	5.44755	1.78764	1.71383	9.18127
Emotional	Equal variances assumed	.179	.676	.847	23	.406	1.23377	1.45666	-1.77956	4.24709
	Equal variances not assumed			.851	22.000	.404	1.23377	1.44948	-1.77228	4.23981
Part_Int	Equal variances assumed	1.575	.222	-.473	24	.641	-.86667	1.83299	-4.64978	2.91645
	Equal variances not assumed			-.449	17.293	.659	-.86667	1.92827	-4.92972	3.19638
Perform	Equal variances assumed	4.654	.041	-2.713	25	.012	-2.41667	.89079	-4.25128	-.58206
	Equal variances not assumed			-2.877	22.883	.009	-2.41667	.83994	-4.15471	-.67863
Total_Score	Equal variances assumed	1.674	.210	.471	21	.642	2.06818	4.38733	-7.05578	11.19214
	Equal variances not assumed			.462	16.357	.650	2.06818	4.47841	-7.40883	11.54520

Note. Based on point-scores.

Tables 15+16

Independent-Samples T-Tests: Gender

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Skill	Female	13	36.5385	3.92885	1.08967
	Male	11	31.0909	4.70010	1.41713
Emotional	Female	14	19.1429	3.67648	.98258
	Male	11	17.9091	3.53425	1.06562
Part_Int	Female	15	22.1333	3.92550	1.01356
	Male	11	23.0000	5.44059	1.64040
Perform	Female	15	8.6667	2.74296	.70823
	Male	12	11.0833	1.56428	.45157
Total_Score	Female	12	85.2500	7.87545	2.27345
	Male	11	83.1818	12.79702	3.85845

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Skill	Equal variances assumed	.316	.580	-1.545	22	.137	-3.08333	1.99605	-7.22289	1.05622
	Equal variances not assumed			-1.545	21.171	.137	-3.08333	1.99605	-7.23231	1.06564
Emotional	Equal variances assumed	1.516	.231	-1.056	23	.302	-1.52597	1.44457	-4.51430	1.46235
	Equal variances not assumed			-1.018	17.905	.322	-1.52597	1.49856	-4.67553	1.62358
Part_Int	Equal variances assumed	.076	.785	.000	24	1.000	.00000	1.82499	-3.76660	3.76660
	Equal variances not assumed			.000	23.892	1.000	.00000	1.81141	-3.73947	3.73947
Perform	Equal variances assumed	5.812	.024	.429	25	.671	.43333	1.00975	-1.64629	2.51296
	Equal variances not assumed			.412	18.963	.685	.43333	1.05103	-1.76679	2.63345
Total_Score	Equal variances assumed	.000	.985	-.849	21	.405	-3.68182	4.33669	-12.70046	5.33682
	Equal variances not assumed			-.848	20.686	.406	-3.68182	4.34302	-12.72198	5.35834

Note. Based on point-scores.

Figure 46. *Student Questionnaire Results*

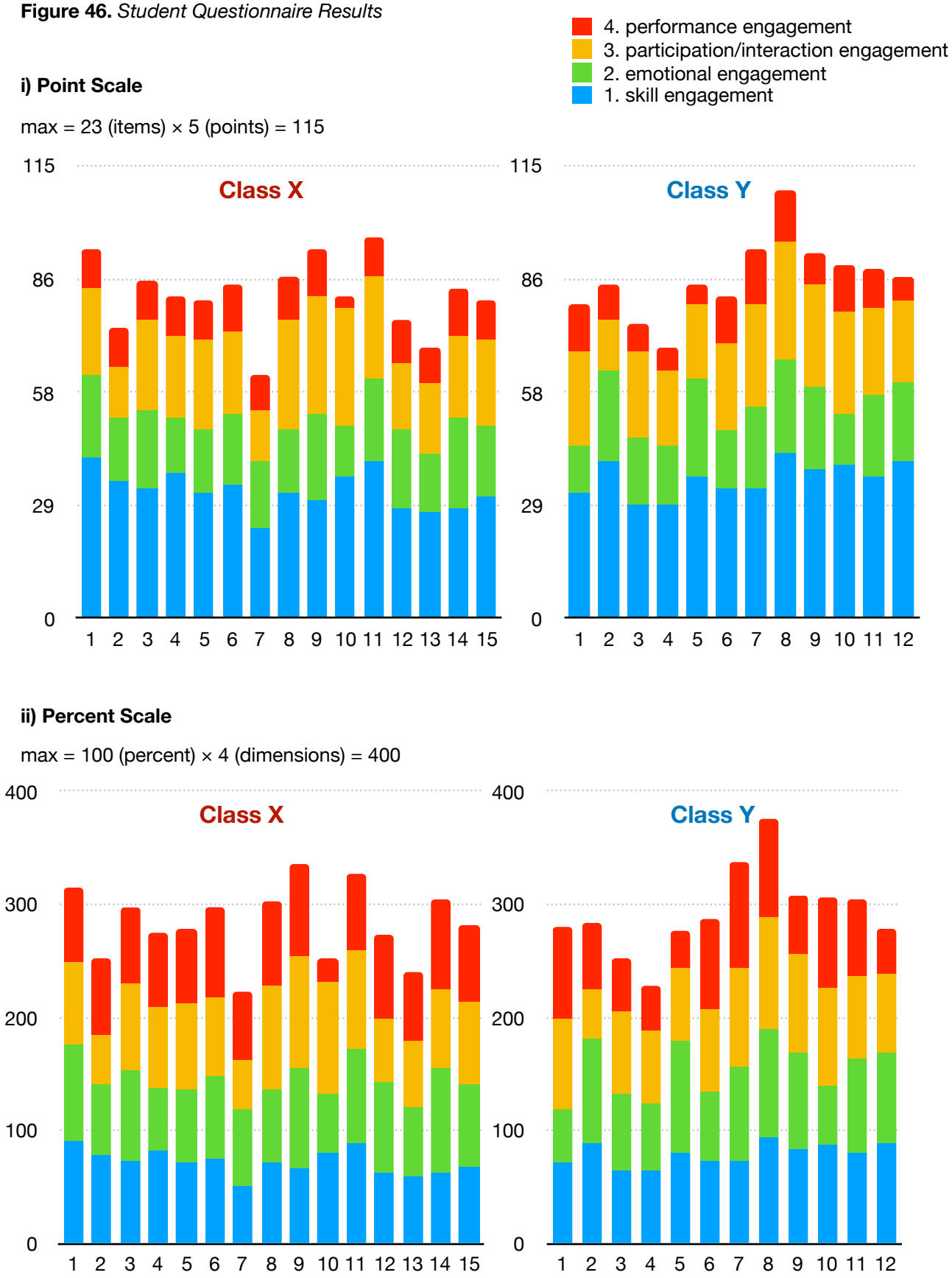


Table 17. *Student Questionnaire Per-Item Responses*

	Counts per Response					Percent Weight				
Item	not like me	less like me	neutral	more like me	totally me	not like me	less like me	neutral	more like me	totally me
1	2	4	7	5	9	7.4	14.8	25.9	18.5	33.3
2	1	6	6	7	7	3.7	22.2	22.2	25.9	25.9
3	1	1	4	13	8	3.7	3.7	14.8	48.1	29.6
4	2	4	7	9	5	7.4	14.8	25.9	33.3	18.5
5	0	1	3	10	13	0.0	3.7	11.1	37.0	48.1
6	1	3	7	7	8	3.7	11.1	25.9	25.9	29.6
7	0	1	9	6	11	0.0	3.7	33.3	22.2	40.7
8	1	3	9	8	5	3.7	11.1	33.3	29.6	18.5
9	0	2	5	12	8	0.0	7.4	18.5	44.4	29.6
10	0	4	8	12	3	0.0	14.8	29.6	44.4	11.1
11	0	2	11	7	6	0.0	7.4	40.7	25.9	22.2
12	1	4	4	14	4	3.7	14.8	14.8	51.9	14.8
13	0	0	6	16	5	0.0	0.0	22.2	59.3	18.5
14	1	5	4	10	7	3.7	18.5	14.8	37.0	25.9
15	1	3	12	10	1	3.7	11.1	44.4	37.0	3.7
16	2	6	12	7	0	7.4	22.2	44.4	25.9	0.0
17	0	1	12	9	3	0.0	3.7	44.4	33.3	11.1
18	1	1	7	11	7	3.7	3.7	25.9	40.7	25.9
19	1	4	3	11	8	3.7	14.8	11.1	40.7	29.6
20	1	3	5	11	6	3.7	11.1	18.5	40.7	22.2
21	2	4	8	7	6	7.4	14.8	29.6	25.9	22.2
22	0	2	4	10	11	0.0	7.4	14.8	37.0	40.7
23	0	0	6	9	12	0.0	0.0	22.2	33.3	44.4

Table 18. *Student Questionnaire Averages and Variances*

	Class X						Class Y					
			variances						variances			
itm	*M*	*SD*	skill	emo	part	perf	*M*	*SD*	skill	emo	part	perf
1	3.60	1.30			1.57		3.5	1.4			1.8	
2	3.53	1.06			1.05		3.4	1.4			1.9	
3	4.07	0.96			0.86		3.8	1.0			1.0	
4	3.40	1.18	1.31				3.4	1.2	1.4			
5	4.00	0.85	0.67				4.7	0.7	0.4			
6	3.57	0.94			0.82		3.8	1.4			1.8	
7	3.93	0.88		0.73			4.1	1.1		1.1		
8	3.40	1.12		1.17			3.6	1.0		1.0		
9	4.07	0.70	0.46				3.8	1.1	1.1			
10	3.47	0.83	0.65				3.6	1.0	0.9			
11	3.57	0.85		0.67			3.8	1.1		1.0		
12	3.80	0.94				0.8	3.3	1.2				1.2
13	3.73	0.46	0.20				4.3	0.8	0.5			
14	3.40	1.24	1.44				3.9	1.1	1.1			
15	3.27	0.80				0.6	3.3	1.0				0.9
16	2.87	0.74				0.5	2.9	1.1				1.1
17	3.54	0.78	0.56				3.6	0.8	0.6			
18	3.73	0.88			0.73		3.9	1.2			1.2	
19	3.60	1.30			1.57		4.0	1.0			0.8	
20	3.50	1.09	1.11				3.9	1.1	1.1			
21	3.60	1.06		1.04			3.2	1.4		1.8		
22	3.73	0.96		0.86			4.6	0.7		0.4		
23	4.07	0.88	0.73				4.4	0.7	0.4			
		Sum	7.11	4.48	6.60	1.94		Sum	7.51	5.27	8.51	3.15
	Chronbach's α		0.77	0.60	0.89	0.83	Chronbach's α		0.64	0.88	0.62	0.96

Appendix III: Student Focus Groups

Figure 47

Focus Group Questions

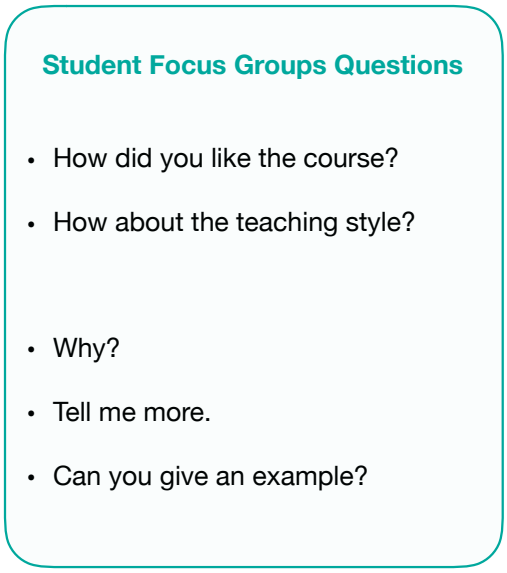


Figure 48

Student Focus Groups: the Data Processing Flowchart

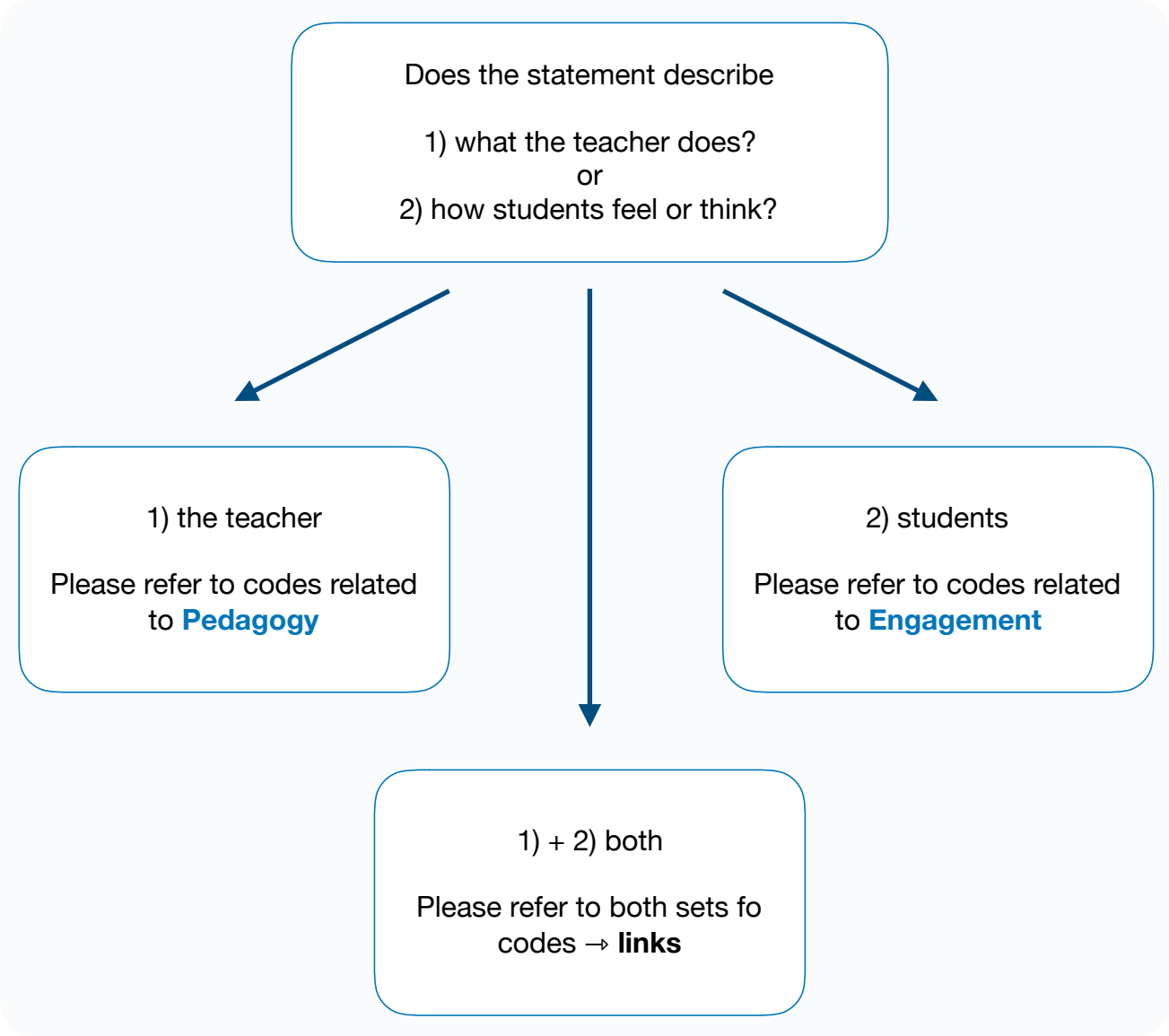


Table 19

Student Focus Groups Results

		Focus Group X		Focus Group Y	
category	code	count	percent weight	count	percent weight
Choice of Pedagogy	P-Auto	0	0	4	15
	P-dial	5	23	0	0
	P-expt	1	5	2	6
	P-monit	3	14	12	39
	P-Q?/ind	1	5	1	3
	P-risk	3	14	1	3
	P-trans	0	0	4	13
	P-T/S	6	27	1	3
	P+	3	14	5	16
	P-W/B	0	0	1	3
Student Engagement	Eng+	8		10	
	C	13		19	
	A	0		7	
	R	19		28	

Student Focus Groups Results (Continued)

Table 20

Student Focus Group X: Choice of Pedagogy

Variable	Code	Description	Example Quote	Freq., *n* (%)
Choice of Pedagogy	P-dial	The teacher facilitates an ongoing classroom dialog.	Participant X4: "I've realized a lot since moving into this country in terms of education. That teachers are quite interactive, as compared to back home. Sometimes education isn't always about learning the material, like you have… yes, the whole interaction, so counts a lot. [It] makes the whole course more vibrant."	5 (23)
	P-equit	The teacher provides equal or equitable learning opportunities.	Participant SX5: "So I'm still dealing with my confidence issues. But I think [Teacher X] is helping me… [inaudible] get me back up."	
	P-expt	The teacher performs demonstrative experiments	Participant SX2: "Like, bringing the experiments every once in a while, or just a short video, like do something different that breaks the routine, and makes it, you know, more interesting than just reading a book or listening [to] someone explain all the information or whatever."	1 (5)
	P-monit	the teacher scaffolds or monitors students' comprehension by: questioning, modeling, checking notes, etc.	Participant SX4: "Like [Teacher X] doesn't just come and, here's the information. Like, he… I don't know, it's like, he like builds it up in sort of way."	3 (14)
	P-risk	The teacher allows students to take intellectual risks.	Participant SX1: "Yeah, even for just curious… if we have a stupid question, he'll like totally entertain it, and like, you know… If we have any interest, he'll totally try to answer it no matter how out-of-the-way or unrelated it is. . . you know, really helps us being engaged in ehm… topics."	3 (14)
	P-T/S	The teachers lowers the teacher-student boundary.	Participant SX6: "Also, I like it's not really hierarchical. He like, like… he's just… interacting with us as if we are on the same level."	6 (27)
	P+	A generally positive statement about pedagogy.	Participant SX1: "[Teacher X] knows the material back-and-forth and knows how to make it comprehensible."	3 (14)

Table 21

Student Focus Group Y: Choice of Pedagogy

Variable	Code	Description	Example Quote	Freq., *n* (%)
Choice of Pedagogy	P-Auto	The teacher provides autonomy.	Participant Y1: "When he explains it, some people have like… certain questions and he answers those individually. That's clear… you know, when… when he explains stuff, and then… some people [do] not understand point A, some people [do] not understand point B, so then we can. After he explains it, we can ask individually."	4 (15)
	P-expt	The teacher performs demonstrative experiments	Participant Y2: "He is also very energized. And he uses real world like experiments and, let's say, he would… bring like a vacuum pump and he would show us how…"	2 (6)
	P-monit	the teacher scaffolds or monitors students' comprehension by: questioning, modeling, checking notes, etc.	Participant Y2: "Also what I realized, what he did is when we have a question from… from… from the booklet… we would have a question, we would ask him to help us, he would answer us in questions to make us think, instead of… just… [interruption] giving us the answer [interruption] and like that, I think, we do it learn."	12 (39)
	P-risk	The teacher allows students to take intellectual risks.	Participant Y5: "I don't think anyone… To be fair, it's not like anyone asks extremely stupid question yet though… like a question… you like, are you serious?"	1 (3)
	P-T/S	The teachers lowers the teacher-student boundary.	Participant Y4: "Just personality… he's like… he doesn't force his jokes… he's just… fun. He… he enjoys interacting with us."	1 (3)
	P-trans	The teacher aids student to translate problems, literally,	Participant Y3: "He… he also learns words for us. Because we don't know what it's called in English, the [a foreign language word], and then… Now, when he's helping us, he knows, yeah, you have to do the [a foreign language word]. It's something in math."	4 (13)
	P+	A generally positive statement about pedagogy.	Participant Y6: "He like answers our questions. He's not like teachers at school. Yeah, what's your… can you like help me with this? They're like, naaaah, you should have known this.[silence]"	5 (16)

Table 22

Student Focus Group X: Student Engagement

Variable	Code	Description	Example Quote	Freq., *n* (%)
Student Engagement	C	Competence	Participant X1: "I was really worried about not being able [to] pick up this much physics in a span of two months. But I feel like it's pretty comprehensible, and it's ehmm… yeah. I feel like I'm learning everything quickly and thoroughly." Participant X2: "I think I recognized like all the… the… the workings and stuff on the board. When I started learning here, but it's just pretty surprising to me how I recognize it, and suddenly, I can understand it, and it wasn't exactly too hard either."	13 (41)
	A	Autonomy	∅	
	R	Relatedness	Participant X2: "Honestly, the dynamic of the class… [silence] I mean, maybe I'm wrong but I've liked it so far. Like, it's a good group." Participant X6: "The class is just super approachable." Participant X5: "I think I'll miss everyone in this class but I'll miss [student's name] the most."	19 (59)
	Eng+	A generally positive statement.	Participant X4: "I enjoyed [the class]… a lot."	8
	Eng–*	A generally negative statement.*	Participant X3: "I took physics, like simple physics, for like two years ago. And I had a… I gonna tell you, I had a terrible teacher. And because of that, I thought that I hated physics."	*

Note. Class X: student engagement in terms of competence, autonomy, and relatedness.

* students expressed negative feelings only in respect to their past experiences; thus, it was assumed that students juxtaposed their past experiences with the current events in the class.

Table 23

Student Focus Group Y: Student Engagement

Variable	Code	Description	Example Quote	Freq., *n* (%)
Student Engagement	C	Competence	Participant Y5: "[re. passing the exam] I agree, we have a good base. I think everyone in this class can do it after his class."	19 (35)
			Participant Y1: "It was so much… learned so much"	
	A	Autonomy	Participant Y5: "Personally, I like doing like ehmm… yeah, work individually, you know, give me tasks, and then ehm… if I need help, then either… if I'm in class, I ask the teacher, obviously. If I'm at home, I just do it… you know, I look it up."	7 (13)
			Participant Y2: "Because I've had [inaudible] can ask [Teacher Y] for anything. Always end up like… again, like, oh, I just answered my own question, okay, thanks anyway, though."	
	R	Relatedness	Participant Y5: "I'm like not excited to finish this, particularly… I mean, obviously, I'm looking forward to finishing the exam. But I'm not like… I'm not like ehm… looking forward to necessarily leave this classroom or this class. Because it's it's ehm… good environment. It was a good routine, as well."	28 (52)
			Participant Y6: "I made two really good friends that I still hanging out with, both of them. Ehm… I have [inaudible] them recently… so every like three or four weeks or so, we… you know, ehm… we discuss the time to meet, so… yeah. I made friend there and I think, [I have] friends here at school, as well."	
	Eng+	A generally positive statement.	Participant Y4: "I enjoyed coming here more than… anything at school."	10
	Eng–*	A generally negative statement.*	Participant Y3: "I had… [silence] bad experience with group work, so [prefer] individual."	*

Note. Class Y: student engagement in terms of competence, autonomy, and relatedness.

* a student expressed negative feelings only in respect to their past experiences; thus, it was assumed that the student juxtaposed their past experience with the current events in the class.

Appendix IV: Teacher Interviews

Figure 49

Teacher Interview Questions

Teacher Interview Questions

- Background
  - Did you always want to teach?
  - What is your teaching philosophy? Guiding principles? Role models?
- Elaborate on different groups
  - How do you think this group will do on the exam?
- Preparation
  - How do you prepare for the classes?
  - Differentiation? Individualization? vs. groups in the past
- Routine
  - Describe what happens during a regular class session.
- Three hands go up. How do you choose?
  - Why?
  - Tell me more.
  - Can you give me an example?

Figure 50

Teacher Interviews: the Data Processing Flowchart

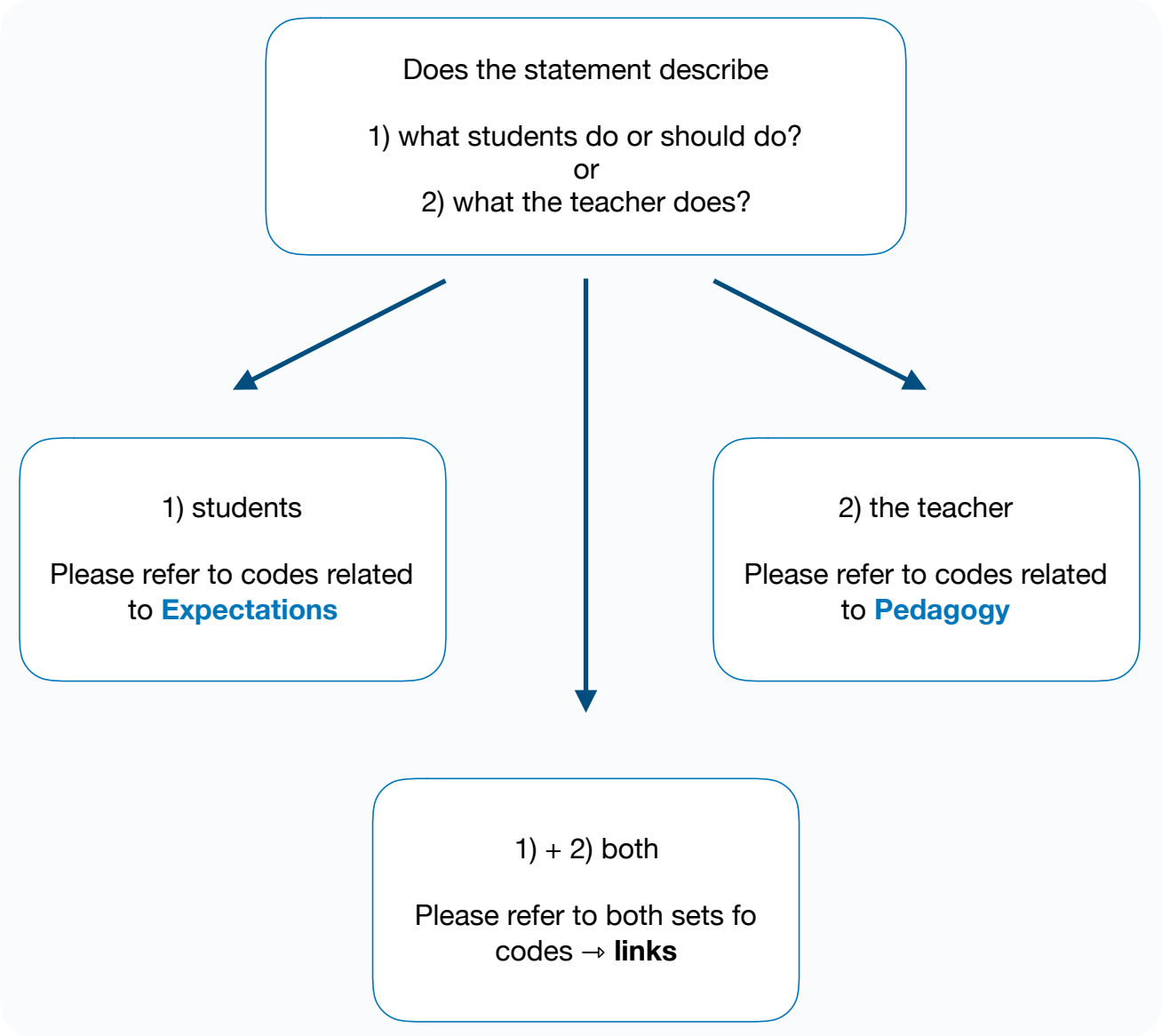


Table 24

Teacher Interview Coding Scheme

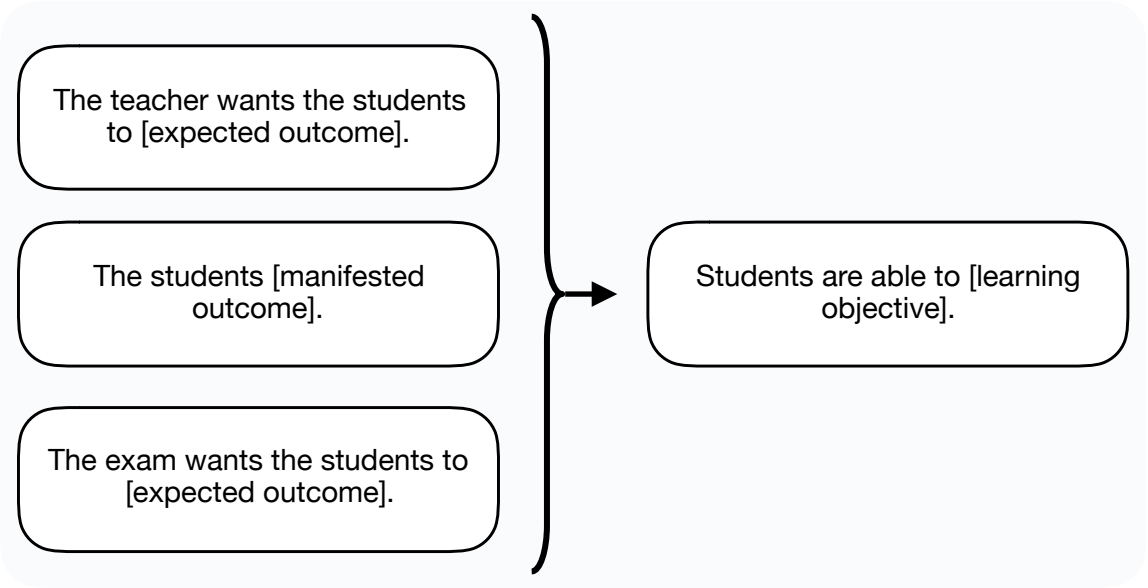
Category	Code	Description
Expectations	E-pass	Students are able to pass the exam.
Intermediate Learning Objectives	O-collab	Students are able to create a collaborative learning environment.
	O-contr	Students are able to initiate contributions.
	O-deco	Students are able to deconstruct problems into steps.
	O-deriv	Students are able to derive equations.
	O-genQ	Students are able to generate questions.
	O-P/M	Students gain procedural or metacognitive knowledge.
	O-risk	Students are able to take intellectual risks.
	O-trans	Students are able to translate problems, literally,
	O-vis	Students are able to visualize physics.
	O-w4it	Students "work for it," or they "face the exercises by themselves."
Choice of Pedagogy	P-Auto	The teacher provides autonomy.
	P-dial	The teacher facilitates an ongoing classroom dialog.
	P-diff	The teacher differentiates between ability groups.
	P-equit	The teacher provides equal or equitable learning opportunities.
	P-exc	The teacher allows extra time for collaborative problem solving.
	P-expt	The teacher performs demonstrative experiments
	P-feed	The teacher actively solicits or uses indirect feedback from students.
	P-indirQ	The teacher avoids direct or harsh corrections
	P-inspS	The teacher's pedagogy is inspired by students.
	P-jarg	The teacher learns and uses foreign-language jargon.
	P-link	The teacher makes explicit pedagogic links.
	P-monit	the teacher scaffolds or monitors students' comprehension by: questioning, modeling, checking notes, etc.
	P-pass	The teacher's pedagogy is conscious of the ultimate objective of the course.
	P-POV	The teacher takes on students' point of view.
	P-proj	The teacher uses the projector
	P-Q?/ind	The teacher allows students to ask questions during individual work
	P-T/S	The teachers lowers the teacher-student boundary.
	P-W/B	The teacher uses the whiteboard.

Expectations vs. Intermediate Learning Objectives

Expectations stated as learning objectives, outcomes desired or manifested. Teachers expressing desired student behaviors and teachers describing manifested student behaviors were treated as expectations; thus, these expectations were formulated as learning objectives. Teachers describing their pedagogic actions were treated as pedagogy.

Figure 51

Expectations vs. Intermediate Learning Objectives



Note. Expected or manifested behaviors

Table 25

Teacher Interviews Results

		Teacher X		Teacher Y	
category	code	count	percent weight	count	percent weight
Teacher Expectations	E-pass	1	1	13	28
Intermediate Learning Objetives	O-collab	7	10	9	19
	O-contr	21	30	0	0
	O-deco	0	0	5	11
	O-deriv	0	0	1	2
	O-genQ	15	21	0	0
	O-P/M	8	11	1	2
	O-risk	10	14	2	4
	O-trans	0	0	2	4
	O-vis	0	0	7	15
	O-w4it	9	13	7	15
Choice of Pedagogy	P-Auto	7	11	3	3
	P-dial	9	14	0	0
	P-diff	0	0	14	16
	P-equit	4	6	3	3
	P-exc	3	5	1	1
	P-expt	0	0	17	19
	P-feed	4	6	5	6
	P-indirQ	0	0	3	3
	P-inspS	5	8	1	1
	P-jarg	0	0	1	1
	P-link	6	9	2	2
	P-monit	19	30	25	28
	P-pass	1	2	4	4
	P-POV	0	0	2	2
	P-proj	1	2	3	3
	P-Q?/ind	1	2	1	1
	P-T/S	4	6	1	1
	P-W/B	0	0	4	4

Teacher Interview Results (Continued)

Table 26

Teacher X Interview: Expectations of Student Performance and Intermediate Learning Objectives

Variable	Code	Description	Example Quote	Freq., *n* (%)
Exp	E-pass	Students are able to pass the exam.	"…motivation the can comes from the fact that… want them to… hm-hmmmm… finish this exam."	1 (1)
	O-collab	Students are able to create a collaborative learning environment.	"You had the… [student J] who knew a lot already, so some stuff were easy for her, but she was also in classroom and helping other students, contributed to the discussion, and working the material."	7 (10)
	O-contr	Students are able to initiate contributions.	"I pay more attention to it, the fact that ehm… if they're allowed to speak, sometimes they will contribute an explanation, which is nice because it creates a dialogue from the students."	21 (30)
	O-genQ	Students are able to generate questions.	They try the exercises ehm… and whenever they had issues, they came to me, and ehm… yeah. And also they came the days after, they always had questions, they always had questions about the exercises."	15 (21)
iLO	O-P/M	Students gain procedural or metacognitive knowledge.	"When you start working on ehm… on… on… on exercise that… you know, it's new and hard or whatever, there will be some elements of chaos. But then, out of the chaos, you need to organize a bit… the process. If you… if you start with chaos, you continue with chaos, then yeah… it's not great."	8 (11)
	O-risk	Students are able to take intellectual risks.	"Okay, yeah. I want them to… feel free to raise their hand and ask questions. and not be afraid of, like, oooh, what is, I don't know, so-and-so going to think about whatever."	10 (14)
	O-w4it	Students "work for it," or they "face the exercises by themselves."	"I prefer if they work for it, yeah. I don't jsut… I don't want to just… ehm… show them the way ehm. . . but again, there is the balance between giving them more autonomy and making sure that they also feel competent enough to face these exercises. . ."	9 (13)

Note. Exp = performance expectations, iLO = intermediate learning objectives.

Percentages have been rounded off to a whole number.

Table 27

Teacher Y Interview: Expectations of Student Performance and Intermediate Learning Objectives

Variable	Code	Description	Example Quote	Freq., *n* (%)
Exp	E-pass	Students are able to pass the	"Just that I want for my students to pass."	13 (28)
iLO	O-collab	Students are able to create a collaborative learning environment.	"So now they are starting… they are not really, not working together on exercises yet but yeah… I expect that in a few weeks they will join together to solve problems."	9 (19)
	O-deco	Students are able to deconstruct problems into steps.	"They've already got the workings so I expect them to look at the exam again to yeah… ehm… How they've done or where went wrong, or… but then by giving my… reading their workings, ehm… that gives me some ideas of, okay, they didn't understand this bit but they did understand that."	5 (11)
	O-deriv	Students are able to derive equations.	"If I give them a function or ask them to derive a certain expression, where you have to combine formulas, which is a newer, one of those new type of questions on the exam. Just… from all the formulas, you know… or you've learned in physics, just derive find a new one. Derive this new expression."	1 (2)
	O-P/M	Students gain procedural or metacognitive knowledge.	"When problem-solving . . . I want the steps... ehm… if you… if you're writing it down…"	1 (2)
	O-risk	Students are able to take intellectual risks.	"Don't be afraid that your answer… but I [want] you to think of it. Ehmm… or just just tell me what you think and okay it might be wrong but you thought about it."	2 (4)
	O-trans	Students are able to translate problems, literally,	"But yeah, especially if English is not your… native tongue which for most of the students, ehm… they have to… ehm… well, they first translate, well they first translate the question from English to their own language and then it becomes a physics question."	2 (4)
	O-vis	Students are able to visualize physics.	"To me, visualization is important. To see what's going on. I mean, we can all just take the formula, plug in the numbers, and then there's my result. But what are we doing? So be able to visualize it… I think… well, to me, that's important. So I just "transit" [sp] that to my students."	7 (15)

Variable	Code	Description	Example Quote	Freq., *n* (%)
	O-w4it	Students "work for it," or they "face the exercises by themselves."	"Well, they will run into the problems if you don't explain it, most of them are able to figure it out on their own. I don't want to give too many hints, I mean, they should be able to figure out stuff themselves."	7 (15)

Note. Exp = performance expectations, iLO = intermediate learning objectives.

Percentages have been rounded off to a whole number.

Table 28

Teacher X Interview: the Choice of Pedagogic Actions

Variable	Code	Description	Example Quote	Freq., *n* (%)
Choice of Pedagogy	P-Auto	The teacher provides autonomy.	"I would like them to have more autonomy. There's something that it's in my mind and that's give them.… And again, what I told you before, for example, in the idea of not giving them… worked examples."	7 (11)
	P-dial	The teacher facilitates an ongoing classroom dialog.	"Because… different material… obviously that allows for this sort of communal, you know, gatherings of people talk, and exchange ideas, and that's part of the process, you know. . ."	9 (14)
	P-equit	The teacher provides equal or equitable learning opportunities.	"[student J], [student Z], maybe [student G], they were constantly raising their hands. So I would always pick, I would try to pick someone else. I-I always want to give all of them the opportunity to speak."	4 (6)
	P-exc	The teacher allows extra time for collaborative problem solving.	"I took longer times, with this group at least, to go through the exercises. So they were sessions where, for example for the first hour and a half, we were just doing the exercises from the day before."	3 (5)
	P-feed	The teacher adjust pedagogy according to indirect feedback from students.	"So you can see that suddenly people that would never be never on the phones, start to going on the phones. So that's when I think I had to sort of cut it, and be okay, [silence] moving on. In order to… you know, maintain the focus of… the majority."	4 (6)
	P-inspS	The teacher's pedagogy is inspired by students.	"I think, I have a good approach in solving exercises, and org- the organization, but in reality, I copied the students."	5 (8)
	P-link	The teacher makes explicit pedagogic links.	"I think one benefit of having the students feeling at liberty to speak that you can create this easy transitions from topic to topic, or from… like-like you can grab on something that a students said and use it on the board. Someone says something, you can grab that."	6 (9)
	P-monit	the teacher scaffolds or monitors students' comprehension be: questioning, modeling, checking notes, etc.	"I like it when I have a dialogue in the classroom, because it's ehm… I can understand where they are. . ."	19 (30)

Variable	Code	Description	Example Quote	Freq., *n* (%)
	P-pass	The teacher's pedagogy is conscious of the ultimate objective of the course.	"I hope that [what] I did the classrooms and everything everything, that also worked towards motivating them in working, participating, I mean because yeah, they have to do the scores because they have to pass the… the exam, so they can get into university. . ."	1 (2)
	P-T/S	The teachers lowers the teacher-student boundary.	"I think it's this, you know, like having a classroom that's…. ehm… the distance between the teacher and the student is ehm… smaller."	4 (6)

Note. Quotes from a selection of low-frequency code have been omitted.

Percentages have been rounded off to a whole number.

Table 29

Teacher Y Interview: the Choice of Pedagogic Actions

Variable	Code	Description	Sample Quote	Freq., *n* (%)
	P-Auto	The teacher provides autonomy.	"So I try to get them to participate or yeah… I mean, if someone doesn't want to, I cannot force them to."	3 (3)
	P-diff	The teacher differentiates between ability groups.	"I think you have to adapt to the… to get the most out of your students, yeah… but yeah, of course, in an ideal world… yeah… I think this… yeah, unfortunately with the… ehm… with the foreign students, you typically… you can get very different levels of… of… well, students."	14 (16)
	P-equit	The teacher provides equal or equitable learning opportunities.	"Well, if someone has already answer[ed] the question, I'd pick another one first. But ehm… the first time will just be random or ehmm… someone has ehmm… If I don't get a lot of feedback from one, from one of these persons, that one should go first."	3 (3)
	P-expt	The teacher performs demonstrative experiments	"Well, I did do the experiment with refraction because you can still see the red laser beam on the wall. I think you were in my class when I showed the—tried to show—the diffraction of light with this custom-made diffraction grating."	17 (19)
	P-feed	The teacher adjust pedagogy according to indirect feedback from students.	"And by hearing the wrong answer, I could kind of improve on, okay, I should focus on this or ehm.. Oh, apparently, they struggle with this part. Ehm… yeah, let's ehm… go deeper here or let do that in more detail or something…"	5 (6)
	P-indirQ	The teacher avoids direct or harsh corrections, uses indirect questioning.	"Okay okay, that's good, or that part of your reasoning is good but this is not or… I won't tell them what's wrong but I will tell them what part is right and then how they can use that to get to the answer. I like to… to be positive…"	3 (3)
Choice of Pedagogy	P-inspS	The teacher's pedagogy is inspired by students.	"Some inspiration you get from your students. They are like, how does this work? Well, I don't know. But actually, I would like to know how it works."	1 (1)

Variable	Code	Description	Sample Quote	Freq., *n* (%)
	P-link	The teacher makes explicit pedagogic links.	"I always try to find something where are you can [connect it] in your daily… or at least, in your own life, just link it to something that they've seen or do or… And I don't want it to be some vague stuff."	2 (2)
	P-monit	the teacher scaffolds or monitors students' comprehension by: questioning, modeling, checking notes, etc.	"what about this resulting force? Which one is… and then, okay, who thinks that one… who thinks it's two… and then okay, could you tell me why do you think it's one? And then… which is not the right answer but then… or does your intuition tell you? But then that also tells me ehm… ehm… where… ehm… well, I think it can help me to understand what ehm… yeah, what goes wrong in the reasoning [inaudible] or what's going on in their mind."	25 (28)
	P-pass	The teacher's pedagogy is conscious of the ultimate objective of the	"My job is to get them through the exam in the end, or get them to pass the exam."	4 (5)
	P-POV	The teacher take on students' point of view.	"I'm just trying to be [a] student and how would… what would help me me understand the stuff. I'm trying to see it from their point of view."	2 (2)
	P-proj	The teacher uses the projector.	"It's a good idea to have the picture on the beamer and then okay, we are looking at this… just just just a… ehm… to help visualize the stuff."	3 (3)
	P-W/B	The teacher uses the whiteboard.	"When is problem-solving, I don't… I don't want, okay, first I don't want these… I want the steps on the whiteboard. Let's go to the… ehm… if you if you're writing it down, ehm… well, the pace of… of the solution is determined by how fast you write on the board."	4 (5)

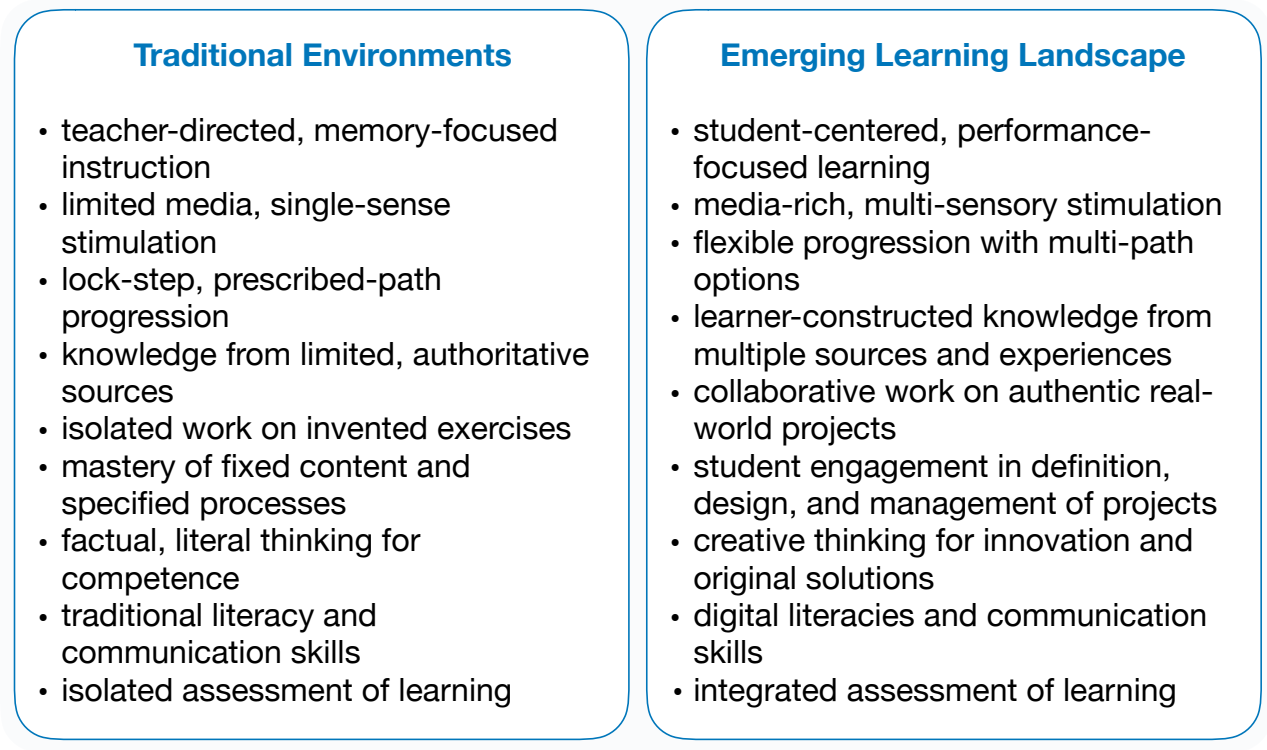
Note. Quotes from a selection of low-frequency code have been omitted.

Percentages have been rounded off to a whole number.

Appendix V: Miscellaneous

Figure 52

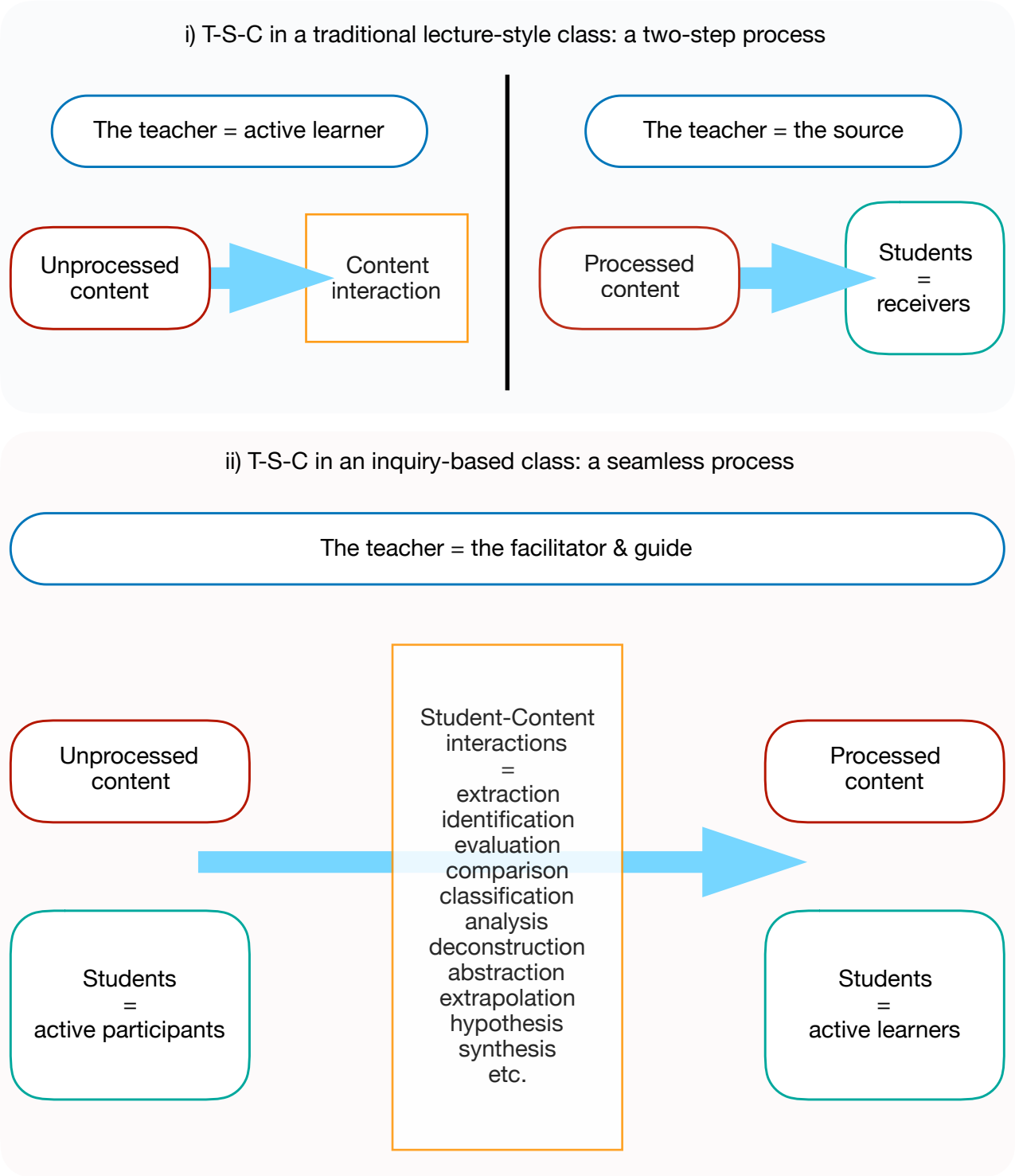
Traditional and Emerging Learning Landscapes



Note. Adapted from Maloy et al., 2010, p. 20.

Figure 53

Teacher-Student-Content Interactions: Two Extremes on the Spectrum of Pedagogy



Note. Novotny, 2020a.

Figure 54

Changes Over Time in Student-Initiated Contributions in Class X (Red) and Class Y (Blue)

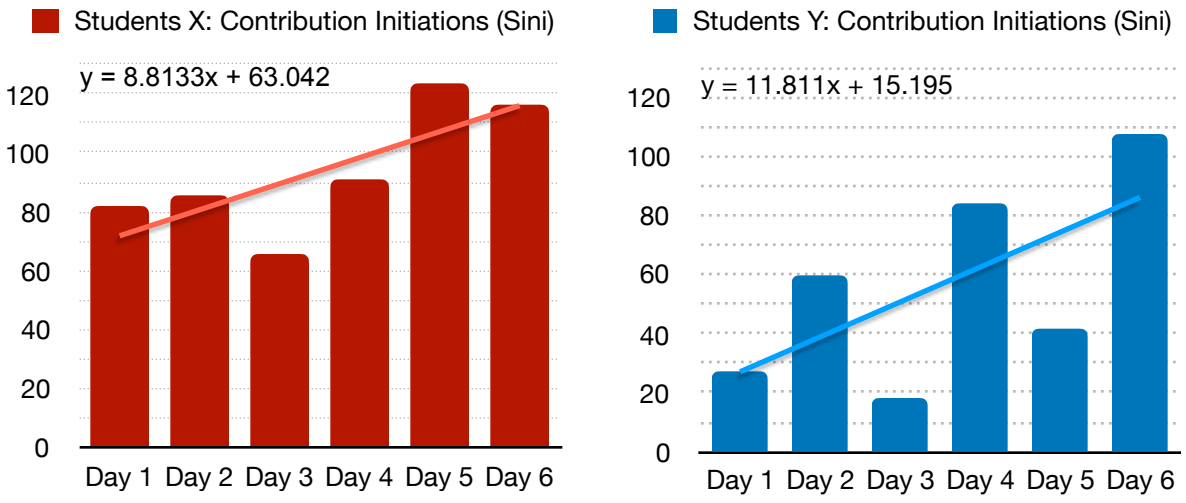


Figure 55

Changes Over Time in Students' Elaborations in Class X (Red) and Class Y (Blue)

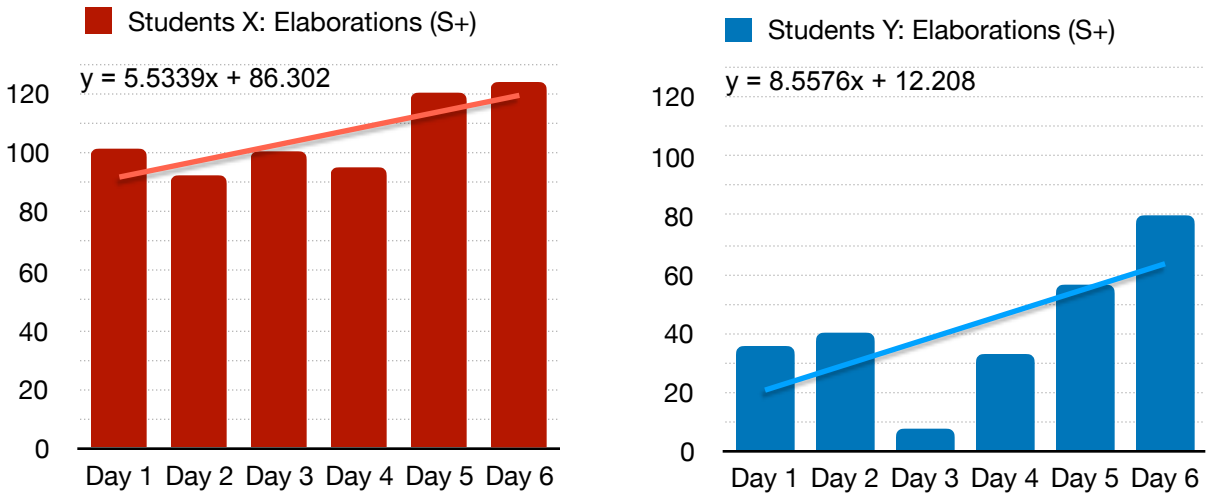
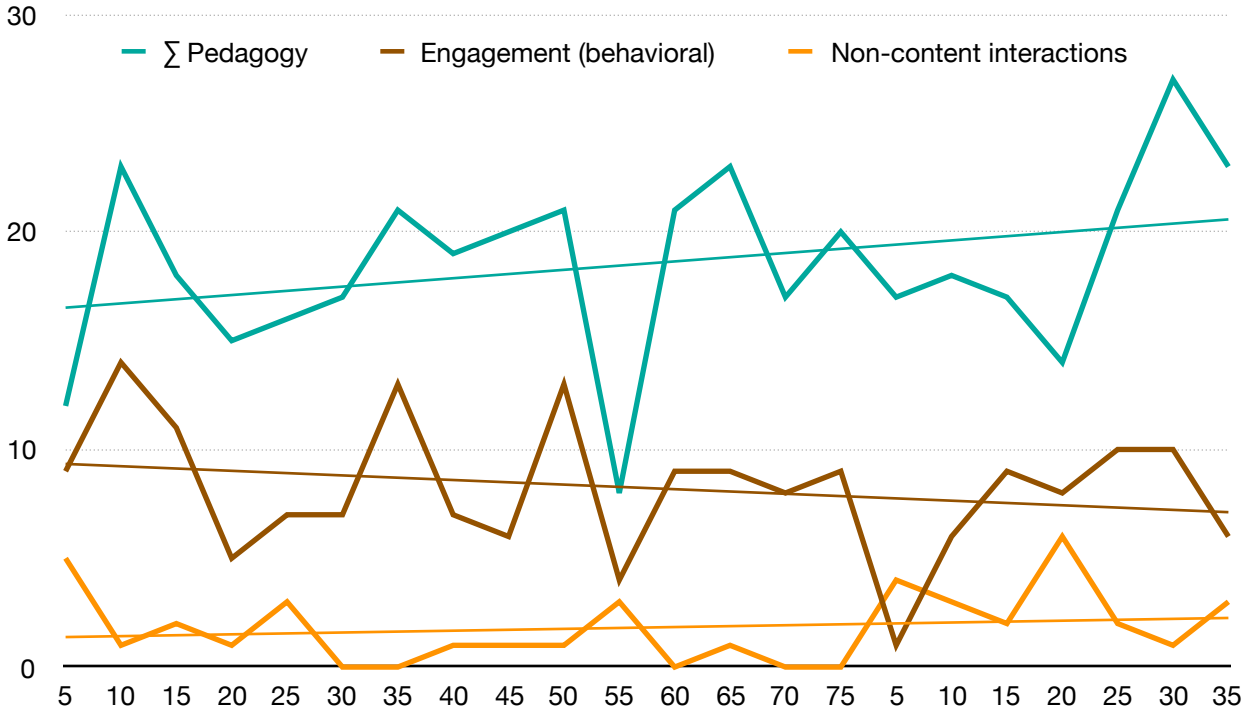


Figure 56

Pedagogy, engagement, and non-content interactions as time-dependent functions (over one lesson)



Note: x-axis = instances, y-axis = time in 5-min intervals

Figure 57

Pedagogy, engagement, and non-content interactions as time-dependent functions (over one lesson)

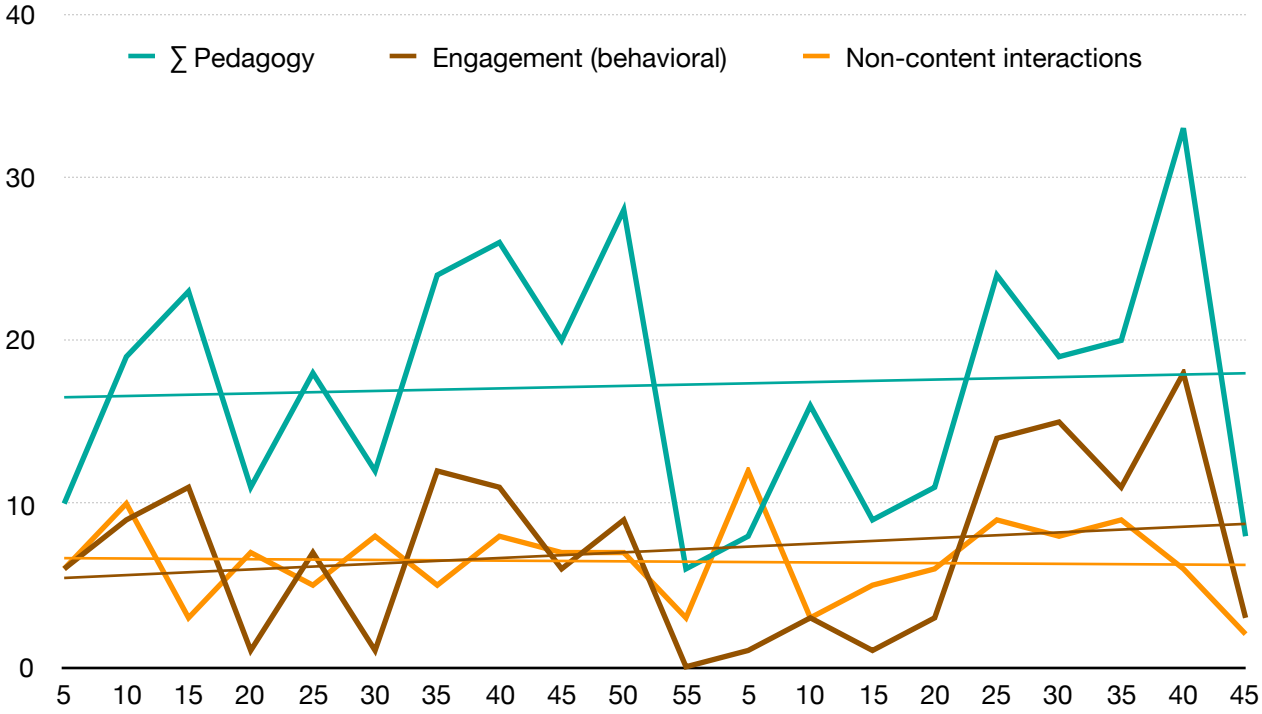


Table 30

Examples of Classroom Interaction Patterns

Ongoing Classroom Dialog	
S2Tq	A student asks the teacher a question.
Tr	The teacher repeats or restates the question.
S2T	Another student answers the question
S2Tq	A student asks the teacher a question.
S+	The student elaborates or adds evidence to their line of reasoning.
S2S	Another student answers the student's question.
T-C	The teacher interacts with a model or performs an experiment.
Tq	The teacher asks a question.
S2T	A student answers the question.
Tr	The teacher restates the answer.
T-C	The teacher links the answer to the model.
Pedagogic Link-Making	
Tq	The teacher asks a question.
S2T	A student answers the question.
Tr	The teacher repeats or restates the student's answer.
T-C	The teacher links the answer to the content (a model, graph, animation).
T2C	The teacher talks to the class.
Sini	A student initiates a contribution
Tr	The teacher repeats or restates the student's contribution.
T-C	The teacher links the contribution to the content (a model, graph).
Sini	A student initiates a contribution.
Tr	The teacher restates the student's contribution.
TLE	The teacher links the contribution to expectations.
Q?	The teacher prompts a question.
S2Tq	A student asks the teacher a question.
TLP	The teacher links the question to the prior knowledge.
S+	The student elaborates or adds evidence.

Students Elaborating, or Adding Evidence	
Sini	A student initiates a contribution.
Tr	The teacher restates the contribution
T+	The teacher asks the students to elaborate or add evidence.
S+	The teacher elaborates or adds evidence.

9.0 Figures

Figure 1 Conflicting Degrees of Cognitive Stimulation

Figure 2 Percent Student Engagement (Gallup, 2016)

Figure 3 Percent Engagement, Non-Engagement, And Active Disengagement (Gallup, 2016)

Figure 4 The Effects of Expectations

Figure 5 Introduction Summary

Figure 6 Teacher Expectations Shaping Learning Contexts, and Contexts Affecting Students' Psychosocial Needs

Figure 7 The Knowledge Gap

Figure 8 Two Research Sub-Questions vs. Three Sets of Variables

Figure 9 The Context-Self-Action-Outcome Model (e.g., Connell & Wellborn, 1991)

Figure 10 An Overview of the Theoretical Framework

Figure 11 The Pedagogic Triangle: Teacher-Student-Content Interactions (City et al., 2009)

Figure 12 Effective Pedagogic Actions

Figure 13 Less Effective Pedagogic Actions

Figure 14 The Constructs Measuring Pedagogy

Figure 15 Motivation ⇾ Engagement

Figure 16 The Self-Determination Continuum (Ryan & Deci, 2017)

Figure 17 Application of CET to Classroom Contexts (Deci et al., 2017)

Figure 18 Student in Complex Multi-Variable Contexts

Figure 19 Examples of Two-, Three-, and Four-Component Models of Engagement

Figure 20 The Tripartite Conceptualization of Engagement

Figure 21 Measuring Observed Student Engagement

Figure 22 The Project Timeline

Figure 23 The Data Collection Phase: the Methods

Figure 24 The Focus of Classroom Observations

Figure 25 The Focus Of Student Questionnaires

Figure 26 The Focus of Student Focus Groups

Figure 27 The Focus of Teacher Interviews

Figure 28 A Review: Research Questions vs. Sets of Variables Vs. Methods

Figure 29 Modeled Interactions With the Content

Figure 30 Three Constructs Measuring Pedagogy

Figure 31 Classroom Observations: Promoting Engagement vs. Observed Engagement

Figure 32 The Student Course Engagement Questionnaire (SCEQ), the Results

Figure 33 Student Engagement According to Focus Group X and Y

Figure 34 Student Focus Groups X and Y: Student Statements

Figure 35 Student Focus Group X: Explicit Links Between Pedagogy and Engagement

Figure 36 Student Focus Group Y: Explicit Links Between Pedagogy and Engagement

Figure 37 Pedagogical Emphases

Figure 38 Teacher X Interview: Expectations and Pedagogic Actions

Figure 39 Teacher Y Interview: Expectations and Pedagogic Actions

Figure 40 Expectations ⇾ Intermediate Objectives ⇾ Pedagogical Actions ⇾ Social Interactions

Figure 41 Pedagogical Emphases: a Generalized Scheme

Figure 42 Focus Groups' Dominant Psychosocial Needs and Favored Pedagogy

Figure 43 Contextual Factors Affecting Expectations, Pedagogy, and Engagement

Figure 44 Pedagogic Actions Enhancing Engagement

Figure 45 Research Questions, vs. Sets of Variables Vs. Methods

Figure 46 The Student Course Engagement Questionnaire (SCEQ), the Individual Student Results

Figure 47 Focus Group Questions

Figure 48 Student Focus Groups: the Data Processing Flowchart

Figure 49 Teacher Interview Questions

Figure 50 Teacher Interviews: the Data Processing Flowchart

Figure 51 Expectations ⇀ Intermediate Learning Objectives

Figure 52 Traditional and Emerging Learning Landscapes

Figure 53 Teacher-Student-Content Interactions: Two Extremes on the Spectrum of Pedagogy

Figure 54 Changes Over Time in Student-Initiated Contributions in Class X (Red) and Class Y (Blue)

Figure 55 Changes Over Time in Students' Elaborations in Class X (Red) and Class Y (Blue)

Figure 56 Pedagogy, Engagement, and Non-Content Interactions as Time-Dependent Functions (Over One Lesson)

Figure 57 Pedagogy, Engagement, and Non-Content Interactions as Time-Dependent Functions (Over One Lesson)

10.0 Tables

Table 1 Classroom Observations: Teacher Expectations

Table 2 SCEQ: Bivariate and Point-Serial Correlations

Table 3 Observation Rubric (Version 4.8)

Table 4 Observation Log Sample

Table 5 Classroom Observations: Choice of Pedagogy (Deconstructed)

Table 6 Classroom Observations: Student Engagement (Behavioral, Deconstructed)

Table 7 Student Questionnaires Dimensions

Table 8 The Student Course Engagement Questionnaire (SCEQ), Descriptives

Table 9 The Student Course Engagement Questionnaire (SCEQ): By Class And Gender

Table 10 Student Questionnaires Descriptive Statistics

Table 11 Chronbach's Alpha: Total Score

Table 12 Chronbach's Alpha: Dimensions Of Engagement

Table 13 Independent-Samples T-Tests: Class

Table 14 Independent-Samples T-Tests: Class

Table 15 Independent-Samples T-Tests: Gender

Table 16 Independent-Samples T-Tests: Gender

Table 17 Student Questionnaire Per-Item Responses

Table 18 Student Questionnaire Averages and Variances

Table 19 Student Focus Groups Results

Table 20 Student Focus Group X: Choice of Pedagogy

Table 21 Student Focus Group Y: Choice of Pedagogy

Table 22 Student Focus Group X: Student Engagement

Table 23 Student Focus Group Y: Student Engagement

Table 24 Teacher Interview Coding Scheme

Table 25 Teacher Interviews Results

Table 26 Teacher X Interview: Expectations of Student Performance and Intermediate Learning Objectives

Table 27 Teacher Y Interview: Expectations of Student Performance and Intermediate Learning Objectives

Table 28 Teacher X Interview: the Choice of Pedagogic Actions

Table 29 Teacher Y Interview: the Choice of Pedagogic Actions

Table 30 Examples of Classroom Interaction Patterns

11.0 Addendum: Clinical Education

The emerging field of *Clinical Education* "is like nursing—it is to remedy what's ailing, fix what doesn't work, repair what's broken" (Slayton, 2012). Clinical education is (Novotny, 2020b):

- Analytical: It is critical and descriptive in what works and what does not.
- Reflective: It weighs in on the efficacy of pedagogic choices with respect to student learning. Thus, it is goal-oriented. In education, student learning is paramount (Rodgers, 2002).
- Interactive: It maintains an ongoing dialog with a wider community of experts and non-experts. Communication aims to create a sense of balance between the norms and standards, the needs of society, what parents want for their children, and what students hope for their own futures.
- Contextual: It is cognizant of socio-political contexts, individual differences, and social inclusion. It responsibly advocates for social and economic justice but without giving a voice to potentially subversive ideas.
- Purposeful: It aims to refocus educational research from gimmicky to purposeful and from pretentious to practical.
- Humble: It is devoid of ostentatiousness and pompous intellectualism.
- Responsible and Accountable: It is proactively responsible and accountable in retrospect.

Audentes fortuna iuvat. Aut viam inveniam aut faciam.