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Malleable Factors in Teaching: Why and How to Address Them from a Constructivist Perspective

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Malleable Factors in Teaching: Why and How to Address Them from a Constructivist Perspective

In this conceptual article we propose a new approach to investigating changeable factors in teaching. Using a constructivist approach as conceptual framework we argue for investigating changeable factors recognizing their malleability and suggest studying teaching as a set of natural experiments. Methodologically, we propose an abductive research approach that moves among four constructs: perceptions, notions, conceptions, and theories. Our proposed research approach is illustrated with a case from a recent empirical study that examines playful learning environments.

Keywords: Changeable factors, malleable factors, quantitative methods, constructivism, abductive approach, playful learning

It is a challenge to identify and measure institutional factors and treatments in teaching, as these are often theoretically well-described but empirically not clearly identifiable. However, a number of studies actualize the need of focusing on institutional factors and treatments by pointing out the importance of teachers/classrooms for student achievement (Rivkin, Hanushek & Kain, 2005; Hanushek, 2011). At the same time, it is generally acknowledged that the strongest basis for understanding and strengthening the quality of teaching is established when a range of factors are considered, and when changeable factors, that is institutional factors and treatments on which one can actually intervene (Yik, 2022), are given particular awareness (Hanushek, 2011; Scheerens, 2017).

In this conceptual article, we suggest an approach for investigating changeable factors that is based on a conceptual framework anchored in constructivism. After an introduction where we clarify the idea of changeable factors and outline previous studies of them, we argue in four steps for studying teaching as a set of natural experiments and propose,

illustrate, and discuss an abductive research approach. First, we take a constructivist starting point reasoned in the outline suggesting that the changeable factors are malleable (they take different forms in different situations). Secondly, we argue that this understanding leads to the idea of teaching as a set of natural experiments. Thirdly, we illustrate how this notion of teaching has methodological implications, and we propose an abductive approach to studying the malleable factors. Fourth and finally, we illustrate our approach by applying it systematically on a case from a recent empirical study.

Changeable and Malleable Factors in Education and Teaching

Educational research often separates causes of academic performance into 'given,' 'endogenous,' or simply 'prior' conditions or factors on the one hand, and changeable factors on the other hand (Scheerens & Marks, 2017). The idea that they are changeable refers to the fact that one can actually intervene on and affect these factors (Yik, et al., 2022). Given, endogenous, or *prior factors* include student demographics, factors related to the individual students (previous educational results, admission criteria, housing situation, etc.), teacher experience, classroom dynamics, and the like, whereas *changeable factors* are intervention programs, policies, and practices hypothesized (or believed) to enhance educational performance (Scheerens, 2017). They include both what we call institutional factors, such as class size, student–staff ratios, indoor environment, length of the school day, and pedagogical factors, that is all types of teaching efforts and activities.

Although there is widespread agreement that changeable factors are important to student achievement, it has been difficult in reliable ways to identify specific factors with a reasonable effect size (Rivkin, Hanushek & Kain, 2005; Rockoff, Jacob, Kane & Staiger, 2011). Scheerens (2017) states that "although we have ample evidence that 'teachers and schools matter, in terms of variance components, the question on how they matter is more

complex" (p. 253). Hanushek (2011) reaches a similar conclusion, and reflects on recent decades' research:

> Literally hundreds of research studies have focused on the importance of teachers for student achievement. Two key findings emerge. First, teachers are very important. No other measured aspect of schools is nearly as important in determining student achievement. Second, it has not been possible to identify any specific characteristics of teachers that are reliably related to student outcomes. (Hanushek, 2011: 467)

Studies suggest that a lack of focus on, and the difficulty of addressing the changeable factors, are crucial reasons for the lack of progress in the research area on the importance of teachers and teaching for student achievement (Johnson, 2006; Ferguson & Hirsch, 2014; Scheerens, 2014, 2017; Borman, Hewes, Overman & Brown, 2003; Archer, Kerr & Pianta, 2014; Rivkin, Hanushek, & Kain, 2005; Rockoff, Jacob, Kane, & Staiger, 2011; Scheerens & Marks, 2017; Timmermans, 2012; Detterman, 2016). Thus, in recent years, a number of studies have sought to understand the reason why it is difficult to determine the changeable factors. Scheerens (2017) provides various possible explanations for the weaknesses of instruments for measuring changeable factors. He, just like Muijs and Brookman (2016) do, point to the lack of instruments as a weakness. Furthermore, Scheerens (2017) attributes the poor quality of the instruments used to measure changeable variables to the fact that they are not developed on the basis of clear conceptual models:

> The way these sets of factors developed over time is an eclectic process, involving common-sense thinking about school organization and teaching, supported by accumulating empirical research evidence, but rarely driven by theory or conceptual models. The influence from more established theories can be discerned in teaching strategies originating from behaviourism or cognitive theory (constructivism), or by organization and planning models. (Scheerens, 2017: 254)

Based on a review of 645 studies, Cheung and Slavin (2016) conclude that "researcher-made tests are associated with much higher effect sizes than are standardized tests" (p. 286). According to Scheerens (2017), this may be caused in the fact that the

changeable factors vary among subjects, educational levels, study characteristics, and educational institutions, they are *malleable*, and often, "research-made instruments [are] more tailored for the treated group" (p. 253). This is substantiated in another review that finds considerable differences in effect sizes between measures inherent to (or aligned with) a treatment, and measures that are independent of the treatment (Slavin & Madden 2011). Scammacca, et al. (2007), de Boer, Donker, & van der Werf (2014) and Edmonds, et al. (2009) also find that studies that use nonstandard tests obtain higher effect sizes than those using standardized tests. Thus, while a number of researchers suggest that changeable factors are important, we still suffer from the lack of conceptual models for determining these factors empirically.

Conceptual Framework

We base our approach to determining changeable factors in constructivism, referring to Niklas Luhmann's systems theory. According to Luhmnann (1995, 2002a), teaching and learning can be described as closed processes, which take place in social and psychic systems respectively. Social systems are described as systems based on communication (classroom interaction, chatting, communication through formulation and answering of assignments), and psychic systems as systems based on consciousness (thoughts, sensations, and imaginations). Although the systems are mutually closed, they may disturb each other through observation and cognition, which according to Luhmann (1997) is possible, as both of them operate in meaning (Luhmann, 1997). A disturbance takes place, if a linguistic query from one system contributes to producing meaning in another system, with 'meaning' referring to both what makes sense and nonsense. This potential meaning development in and between systems leads to a distinct constructivist understanding of education and teaching, which is appropriate to capture the malleable nature of the changeable factors. In the following subsection we describe two key points of the constructivist stance that will pave the way for our subsequent

proposal for a methodological approach to studying changeable and malleable factors in teaching: *subject-dependency* and *context-dependency*.

Subject-Dependency and Context-Dependency

The first key point of this article's constructivist stance is *subject-dependency*. Subject-dependency refers to the conclusion that teaching efforts cannot be understood from an objective perspective. What is perceived and make sense as clear, motivating, engaging, or playful learning by one student (psychic system) is not necessarily clear, motivating, engaging, or playful learning for another. Different subjects perceive teaching differently. Such differences are linked to variations in preferences and to previous experiences and from these derived expectations (Luhmann, 1997). For example, teaching strategies or activities that are recognized by a student from previous learning contexts will be perceived as clear, because this student has expectations of what will happen, whereas another student who do not recognize these teaching strategies or activities may perceive the situation differently. Similarly, teaching strategies and approaches may motivate and engage one student, if these prompt memories of previous positive teaching experiences, whereas previous bad experiences will be demotivating and meet with a lack of engagement. This means that teaching is characterized by great unpredictability and it is completely "unrealistic to hope that the [teacher] could programme the dynamics of teaching" (Luhmann, 2006, p. 182, our translation). One way for teachers to cope with teaching's unpredictability is to reduce complexity by applying schemes (Luhmann, 1995). Educational theories are understood as schemes used by teachers as inspiration for organizing teaching, as these theories are systematic worded (described in publications) and scientifically accepted descriptions of educational matters such as connections between delimited purposes, objectives and efforts. Teachers may use these schemes to reflect on or adjust their teaching.

The second key point of this article's constructivist stance, *context-dependency* refers to the claim that subject-dependency does not mean that everything is arbitrary. Education and teaching are lifelong phenomena, and through experiences from concrete contexts and from the course of their educational paths, the students participate in negotiating and renegotiating meaning to what we might describe as "the basic grammar of schooling" (Tyack & Cuban, 1995), or "well-established, basic social patterns of the understanding of schooling that have sedimented in the respective traditions" (Hopmann 2015: p. 18). This 'basic grammar' may include rules, rituals, and roles that we attach to, and recognize as, 'going to school' (e.g. rituals and routines associated with being a student, that is ways of behaving in class, sitting at their desks, listening to the teacher, raising hands), but it may also include certain approaches to, or forms of teaching that are recognized as 'doing school' in a given class or course, a national school system or certain educational traditions. Such recognized ways of 'doing school' are actions and division of responsibilities between teacher and students associated with certain forms of classroom organizations such as blackboard teaching, group work, assignments and tests or exams or with various teaching activities such as cooperative or collaborative learning, experiential learning, guided learning through discovery, inquiry-based learning, problem-based learning, and project-based learning (Keiding & Qvortrup 2014). To differentiate between experiences and meaning units attached to specific and delimited social systems (e.g., a class or course), and experiences and meaning units attached to more generalized social systems such as specific educational traditions nationally or specific school subjects, we differentiate between *notions* and *conceptions*. Notions are established through negotiations and renegotiations of meaning within specific and delimited social systems, while conceptions are meaning units established across certain classes or courses. Luhmann describes notions and conceptions as "a supply of […] themes that is available for quick and readily understandable reception" (Luhmann, 1995, p. 163). We

are not dealing with "a normative content for meanings, perhaps it is more like a limitation of meaning (reduction) that makes it possible to distinguish appropriate from inappropriate contributions" (ibid.) in ‘going to school’ and ‘doing school’.

Subjective perceptions, situational notions, generalized conceptions and articulated theories interact in complex ways. For instance, if students and/or teachers read about a particular theory (scheme) it may influence their subsequent perceptions and upcoming renegotiations of notions and conceptions. In our opinion, the negotiation and renegotiation of what different subjects engaged in concrete and wider contexts recognize as ‘going to school’ and ‘doing school’ may be the hidden key to understanding the changeable factors and their effect.

Studying Teaching as a set of Natural Experiments

Our conceptual framework – acknowledging subject- and context-dependence – has methodological consequences. The well-known evidence ladder regards systematic reviews and randomized controlled experiments as the ideal (Hede, 2007; Rieper & Hansen, 2007). We certainly value systematic reviews as a way to systematize and get an overview of a large amount of knowledge, but because we embrace and emphasize teaching’s *subject-dependency* and *context-dependency* when it comes to changeable and malleable factors, we do not believe in the possibility of randomizing, or of controlling, them as effectful factors independent of contexts and subjects. This does not mean that we have to reject the whole idea of empirically determining effects of changeable factors, but the malleability of these factors mean that we emphasize the need for a dynamic concept of and method for investigating their effect. Instead of prioritizing methods deemed reliable based on their high replicability, where “Replicability in the traditional sense can be determined only within a given framework and that framework is itself a construction, not an inevitable and unchanging part of ‘reality’” (Lincoln & Guba, 1985, p. 299), we advocate methods that are reliable based

on their opportunity to explore and capture subject- and context-dependencies. Such methods obviously include qualitative methods like ethnographic studies, but – as we shall show in our example – might as well be exploratory quantitative methods.

We conceptualize a methodological approach to investigate changeable and malleable factors in teaching, by conceptualizing teaching environments as *natural experiments*, which are defined by naturally occurring exogenous factors (Craig, Katikireddi, Leyland & Popham 2017). As Mutch (2020) stated, "a natural experiment describes an event or intervention not under the control of a researcher" […]. Unlike clinical trials and classic research studies, the intervention associated with a natural experiment is not constrained by ethics, public perception, or granting agencies. In fact, these natural experiments happen whether people [the researcher] want them to or not!" (p. 135). In our case, exogenous factors are the changeable factors (both institutional and pedagogical) factors. Because of their malleability they vary among subjects, educational levels, study characteristics, and educational institutions, they are not controlled by the researcher. Meyer (1995) argues that in natural experiments, where the researcher cannot control the situation, the focus must shift to understanding the source of situational variations. Within our theoretical framework, the source of situational variations is subject and context dependency, and we propose that the variations manifest themselves through negotiated and renegotiated perceptions, notions and conceptions, which in a complex way interact with renegotiations of theories. Furthermore, we suggest that investigating these negotiations and renegotiations are the key to understand the changeable and malleable factors of teaching. To do such an investigation, we need methods that make it possible to investigate the complex interaction between perceptions, notions, conceptions, and theories of 'going to school' and 'doing school' in specific contexts without assuming or testing for a one-to-one relation between these. This calls for actively exploring not only how the perceptions, notions and conceptions of changeable factors take

form among specific individuals in certain contexts and how they interact with theories, but also, to understand variations relative to specific contexts, how the factors change across different groups of individuals and over time. One could say that we prioritize methods that make it possible to investigate both the factors as malleable and the malleability of these factors.

Abduction as a Conceptual Methodological Rationale

Our conceptualization of the changeable and malleable factors positions us among the abductive approaches, which "refer to the generative, creative and usually iterative process for producing both descriptions and explanations from what can be discovered about the way social actors typify and understand their way of life" (Blaikie, 2018, p. 638). As this statement makes clear, abductive approaches are suitable, not only with regard to the dynamic aspect of the changeable and malleable factors, but also with respect to their sensitivity to context- and subject-dependencies. Both Levin-Rozalis (2010) and Åsvoll (2014) recognize these context- and subject-dependencies, and Åsvoll (2014) advocates abductive approaches based on what he describes as a risk associated with non-abductive approaches, where "the principle of participant perspective, which, among others, includes the subjects' recognition of theoretical interpretations and descriptions, is in danger of being submerged in the quagmire" (p. 301). Kennedy (2018) suggests that abductive approaches yield plausible explanations of data that account for surprises that one may encounter during data collection and analysis. Thus, they are suitable approaches for "discovering new concepts, ideas and explanations by finding surprising phenomena, data, or events that cannot be explained by pre-existing knowledge" (p. 5). This is also emphasized by Alvesson and Kärreman (2011), who suggest that abductive approaches are grounded in "an interest in the problematization and re-thinking of dominating ideas and theory, [since] empirical impressions encourage such a need for novel thinking" (p. 58).

Methodologically, given our position in abductive approaches, we are preoccupied with selecting and developing methods that move procedurally between situational negotiations and renegotiations of 'going to school' and 'doing school' (notions) and individual perceptions. The aim is to be open and sensitive to perceptions and notions, while acknowledging that these reference theories and conceptions as basic meaning units attached to schooling, to rules, rituals, roles, and so on. We propose a four-way abductive movement (described below), where it is important to not mechanically derive hypotheses (as in induction) and test these hypotheses (as in deduction), but to understand both the perceptions and notions, and the theories and conceptions as sources of inspiration for identifying and interpretating meaning patterns (Alvesson & Sköldberg, 2008). With theories as the example, we recognize that perceptions, notions, and conceptions are theory-laden, but we insist that they are not theory-determined, and likewise theory is both determined and underdetermined by perceptions, notions, and conceptions (Phillips & Burbules, 2000; Blaikie 2018). Hammersley (2005) suggests that "what is good evidence for abduction is different from what is good evidence for induction," and proceeds to describe abduction as "the development of an explanatory or theoretical idea, this often resulting from close examination of particular cases" (p. 5; also see Hammersley, 2007). We suggest discussing new theoretical cases and new evidence of contextual effectiveness at the same time, thereby refining theories and contributing with profound and context-related findings (Levin-Rozalis, 2010). Based on this, our approach is simultaneously positioned in two methodical camps, a deductive and inductive methodology (Blaikie & Priest, 2017, p. 26). We present our understanding of the abductive processes in figure 1.

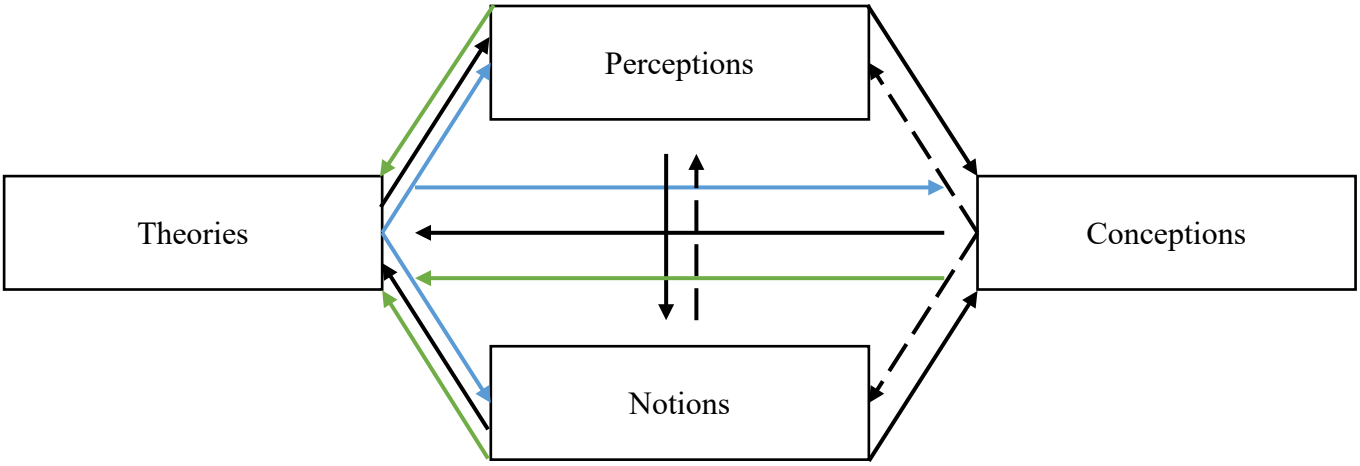

Figure 1: The abductive quartet of four empirical constructs: theories and concepts (of learning, teaching etc.), contextual notions and subjective experiences.

As suggested in the section "A constructivist stance," we understand *theories* as systematic, worded and scientifically accepted descriptions (schemes) of educational matters such as connections between delimited purposes, objectives, and efforts, when we limit ourselves to educational science. They are frames of expectations that guides teachers when 'doing school.' *Conceptions* are understood as generally applicable understandings of 'going to school' (rules, rituals, and roles) and certain approaches to, or forms of teaching that are valued and recognized as 'doing school' in a school system or a given tradition. *Notions* are understood as situation-specific ways of 'going to school' and 'doing school,' whereas *perceptions* refer to subjective experiences and expectations of what takes place in practice, that is, for concrete actualizations of 'going to school' and 'doing school.'

The blue arrows in figure 1 illustrate the traditional *deductive* process of confirmatory testing theoretical constructs. The green arrows illustrate the traditional *inductive* process of proposing theories based on explorative investigations. Our suggested *abductive* process is illustrated by the black arrows. It is worth noting that this abductive process is different from and more than simply the sum of the illustrated deductive and inductive processes, and that the abductive process may begin anywhere in the abductive quartet illustrated in figure 1.

- Theories as presumably incomplete predictions are one essential take-off for the abductive process. The arrow from theories to perceptions illustrates that construction of a research instrument (survey items, interview guides, etc.) must be sensitive to the assessment of key aspects of a theory and be capable of assessing how these factors are context- and subject-specific. Due to our constructivist stance with regards to subject-dependency, we have no arrows going directly from theories to notions and conceptions. Thus, notions and conceptions (of 'going to school' and 'doing school') are expected to be identified through perceptions.
- The arrow from perceptions to notions illustrate the exploratory investigation of situational notions of 'going to school' or 'doing school' across subjective perceptions within a specific situation. Methodologically such investigations identify patterns in interviews or factors in surveys etc. and thus, "objectify meanings by putting them in their wider intersubjective context" (Pouliot, 2007, p. 370) by generalizing from subjective perceptions to situational contexts.
- The arrow from notions to perceptions is more unusual than the above (which is marked by it being dashed). It illustrates the investigation of how situational notions of 'going to school' or 'doing school' internalize and are reflected as subjective perceptions or are perceived by different (groups of) individuals within a specific situation. Methodologically such investigations could use, for example, focused/stimulated recall interviews qualitatively and vignette studies or cluster analyzes quantitatively.
- The arrow from situational notions to theories illustrate the exploratory investigation of 'going to school' or 'doing school' in concrete situations (in a specific school, class, or the like). Methodologically such investigations could identify patterns from classroom observations or factors in surveys from a limited group of students. The

specific observation of notions should test (confirm or challenge) the theories. An exploratory approach means that data should not be forced into pre-determined categories based on theories but be open to context-dependency.

- The arrow from conceptions to theories illustrate the exploratory investigation of descriptions of 'going to school' or 'doing school' within generalized conceptions across contexts or time, using e.g., discourse analysis or exploratory factor analysis of data collected in more situations across contexts and/or time.
- The arrow from conceptions to perceptions (dashed) illustrates the investigation of how generalized conceptions of 'going to school' or 'doing school' are experienced and expressed as subjective perceptions or are perceived by different (groups of) subjects. Methodologically such investigations could, for example investigate case interviews or cluster analysis on survey responses across nations.
- The arrow from perceptions to conceptions illustrate the exploratory investigation of generalized conceptions across subjective perceptions across nations, or traditions etc. Such investigations identify patterns in interviews or factors in surveys etc.
- The arrow from notions to conceptions illustrate the exploratory investigation of generalized conceptions across contexts. Methodologically such investigations identify patterns qualitative or quantitative across perceptions and thus "further objectifying meanings by introducing time and history" (Pouliot, 2007, p. 372).
- The arrow from conceptions to notions is rarer than the above (hence dashed). It illustrates the investigation of how generalized conceptions are specified across different contexts. Methodologically such investigations could use, for example, exploratory factor analysis.

Notions are identified in single situations (with more than one subject, i.e. representing multiple perceptions), whereas conceptions due to its generalized character cannot be identified from a single situation.

We predict that the abductive approach illustrated in figure 1 may be used in studies that use quantitative as well as qualitative or mixed methods. The choice of method must be made with reference to one's focus in the model and with reference to a specific research interest. For example, referring to Pouliot (2007)'s (qualitative) methodology geared toward a constructivist style of reasoning, one should follow a three step logic from 1) recovering subjective meanings (perceptions) from ethnographic studies or the like, to their objectification thanks to 2) contextualization (notions) from e,g. discourse analysis and 3) historicization (conceptions) through narrative, dynamic accounts. These conceptions may subsequently form the basis for other types of analyses that focus on for instance relations between the conceptions and either theories or notions.

Example—investigating Learning Environments and Activities

In this section, we illustrate the above proposed approach, by applying it systematically on a case from a recent empirical study. The case is a quantitative survey study, where Author, et al (2022a, b) examines how learning environments were redefined over time from April 2020 to December 2020 during the reopening of schools in response to the two-phase COVID-19 disruption and physical and social restrictions), and whether the learning environment of the re-opening was characterized by different learning activities. The assumption was that the different restrictions transformed 'the basic grammar of schooling' attached to the learning environments and learning activities. This assumption was confirmed through an analysis which showed that an increased use of outdoor environments and organisation into small groups in study courses not defined by traditional school subjects due to hygiene regulations and restrictions led to teaching being experienced as more student-centred as opposed to

teacher-centred, and to teaching with more inquiry-based approaches rather than text or content-focused approaches (Author, et al. 2022a). Thus, it is an exemplary case when it comes to examining natural experiments, as we see COVID 19 as one of many ways natural experiments take form in teaching (Mutch, 2020), and both malleable factors (learning environments and activities) and the malleability of these (how the environment and activities change over time). To investigate how the teaching activities took form, Author, et al. (2022a,b) used the theory 'Playful learning environments' coined by Parker and Thomsen (2019), as this theory provided an opportunity to operationalize the interest in the balance between student-centred as opposed to teacher-centred teaching and inquiry-based approaches into seven types of learning activities (see Appendix 1). Referring to Figure 1, the starting point of the case in the abductive process was thus a theory. Based on this initial theoretical understanding, survey items were constructed in order to address student-centred and teacher-centred teaching (see Appendix 2) and the seven types of learning activities (see Figure 2).

Data were collected through surveys of primary school students at two different times during the reopening of schools: June and December 2020 (N=1,222 and N=2,655), described in depth in Author, et al (2022a, b) where students were asked to indicate the frequency of various teaching events within the last 14 days (as recommended to activate a specific instead of general memory (Olsen, 2006)) indicated by 31 survey items (see Appendix 2 and Figure 2).

With the concepts of this article, the two data collections provide an opportunity to examine, if and how students' perceptions form into notions in relation to the balance between student and teacher centering and in relation to different types of inquiry-based approaches, and how they are negotiated and renegotiated in two different situations, which are staggered in time and where COVID 19 has been an exogenous interfering factor. As part of a larger historical movement in the education system, we have in recent years seen an increased focus

on learner-centred and inquiry-based approaches (Loyens & Rikers 2011; Albrechtsen & Qvortrup 2017), and thus these approaches can be expected to be part of the students' generalized conceptual repertoire (conceptions).

Explorative factor and cluster analyses were used to test how students related to the initial theoretical understanding of playful learning environments and the distinction between teacher-centered and student-centered learning approaches. Factor analysis is a way of grouping of variables (survey-items) and these analyses were used to determine the *notions* among students as constructs based on individual student *perceptions*, whereas cluster analysis is a way of grouping respondents. Both analyses apply statistical methods used in exploratory and descriptive data mining, to describe variations in data in terms of factors (of correlated variables) or clusters (of individuals with similar survey responses) and are thus sensitive to both the context and the subjects of the data collection. We use them to identify underlying, situation-specific factors (*notions*) of teaching practices among students and clustering students according to how they *perceive* teaching as balanced between teacher- and student-centered (as described in the next two subsections).

Malleable Factors' Context Dependency: Playful Learning Environments' Factor Structure

Above, we argued that the factor analyses provide the opportunity to determine whether situationally *notions* of playful learning can be identified based on individual *perceptions* of the teaching events and if so how these form. In both data sets valid four-factor models that passed reliability and validity checks were found. Chronbach's alpha (standardized α) tests revealed that the internal consistency of the factors were acceptable (all $\alpha>0.6$) (Ursachi, Horodnic, & Zait, 2015), Thus, in both cases situationally *notions* of playful learning were identified (Author, et al (2022a, b). However, with the variation in the results of the analyses between the data sets in June and December, respectively, it becomes clear that these notions

are context and subject sensitive. Based on the data from June, the best model for describing the data identified the four latent factors illustrated as blue circles in figure 2. The four latent factors identified in the data from December (now in a different/later situation) were somewhat different, illustrated as green circles (in figure 2). Both models derive from the same initial (theoretical) types of learning activities, but the identified factor structures differ – these structures are subject- and context-dependent.

To summarize, figure 2 illustrates how our abductive exploratory methodology identifies how notions (of teaching activities) are context-specific and (at least in the two situations investigated in this study) related to, but different from the theoretical descriptions of teaching activities.

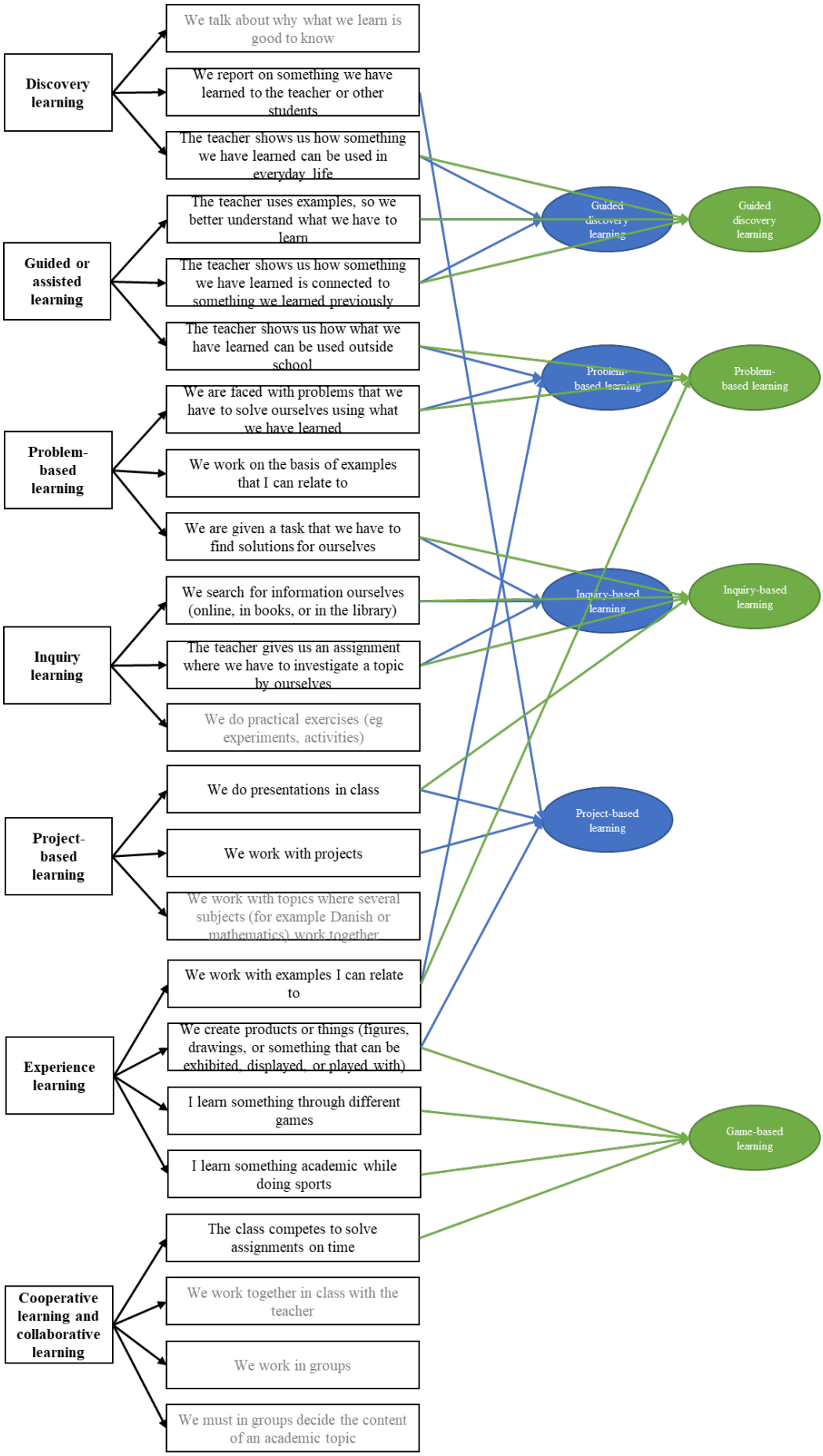
Discovery learning
We talk about why what we learn is good to know
We report on something we have learned to the teacher or other students
The teacher shows us how something we have learned can be used in everyday life
Guided or assisted learning
The teacher uses examples, so we better understand what we have to learn
The teacher shows us how something we have learned is connected to something we learned previously
The teacher shows us how what we have learned can be used outside school
Problem-based learning
We are faced with problems that we have to solve ourselves using what we have learned
We work on the basis of examples that I can relate to
We are given a task that we have to find solutions for ourselves
Inquiry learning
We search for information ourselves (online, in books, or in the library)
The teacher gives us an assignment where we have to investigate a topic by ourselves
We do practical exercises (eg experiments, activities)
Project-based learning
We do presentations in class
We work with projects
We work with topics where several subjects (for example Danish or mathematics) work together
Experience learning
We work with examples I can relate to
We create products or things (figures, drawings, or something that can be exhibited, displayed, or played with)
I learn something through different games
I learn something academic while doing sports
Cooperative learning and collaborative learning
The class competes to solve assignments on time
We work together in class with the teacher
We work in groups
We must in groups decide the content of an academic topic
Guided discovery learning
Problem-based learning
Inquiry-based learning
Project-based learning
Guided discovery learning
Problem-based learning
Inquiry-based learning
Game-based learning

Figure 2: The relationships among theoretical dimensions, operationalized items, and empirically identified notions in two different contexts.

Malleable Factors' Subject Dependency: Learner- or Teacher-Centered Approaches

Explorative cluster analysis was used to differentiate among groups of students around their *perceptions* of the learning environments regarding the items attributed to the theoretical distinction between student-centred and teacher-centred teaching (cf. Appendix 2) at the two different data collections (June and December 2020) (Author, et al 2022a, b). Students were theoretically expected to be grouped in clusters along a continuum between perceptions of a strictly teacher-centered and strictly learner-centered learning environment.

Based on the data collected in June 2020, a four-cluster result was identified, whereas a three-cluster result was extracted from the data gathered in December 2020. For the four-cluster result, the two smallest clusters were placed at one end of the continuum of student- and teacher-centered teaching. One cluster (19% of the students) found that the learning environment included activities that were mostly teacher-centered, whereas another cluster (14% of the students) consisted of students who found their learning environment to be mostly student-centered. The largest cluster of students in the sample (30% of the students) was situated somewhere in the middle of the continuum of teacher- and student-centered perceptions and was labeled 'no clear direction,' as it consisted of students who indicated an infrequent use of either student- or teacher-centered activities. However, the second largest cluster (27% of the students) was also situated somewhere in the middle of the continuum, as it consisted of students who found that their learning environment included both student- and teacher-centered activities. This cluster was called 'supported student-centered learning.' Thus, the two largest groups of students co-existed as separate clusters in the same place on the continuum (see blue clusters in figure 3) (Author, et al 2022).

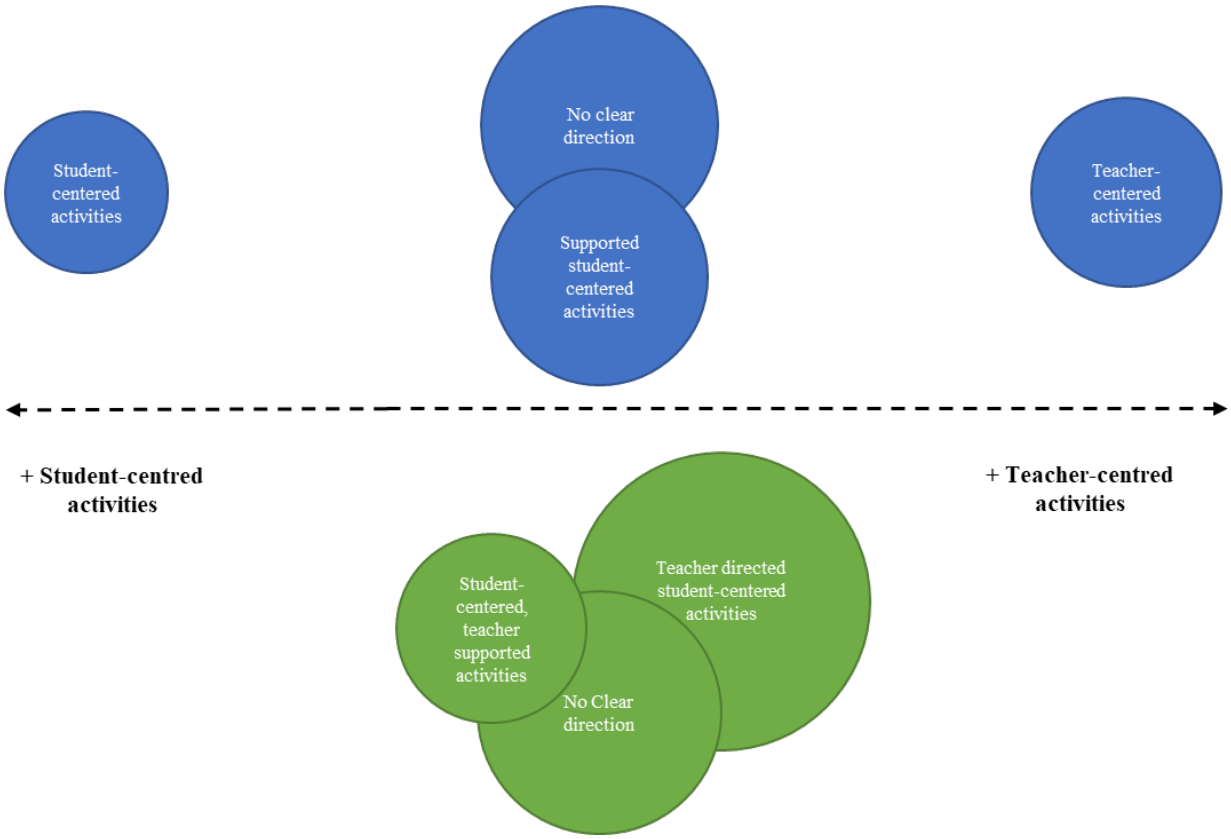

Figure 3: The experiences of teacher- and/or student-centered activities, positioned on the anticipated theoretical one-dimensional continuum. Blue clusters reflect results from the first data collection, and green clusters, the second.

The fact that the 'No clear direction' and 'Supported student-centered activities' clusters, which seem very different, coincide on the continuum of student- and teacher-centered approaches, made us question the appropriateness of the used theoretical basis for the study. The three-cluster result based on data from December, represented as green clusters in figure 3 make us question the continuum even more. The largest cluster consisted of almost half of the students (49%), students who found the teaching both teacher- and student-centered but weighted towards the teacher-centered. The second largest cluster (32%) consisted of students who noted an infrequent use of either student- or teacher-centered activities, whereas the smallest cluster (19%), consisted of students who noted a frequent use of both teacher- and student-centered activities, but weighted towards the student-centered. Considered together, the three clusters are situated on top of each other in the continuum.

Based on our exploratory approach to students' perceptions, we get a quite different picture, namely a two-dimensional model, represented in figure 4, that contrasts with the one-dimensional continuum from the theoretical basis, with student-centered approaches at one end, and teacher-centered approaches at the other (as represented in figure 3). The dotted axis at the top of figure 4 spans the expected (one-dimensional) continuum from figure 3 but reveals a two-dimensional space underneath it. Thus, figure 3 is only a projection of the clusters' position in two-dimensional space.

To summarize, figure 4 illustrates how our abductive exploratory methodology identified, how perceptions (of the degree of teacher/student-centeredness) are subject- and context specific. Figure 4 also clearly indicates that if we had maintained or insisted on the one-dimensional, theoretical starting point (a deductive and confirmatory approach), we would have simplified the picture significantly, and lost a lot of information and overlooked new conceptual understandings.

In Author, et al (2022a,b), the factors and clusters identified (i.e. the context-dependent notions and subject-dependent perceptions) are used in multiple linear OLS regressions to identify correlations between the identified notions and emotional, social, and academic well-being. To illustrate how the approach makes it possible to include malleable factors of teaching in effect studies, we can look at the conclusions in Author, et al (2022a). This study showed that average social wellbeing increased by 0.18 SD with the notion of learning environments as mostly supported learner-centered, 0.19 SD with the notion of learning environments as learner-centered, and 0.21 SD with the notion of learning environments as mostly teacher-centered (with 'no clear direction' as the point of reference). The four exploratory identified approaches to learning—project-based learning, guided learning through discovery, inquiry-based learning, and problem-based learning—were all positively associated with students' academic and social wellbeing. Guided learning through

discovery and problem-based learning were also positively associated with emotional wellbeing, whereas project-based learning and inquiry-based learning were not significantly associated with emotional wellbeing.

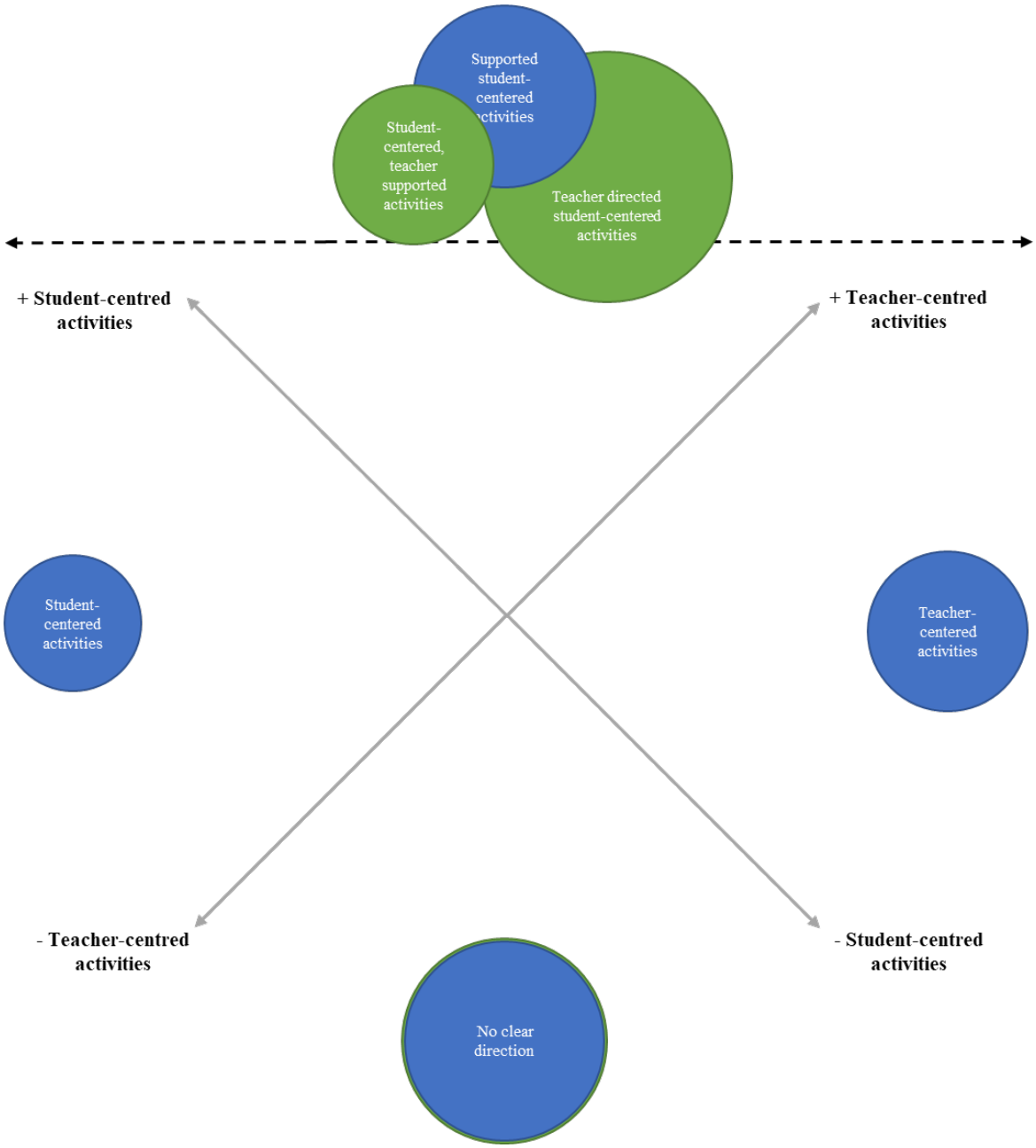

Figure 4: The experiences of teacher- and/or student-centered activities placed in the two-dimensional space. Blue clusters reflect results from the first data collection, and green clusters, the second. Note that the green "No clear direction" cluster is situated at the same spot as the blue "No clear direction", the cluster is however a little larger, which is why one can catch a glimpse of it behind the blue cluster.

Discussion

The approach proposed in this article does not meet the criteria for methods that rank highest on the so-called evidence ladder. It is not because we disapprove with the relevance of, or need to, investigate effects. However, when it comes to changeable and malleable factors, we argue that we need instruments that are tailored to the group in question and are context-sensitive, as also suggested in a number of previous studies (see the section, "Malleable factors in education and teaching"). This does not mean that we do not add value to repeated validations of existing instruments, as it contributes to refinement of and increased awareness of the strengths and weaknesses of instruments. Neither does it mean that we disagree with Scheerens (2017) and Muijs and Brookman (2016), who identify the lack of standardized instruments as a weakness. The lack of standardized instruments is a weakness, not when it comes to examining the changeable and malleable factors where the primary criterion is that instruments should be tailored for the context, but a weakness when it comes to capturing the malleability of these factors. To identify the malleability, one need to do comparative investigations across (groups of) individuals, time, or context. To fulfill the need for both context tailored instruments and comparative investigations, we suggest that the instruments ideally may be standardized at the item level, rather than the factor or cluster level, as illustrated in figure 2 and figure 4. The standardization at the item level makes it possible to capture similarities and variations between identified factors in different datasets (collected in different situations and/or at different times). We are talking about this having to be *the ideal*, because it will not always be possible to meet the requirement for standardization, as it may be incompatible with the ideal of context sensitivity. The balance between the two ideals is always to be determined in relation to a specific research interest and whether it weighs reliability in relation to the malleable factors (subject- and context-dependencies) or to the malleability of these factors (comparability between data collections).

We suggest moving abductively among the four constructs of *notions*, *perceptions*, *conceptions,* and *theories*, and thereby follow the ongoing negotiation and renegotiation of theoretical arrangements of expectations and of the conceptions, notions, and perceptions of 'going to school' and 'doing school'. By doing this, we have the opportunity to follow the negotiation and renegotiation of central meanings of 'going to school' and 'doing school' as it takes place in teaching. It increases our understanding of teaching as it develops in actual contexts, and thus it leads to the best specific prediction, but never to a universal conclusion. We do not see this as a weakness, but as a strength, as it recognizes the subject- and context-dependency as well as the tentativeness of results.

Although our approach acknowledges students' subjectivity, it does not, however, address their individual backgrounds (socio-economic, etc.). Furthermore, our approach does not allow for an interpretation of how political, ideological, and socializing factors that are unrelated to conceptions and theories of 'going to school' and 'doing school' affect teaching and students' perceptions of it (Åsvoll 2014).

The approach we suggest is essential to strengthening the opportunities for intervention, as it offers the possibility of pinpointing changeable and malleable aspects of teaching (natural or intended experiments (interventions)) that are reliably related to output measures of varying kinds). This has been exemplified by the multiple linear OLS regression analyses in Author, et al (2022a,b). Although the referenced articles focused on well-being, the output measures may vary (Fenstermacher & Richardson, 2005) and we hypothesize that outputs might in other cases be more delayed or subtle. As described in a previous section, we have in recent years seen an increased focus on learner-centered and inquiry-based approaches, justified by an increased focus on student immersion and involvement, among other things (Qvortrup, 2021), and it is important to also be able to include new teaching approaches like these in effect studies. We argue that our approach is a step towards progress

in this research area (cf. the lack described in the introduction). In the article, we have only exemplified the article's approach through a single case, which has a number of limitations and whose scope in relation to the large field of possible changeable and malleable factors is very limited. In the future, it will be important to exemplify and specify the approach based on more cases, and with reference to a greater variety of methods (both quantitative and qualitative). Also, we welcome studies and discussions addressing the influence of researchers' preconceptions, as our abductive model intends to take researchers' preconceptions into account. We have not addressed this theme specifically in this article, but we ourselves have been careful to describe our conceptual framework and preconceptions and we exemplify how the model gives rise to make (assumed) connections between theory, conceptions, notions, and perceptions explicit.

Conclusion

In this article, we have proposed an abductive research approach to studying changeable, malleable factors, based on constructivism as conceptual framework, and we have illustrated this approach by applying it systematically to a case study, which examines playful learning environments. The abductive approach allowed us to openly explore various constructs when investigating malleable factors, which means that data are not forced into pre-designated categories based on a theory or conceptions, but are investigated as dynamic and volatile factors, which are stabilizing as notions in various situations based on variations in individual perceptions and are also constantly subject of new malleability. In our example, we took a theoretical starting point, and we have demonstrated how an investigation must examine the factors as both individual perceptions, situational notions, and as dependent on (pre-)conceptions. At the same time, we suggested that studies may well start in the conceptions category in our model of abduction, but it is important to move around the model and to do

repeated comparations across, time, individuals, or contexts, to capture the malleability of the factors.

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Appendix 1: Types of learning activities identified by Parker and Thomsen (2019).

Various types of learning activities	Dimension description
Cooperative learning or collaborative learning	Cooperative learning or collaborative learning follow from instructional strategies designed to make the most of positive social interactions among peers by grouping learners to complete an assignment or task.
Learning through experience	Learning through experience is an umbrella term that covers theories and practices that share common principles about the value of experience, both within and beyond the classroom, for meaningful learning.
Learning through discovery	Learning through discovery is not restricted to finding out something that was unknown to humanity but includes all instances of acquiring knowledge by using one's mind, and one's prior knowledge of an area.
Guided, assisted, or enriched learning through discovery	Guided, assisted, or enriched learning through discovery occurs when teachers provide a range of support—such as hints, guidance, coaching, feedback, worked examples, scaffolding, or elicited explanations—to prepare learners to acquire knowledge.
Inquiry-based learning	Inquiry-based learning is an approach in which learners' work is organized around relevant, authentic, and open-ended questions, and emphasizes process, questions, involving internal and external school community resources, iterative or recursive learning, reflection and deep thinking, ongoing assessment, and action.
Problem-based learning	Problem-based learning involves working through and reflecting on problems in small, self-oriented groups, with guidance from teachers who act as facilitators. In problem-based learning, the context for learning is set by a real-world problem with multiple dimensions around which a unit of work is planned.
Project-based learning	Project-based learning is a type of learning where the central idea around which learning is planned and

structured is the output—a project (ibid.). Key features of the approach include learning by undertaking complex tasks and producing realistic products that culminate in events or presentations.

Appendix 2: Observed variables included in the cluster analysis, sorted into the theoretically hypothesized teacher- and student-centered domains.

Domain	**Question text**	**Response scale**	**Item text**
Teacher centered	Think about the last 14 days. How much have these activities been part of teaching?	1 Not at all/2 To some extent/3 To a moderate extent/4 To a large extent	The teacher presents a topic or an assignment We watch a video on a topic We read about a topic in various texts (as books, e-books, etc.) We work on assignments (on paper, desktop computer, laptop Chromebook, tablet, or similar)
Student centered	Think about the last 14 days. How much have these activities been part of teaching?	1 Not at all/2 To some extent/3 To a moderate extent/4 To a large extent	The teacher asks for our opinions on what we are working on We report something we have learned to the teacher or other students We ask our own questions about assignments or topics We made presentations in class