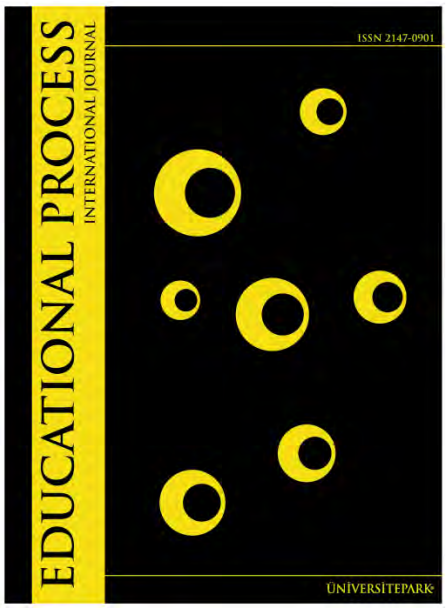

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Tracking Learning and Teaching Chains and Their Variations in the Development of Mixed-Methods Methodology

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Abstract

Recently, inspirational articles on research methodology have been written on the development of the mixed-methods approach. This area of study concerns methodological trends in the construction of research designs. One may ask, whether it is possible to construct a notional piece of investigation, potentially highlighting a research design that successfully seeks to identify a causal mechanism. The purpose of the current study is to consider how to construct a research design that would illustrate the application of methodological ideas in the context of educational research, such as school education and learning. This study produces three dimensions of causal mechanism: a horizontal dimension (chain length), a vertical dimension (possibilities of different variations), and tentatively a hypothetical causal network dimension (including context factors).

Keywords: Mixed methods, causal mechanism, research design, teaching, learning.

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Introduction

New Trends in the Mixed-Methods Approach

An interactive research framework to capture a phenomenon

Recently, efforts have been made to plan a mixed-methods research design "from scratch," or at least to try to allow flexible modifications during the research process. The opposite practice, however, is represented by those who speak of typologies of mixed-method (MM) designs. These are "interactive" and "typological" research frameworks, and, for example, Maxwell and Loomis (2003), as well as Creswell and Plano-Clark (2011), refer to them as "dynamic" and "typology-based" approaches. Recent highlights reflect an interest in departing from typological research in favor of interactive and customized research settings. The goal is to consider genuine and versatile integration between qualitative and quantitative methodologies (Bryman, 2007; Fetters & Molina-Azorin, 2017), as well as meta-inferences. However, integration is also seen as very challenging (Maxwell, Chmiel, & Rogers, 2016). Actual integration is the goal and essence of mixing methods, based on the concept definition alone, which differs from the multi-methods concept (Anguera, Blanco-Villaseñor, Losada, Sánchez-Algarra, & Onwuegbuzie, 2018).

How does the researcher design a research setting if it is not based on the so-called typological models? One alternative can be the so-called "mental models." For example, Mohr's (1982) distinction between variance theory and process theory highlights the difference between these models in terms of the essence of the study and its causal nature. However, it is also more common to talk about the need to construct a research plan in view of the characteristics of a phenomenon. This goal is in sync with the goal of a tailor-made study design. The progress of the research also affects the research plan: Findings affect the content of the new and more advanced research design. Therefore, the research setting is continually forward-looking, but also interested in and inspired by its own findings. Researchers make interpretations and conclusions, but what they also do is test them (Maxwell et al., 2016).

It is important that the researcher makes active decisions about the rationale of mixing methods (e.g., Greene, Caracelli, & Graham, 1989). According to Fetters and Molina-Azorin (2019), when designing a mixed-methods research model, its tasks (e.g., comparing, matching domains, developing instruments, generating and testing models) should also be considered in advance, i.e., at the planning stage. They noted that Morgan (2019) mainly emphasized the tasks that are to be considered after data collection, i.e., his focus on interpreting merged data (convergence, complementarity, and divergence). Fetters and Molina-Azorin (2019) put it this way:

We wish to emphasize that a key to advancing conceptualization of 'integration' in the context of mixed methods research requires consideration during all phases of research. Moreover, we assert mixed analysis benefits from forethought and articulation of the researcher's intent during the design phase prior to the merging of data. (p. 13)

Current methodological thinking reflects the need to tailor each research setting to its tasks (and to consider the evolution of these intentions based on findings). However, the need to plan cannot be underestimated. That is, when "building" a phenomenon, its structure and content should be discussed. The research literature related to the

phenomenon should also be considered in the design process: Research is about anticipation and construction of a research object, but also about testing the correctness of a model based on that design. For example, in educational sciences, the learner, the teacher, the teaching-learning process and the learning outcomes are central to the focus. Of course, qualitative (Qual) and quantitative approaches (Quant) as monomethods also provide their own starting points for the idea of how to achieve a completeness in mixed methods. The phenomenon requires an understanding and opening of its mechanism (Qual), but also a systematic classification of findings (Quant). Let us begin by considering these methodological questions, especially in the context of a research design where the construction of a causal mechanism is one of the key challenges.

Causality and understanding the essence of a phenomenon

The question of causality has always fascinated researchers, including human scientists. The problem in human sciences is how to find the causality hidden in the phenomenon and, especially, how to understand it. In a comprehensive approach to causality, qualitative (when construed constructively, i.e., when there is no causality), and quantitative (when based on positivist thinking, i.e., externally detectable factors exist, and only the research data is to be obtained from them) methods on their own have been deficient. Specifically, critical realism as a philosophy of science has been developing a new way of seeing causality in human sciences, what is also visible in many logical ideas of Maxwell (e.g., 2012a, 2012b). Recently, Krause (2018a, 2018b) and Yin (2016) have also been involved in communicating a new way of seeing causality as an integral part of human sciences. Maxwell (2012b) advocates an alternative understanding of causation. This alternative is known as a generative approach, a process approach, or a realist approach, and it has been influential in philosophy, social sciences, and history. He supports a realist process theory of causation, which tries to link ontological realism and epistemological constructivism. Maxwell and Mittapalli (2010) further specify what a process approach to causality means:

> In philosophy, the most widely accepted alternative to the regularity approach to causality is a realist approach that sees causality as fundamentally referring to the actual causal mechanisms and processes that are involved in particular events and situations. (p. 155)

> A process theory of causation does not require abandoning quantitative, variance-based methods for investigating causality; it simply requires recognition that process-based approaches are as legitimate as, and often complementary to, variance-based ones. (p. 156)

Maxwell's (2004a, 2004b, 2012a, 2012b) methodological thinking focuses on events and processes, human agents and their experiences, thoughts, as well as meanings and activity. Support for this emphasis comes from critical realism, but also from the recent teleological and educational philosophical analysis of teaching (Opdal, 2018).

Descriptions of the causal process vary according to whether the importance of the environment and context is emphasized or in addition to the human mental perspective. Realists highlight the importance of the process with a special focus on local conditions. For Yin (2016), the study of causal processes consists of using direct field-based methods that result in a specific local setting (Erickson, 2012; Maxwell, 2004, 2012; Miles & Huberman, 1994), in which people may intentionally (agentially) take some causal action. So, for Yin, the agential causation is a third type of causality.

Yin (2016) considers that a correlative and process-oriented approach to causality can have a complementary relationship within the same study. However, Krause's position here is even steeper. He opposes the averaging of knowledge and emphasizes the importance of researching individuals. The researchers should not worry about how different or rare their cases are. Krause compares two different approaches that he calls "associative" and "correlative." He illustrates the conceptual complexity required in qualitative research of causality in the following way (2018a):

Sufficient condition causes of a given effect may be quite complex and consist of a large conjunction of necessary elements, some necessary only in certain combinations with particular others, some necessary in all. Until all the necessary condition components of a sufficient condition cause are known, none can confidently be said to be known. A conditionally necessary causal influence on a given effect requires the company of certain other necessary antecedents to conjointly constitute a compound sufficient condition cause of that effect. An unconditionally necessary causal influence on a given effect is something always required in order to constitute a sufficient condition cause of that effect. (p. 2692)

He advocates examining associations qualitatively rather than statistically and correlatively. The relationship of associative review to the phenomenon is stricter, more sensitive and less doubtful. This comes – at least at the principled level – close to the formulas of Maxwell, who supports a qualitative research methodology to perceive causality. Krause (2018b) stated that:

As the nature, course, and circumstances of each human life are somewhat unique (e.g., what situations and experiencings causally influenced what experiencings and behaviors when, and what behaviors and situations causally influenced what subsequent situations when), averaging over the results of studies of several lives (or over a series of occasions in a single life) wastes much of the information obtained about this uniqueness of individual persons' lives (or of occasions in these lives). (p. 1316)

Thus, he criticizes "averaging" because it destroys information, "so every individual case, rather than only relationships among variables, may have something important to contribute to SHP" (Scientific Human Psychology) (Krause, 2018b, p. 1322).

Johnson, Russo, and Schoonenboom (2019) also illustrate how important it is not only to find causality, but also to understand it. Johnson et al. (2017) wrote that "qualitative research can help in understanding causal explanation through observations, interviews, and case studies" (p. 147) (e.g., Blatter & Haverland, 2012; Johnson & Schoonenboom, 2016; Maxwell, 2012). The quantitative tradition is not just a "tight" grip on the causality of the phenomenon:

Although quantitative researchers believe they are getting at causal truth, they also realize that empirical truths are often context and model dependent, and warrant is directly based on the degree of empirical evidence for the causal claims, rather than making strong claims of definite or ultimate proof of cause and effect. (Johnson et al., 2017, p. 153)

One recent approach in the qualitative methodology according to Johnson et al. (2019) is causal process tracing (CPT) (Beach & Pedersen, 2013; Bennett & Checkel, 2014; Blatter & Haverland, 2012; Collier, 2011; Mahoney, 2012). The authors refer to Blatter and Haverland (2012) as follows, giving in my view several references to empirical research on the causal

mechanism, especially in education. Here are the assumptions of CPT according to Blatter and Haverland (2012):

(a) Most social outcomes result from a combination of causal factors (multiple causation); (b) there are multiple paths to the same outcome (equifinality); (c) factors can operate differently in different contexts (context dependency); and (d) causality plays out in time and space, which can be studied empirically. (pp. 154-155)

Understanding the causal mechanism always requires the mechanism to be opened, and the function of the elements to be examined in a sufficiently long qualitative process description. However, it is obvious that a correlative analysis will give the researcher useful tips on "messy" yet large data. The verification of mechanisms can take place, using a correlative analysis, which makes it possible to identify the causal mechanism of connections for different context factors. Quantitative analysis is also about the systematic connections between the various factors when the variables are categorical. Blatter and Haverland (2012) talk about the same outcome from different paths, but we should also look at the process so that it can show "intermediate outcomes" (e.g., motivation) because there are more paths that lead to them also, and not only to the final "outcome" (e.g., learning outcome). At the heart of causality lies the authors' statement about the "in time and space" aspect, as it emphasizes the essence of the phenomenon being studied, which is "in motion" and perceived as a whole, not just as loose elements.

Moving from "recognizing" the challenges of integration toward better research designs

Even if the goal is the integration (Quant, Qual), the implementation of a single research design or successive studies will not always be successful in reaching stated goals. This can be viewed, for example, in the case of conflicting results, even if the researcher expects the data analysis to lead to the same findings. However, what is meant by "contradicting results" is also challenging and relative. Different data can also bring something new. It is not a clear contradiction. It is accompanied by an additional function of the mixed-methods research design (Greene et al., 1989). Precise mixed-methods studies can produce findings that cannot be easily understood. Little attention has been paid to this essential aspect of the research process; however, Sanscartier (2018) and Uprichard and Dawney (2019) focused on this issue in their recent articles.

Uprichard and Dawney (2019) support the view that data integration is a meaningful goal, but that it may not necessarily produce an optimal research result in a given MM study. Data is not always integrated or "coherent," and this can be natural due to the research object's "messy" nature. The goal of integration is, of course, to create an understandable whole of the research object. However, the phenomena to be studied are intertwined in many ways, as Uprichard and Dawney (2019) describe the complexity involved:

Furthermore, if we assume that social phenomena always exist in entanglements with other social phenomena, then we also need to assume the possibility that empirical work captures and may further complicate those entanglements. p. 22)

Methods produce objects, and different methods can produce objects that look quite different, even when they are purportedly investigating the same social entity. (p. 24)

It is not a controversy in the philosophy of science, meaning that different researchers see the phenomenon differently, as constructivism teaches. But the fact is that in social

sciences, for example, the educational phenomenon is typically multidimensional and wide, and if it is described in different parts only partially, links between the sub-descriptions may remain unnoticed by the researcher. Therefore, the mixing of methods should aim at research on interactive entities with a central focus on the causal mechanism contained in the phenomenon, which empirically produces different phenotypes. The results are easily "disconnected" if only analytical (narrow) studies are performed (Salomon, 1991). They can, of course, be combined, and pursued first in a "hypothetical" systemic (broad-based) model. However, the functionality of the mechanism is genuinely tested by making a wide-ranging systemic, mixed-method study. In a similar way, Uprichard and Dawney (2019) stated that, "Diffraction assumes that the whole is always part of something else and that, sometimes, research thoroughly confuses and messes up what we see as the parts and wholes of what we are studying" (p. 27).

Nevertheless, Uprichard and Dawney (2019) did not want to state that integration is not an essential goal in all studies that apply mixed-methods methodology. However, it is good to be openly aware that the complexity of the research object is challenging for the researcher. It is perhaps precisely so when research is at its early stage in a field where there is little existing research, but the researcher's goals to elaborate on the phenomenon of the subject are ambitious. It is a good thing that the research process is open and that the reporting process shows the "mess" when the results produce it. However, allowing mess and developing practices to organize it, such as the "craft attitude" (see Sanscartier, 2018), cannot replace the need for careful planning in view of these problematic situations. The phenomenon-oriented design is a key factor here because designing is still viewed, on the one hand, as being too typological and, on the other hand, as the opposite, i.e., when the final process is handled "flexibly," allowing for messiness and the application of craft attitude. Maxwell (2013) pointed out that structure and flexibility are not mutually exclusive. We can plan the research beforehand, but we can still renew the outline. Here, it is worth evaluating the following aspects of a design: (1) the importance of a tailor-made design (so that the literature on the phenomenon is included), and the "phenomenon first" orientation, (2) typologies and the corresponding schematic design, or (3) a design that is realized mainly during the process itself. The wider structure of the phenomenon could prevent the study of messiness – with the above having referred to the concepts of analytic and systemic research approaches. The narrower the focus of the study, the more random the empirical findings.

Can Qual and Quant form a seamless human science methodology?

The idea that monomethods might not need to be thought of separately, that is, the "indistinguishability thesis," is one of the most challenging problems in developing mixed-methods research. The indistinguishability thesis may be considered as one scenario or long-term goal in the development of human science and mixed-methods research methodology. The positions of some of the MM methodologists differ in this regard. Morgan (2018) stated that: "I thus argue that we should continue to follow the more traditional path within MMR and conceive of QUAL and QUANT as meaningfully distinguishable categories" (p. 269). Morgan represents the position that a certain degree of separation can contribute to the design of mixed methods, while recent statements on mixed methods show that Quant and Qual contrast, or a difference in views is not a fruitful starting point for methodological development. However, Bazeley (2018), Hammersley (2018), Maxwell (2019), and

Sandelowski (2014) all deviated to some extent in recent statements from what Morgan (2018) had suggested. For example, in his reply to Morgan (2018), Hammersley (2018) states that:

And I share her [he refers to Sandelowski (2014)] concern about the simplistic contrasts that are typically drawn between quantitative and qualitative methods in the mixed methods literature, though these are also to be found elsewhere of course. But its value lies in comparing what is produced in relation to specific aspects of the research process (type of data, kind of analysis, etc.) rather than in the global terms of quantitative versus qualitative. (p. 258)

In standard use, the monomethods can vary. However, in the ideal sense, they can also be characterized as having many potential common features; that is, having the same goals and requirements. This means that we must search for "other" monomethods – ideals that are typically combined by their merits. This is the essence of the "strong" mixed-methods approach. As previously highlighted, in view of the need for true integration and the fact that research does not consist only of qualitative and statistical components, the indistinguishability thesis is a logical extension of this goal and is ideal in the development of methodology. Maxwell (2019) stated that, "This complementarity of variance and process mental models can facilitate a different goal from the usual understanding of 'triangulation,' which involves using different methods to support or test a single conclusion" (p. 4). According to Maxwell, the complementarity of the two methodologies can be considered as the main strength of the mixed-methods approach.

Quite a radical or "modern" interpretation of mixed methods was purported by Bazeley (2018), who believed that the division into quantitative and qualitative research methodology can be rather a distraction. Data collection and the methods that the researcher chooses are significant in terms of what kind of perception they have about a certain phenomenon. However, is there any kind of phenomenon (also in human sciences) that is absolutely independent of the choice of data – whether quantitative (numbers) or qualitative (words)? This view actually underlines one of the most essential theses of critical realism. Methods or methodologies, per se, do not "change" the phenomenon, even though they affect the way interpretations are presented. Of course, by using different data, we strive to create a holistic view of the phenomenon. Bazeley (2018) stated that, "Data are 'taken' rather than 'given,' they are selectively constructed by researchers from experiences as 'raw data' are collected and then converted to serve as evidence" (p. 336).

Cases where causal mechanisms underlying learning can differ from their settings

Despite different concepts introduced in the discourse of the mixed-methods approach, many of the problems examined so far, and their related solution alternatives, are ultimately aimed towards the same goal; the highest possible level of integration. The ideas of methodological literature and their reflection in the current study have produced the following conclusions:

- A research object should be actively constructed, emphasizing design;
- We are now ready to follow a tailor-made approach to research;
- The methodology is not left as loose in the planning of the research design, but is linked to the scientific literature that characterizes the nature of the phenomenon;

- Overly narrow or context-free, disconnected research findings easily lead to “mess” and contradictory discoveries;
- The occurrence of diffraction decreases as the research progresses and builds better mental models to elaborate on the phenomenon.

The following illustrate the imaginary, yet realistic, model alternatives that have been developed to apply the ideas of the mixed-methods methodology discussed here to explore the causal mechanism, especially in the context of (school) teaching and learning. It is about the relationship between the agent and the structure. On the one hand, there is a need for data from a mental point of view (for example, in an interview conducted with a teacher as part of a case study, the same point of view can be presented through a larger-scale data size, e.g., the application of questionnaires), but, on the other hand, the teaching process requires a description of the structure. There is a chain of causal mechanisms associated with teaching, the teacher, the learning situation and the learner’s work, which, when realized, creates different variations. In terms of learning, there are chains that lead, for example, to the permanent adoption of a new concept, to the tentative learning in which there is still uncertainty, but also even to poor learning. Teaching and learning are viewed as an encounter, which, if successful, requires activation of the teaching process on both sides; the learner’s and the teacher’s.

The following are fictitious cases that present examples of where certain things are standardized; but are the same as teaching methods. Here, the chosen method is the individual dialog between a teacher and a learner within a pedagogical function. The applied method could be something else (e.g., lecture, applying modern information technology), but educational psychological ideas also work in such cases in a similar way – at least for the most part.

Encounter case 1. The teacher and the learner have a high degree of self-efficacy. This can lead to a “further study” of the subject by the teacher or, alternatively, to the use of a high-quality practical teaching theory by the teacher (with several parallel pedagogical operationalization’s for content knowledge). For example, this starting point leads to a high-quality discussion with the student and to independent studying. The learner’s learning is intense, but the teacher and the learner still discuss the learning product. High-quality learning outcomes can be viewed as if reversed in order to track explanations for learning. If the factors (self-efficacy and practical theory) are in the “top position” (see Figure 1, and the larger area in the chain component), the learner’s learning is more likely to be possible. If the corresponding factors are in the “down position” (see Figure 1, and the lower area in the chain component), the learner’s learning is less likely to be possible (or at least not supported). At the end of this causal chain is a learning process that is in line with the stated goal.

Encounter case 2. It is possible that the teacher’s self-efficacy is weak, but that they will decide about their own learning (and it will help to choose items for meaningful conversations with the learner). A high-quality practical theory can also replace the need for study. The result can be the same as in the earlier case – high. The probability of this option is lower, since according to the idea of the causal mechanism, a high degree of self-efficacy generates a desire and a decision to activate, and research reviews based on empirical studies that refer to the power of self-efficacy.

Encounter case 3. If the teacher does not have a relevant knowledgebase with pedagogical content knowledge (e.g., a novice, at least for the content in question), any meaningful discussion with the learner is quite unlikely or even impossible. It is rare and unlikely that the teacher will find an alternative pedagogical solution that can produce a successful outcome.

Encounter case 4. It is also possible that the teacher, with a high level of self-efficacy, does not decide to learn and, thus, no relevant discussion with the learner takes place. However, this would not be considered common, as the high-level feeling of self-efficacy is built upon the existence of successful experiences (therefore, of course, a longer time perspective is needed).

The combination of certain phenotypes, or settings, is very likely to provide the learner with a solid and high level of learning. However, whilst that chain may sometimes be disturbed, the probability for a good level of learning will still likely be maintained. On the other hand, we can perceive a chain in which many factors undermine the likelihood that the learner and teacher will encounter a relevant learning project. When this happens, the potential of the learning process can be significantly impaired. The causal mechanism is such that the research seeks to identify factors relevant to teaching and learning, regardless of their frequency. Certain factors build the likelihood that the encounter between learner and teacher will be meaningful; it produces results. However, the actual interpretation of this lies in the hands of the researcher: the interpretation, for example, gives the idea of why self-efficacy works as it works and what it produces in the teacher, in preparation, in his "learning," but also in a wider and more interactive way in other structures, activities and mental processes happening within actors.

Although the current study is of a methodological nature, the construction of a model naturally requires consideration of content-based research literature – in this case, topics such as teachers' self-efficacy, teachers' practical knowledge and theory, and learner cognition etc. (e.g., Cappella, Aber, & Kim, 2016; Lee, Chen, & Wang, 2017; Levin, 2015). Combining methodological thinking and content literature might result in a mechanism that, in the real context of teaching, arrives at different "positions." Figure 1 illustrates the factors in the detection of a causal mechanism: a) sufficient length of the chain, which must also have a meaningful interpretation in terms of content (i.e., causal mechanism in which adjacent and consecutive factors occur) (see *Dimension 1*, horizontal in Figure 1), and b) a requirement to study different variations when the causal mechanism factors are in the "top position" and "down position" (see *Dimension 2*, vertical in Figure 1). However, the purpose of the current study is not to present a causal mechanism that has already been verified through empirical research. The context serves only as an example here and as a platform to present that certain methodological ideas can be shared in a sufficiently clear and pragmatic way in terms of how to further develop authentic empirical research.

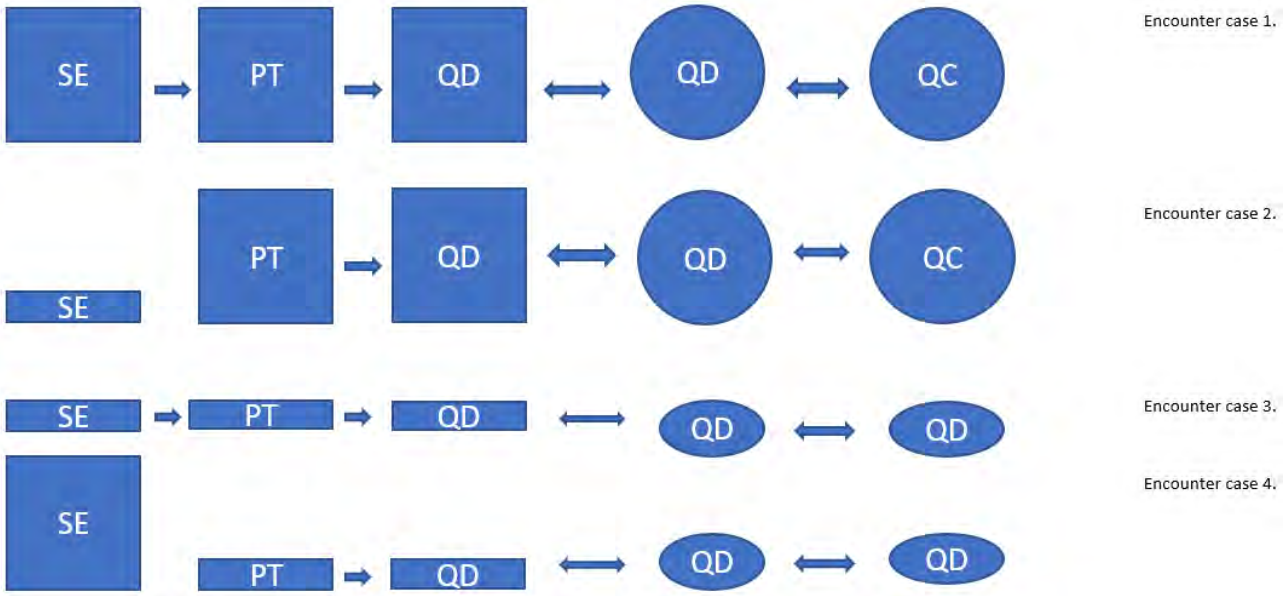

Figure 1. Potential for causal mechanism detection: Chain extension (horizontal dimension) and extent of variations (vertical dimension) [Rectangle: Teacher process, Circle: Learner process, SE: Self-efficacy, PT: Practical theory, QD: Quality of discussion actions, QC: Quality of cognition]

Thus, which elements the chain consists of is not, therefore, irrelevant. The concept of a chain here refers to the need to study the phenomenon as a process[1]. However, the discovery of a causal mechanism as a methodological idea does not mean a requirement for individual study, in which all the functions of the causal chain would be involved with all variations and all contextual factors. The idea or the principle of the chain in methodology is that the interconnected elements of the mechanism are considered sufficiently broadly (e.g., as in this fictitious example). The requirement to study different variations of the chain also shows that MM methodology is systematically interested in the different manifestations of the mechanism (and, thus, differs from a qualitative one, in which a single study may analyze one or perhaps just a few chains, but does not require systematic analysis of the chains). There are various factors that can have an effect on (or a connection to) both the chain factors and the kinds of variations this chain makes. One idea is to consider them as initial context factors (e.g., a novice teacher versus an experienced teacher or, for example, different surprising situational factors). They are, to some extent, important to the process, but they do not necessarily change the "laws" of the causal mechanism. Thus, it is possible that a novice teacher works in the same way as an experienced teacher, but, statistically speaking, novice teachers and experienced teachers will mostly work in different ways.

Contextual factors do not necessarily change the core process of the mechanism. Of course, empirical analysis can find context factors that appear to be crucial in shaping the process that is attached to it. In this case, it is possible that the causal mechanism chain adds "a new factor," a causal mechanism is "fine-tuned," and the chain is a more detailed description of how the entire phenomenon proceeds as a process (although, for example,

[1] Here, the concept of the chain is essentially a practical (methodological) and conceptual tool for researching the underlying causal mechanism. Again, the causal mechanism is a relatively well-established theoretical concept which, of course, requires empirical verification.

the phenomenon of education progresses interactively). Krause (2018a) also wrote about similar aspects. There are factors that are necessary to trigger a given process, and to further shape and continue the process, but then there are factors that may be associated with the process of occasional forming, thus, potentially not deemed to be "essential" to the process.

The theory of self-efficacy thus operates roughly as described above in the text through Encounter case samples 1 through 4. However, something remains to be wasted. Essentially, there are other factors that influence the "chain" and the "chain environment." Encounter cases 2 and 4 seemingly "break" the theory of self-efficacy. However, from the point of view of empirical research and the logic of theory, this theory holds true. "Breaking chains" for the self-efficacy theory reveals that the focus of human science is complex, but not to the extent that it cannot develop a better and more comprehensive theory. Some of the context of the phenomenon and its factors may be more unique than others. The phenomenon proceeds as a process, but in a non-linear fashion, shaped by the factors that are intrinsically involved (see, Jacobson, Levin, & Kapur, 2019).

How do these dimensions (1 and 2, as shown in Figure 1) substantially relate to the mixed-methods methodology? They are linked together; that is, they describe the same phenomenon and its different variations. Dimension 1 focuses on finding, interpreting, and understanding the mechanism, and qualitative work is emphasized more, i.e., how certain factors exactly relate to each other in an understandable way. Dimension 2 shows what kind of variations the mechanism produces empirically, and so, quantitative analysis also plays an essential role. However, these dimensions in analysis 1 and 2 are not separate. They both shed light on the causal mechanism of the phenomenon (or part of the phenomenon). In this context, the previously discussed feature of mixing methods can also be mentioned, namely construction (model) and testing (Maxwell et al., 2016). That is a mixed-methods methodology in the progressive movement of research on a given phenomenon: It is not just a singular study, but that continuing research uses the idea of constructing and testing a theory.

Figure 2 shows a conventional situation that does not value the subject of the study as a causal mechanism, as we have considered. It is possible that the researcher has some familiarity with the previous research (scattered to some extent) that has a connection to the study in hand. Based on this, they would then choose the topics to be studied. A list would then can be drawn up, after which the content of data collection and what (mental, structural) aspects it contains must be decided upon. The methodology can be a monomethod (quantitative or qualitative) or a mixed-methods approach that is not based on the idea of a causal mechanism (or other holistic system). That study may, of course, find some connections or "parts" of the causal mechanism, but their identification is more random, and an unstructured phenomenon does not determine the frame in which the research plan is built for its key conceptual factors.

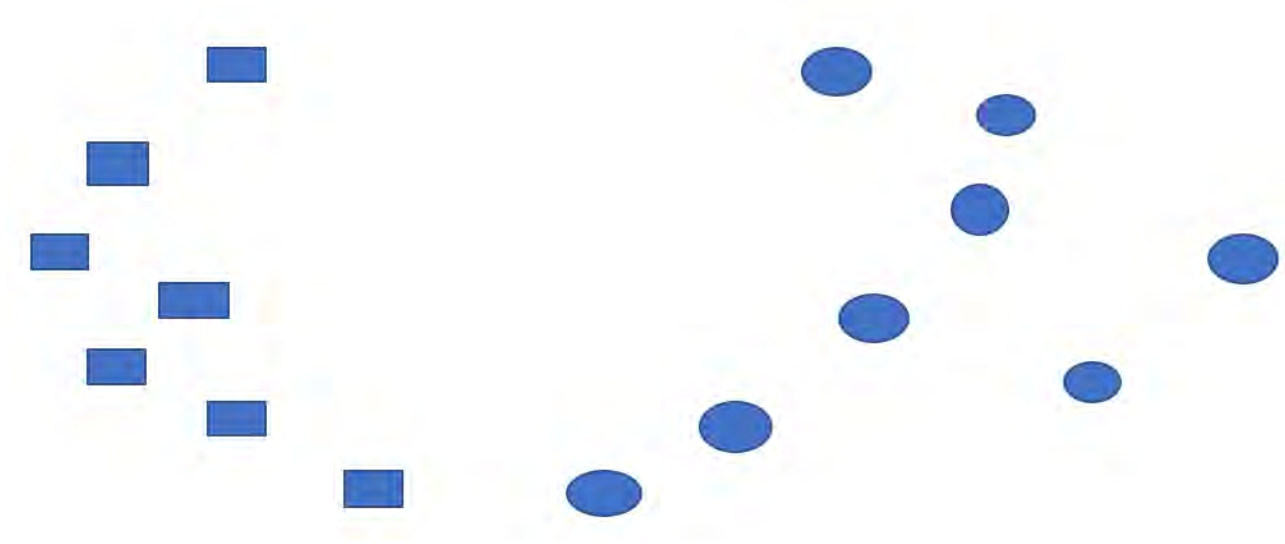

Figure 2. Research without causal mechanism (or an idea of another holistic system), with literature based research focus on teachers and learners [Rectangle: Teacher process, Circle: Learner process]

Toward networks of causal mechanisms and the need for generalization

The concept of causal mechanism is partly problematic and unclear in social sciences (see Gerring, 2010). If we look at the phenomenon of education, the whole subject is a broad and interactive phenomenon that is a process involving various actors. In this way, it is characterized by a temporal dimension, but also by many factors that interact with each other in a complex way. To some extent, it is also a matter of whether or not the causal mechanism implies several "causal mechanisms" within a broad interactive phenomenon, or whether we can use the same concept of that entity that functions as a broad interactive system. Therefore, in the latter case, a single study generally attempts to analyze one or more of the causal mechanisms that affect and function within a broad interactive phenomenon.

The causal mechanism in the MM methodological context of educational research has been generally discussed less in social sciences or its (special) sciences (see, for example, Weller & Barnes, 2016). Morris, Edovald, Lloyd, and Kiss (2016) examined the concept of the mechanism for intervention and trials-oriented research methodology in educational school-based studies. Such a research trend has an interest in how interventions work. Of course, the key methodological issue is how to understand the effect of the impact or its failure. In this case, the causal mechanism is essential. Although the experimental tradition works in a somewhat clearer and simpler environment than a naturalistic one, it is also largely associated with a similar research methodological challenge for the causal mechanism. For example, the authors talk about how the intended outcomes are more distal than proximal in relation to intervention. This fact advocates that a sufficiently broad entity should be used to identify and understand causality, although *it may be part of an even broader context and, in addition, contextual factors still challenge the planning of a research design*. The argument of a broad causal chain is not diminished by the fact that the essence of the educational and teaching phenomenon includes intentionality and a process that is interactive. In other words, the intent of education guides the process, even though the effects are multidirectional. In fact, the reasoning behind a broad chain is even more important because

of the interaction: The short parts do not reveal the whole, i.e., the intent of education, which requires progress in time and process, and also has a "history" not only in the future.

As Tikly (2015) presented, it can be argued whether or not it becomes possible to move beyond the dominant "what works" agenda, as favored by empiricists, "to critically consider what works, for whom, and under what circumstances" (p. 237), and defends the philosophical point of view of critical realism. Gradually, we can make a list of the chains that implement the causal mechanism of student learning in different variations. Different elements in the chain create different choices and either prevent or hinder the probability or, in practice, ensure that learning occurs. In the "agreed" initial phase of the causal chain, there is usually a factor which is "far" from the learner's activity and cognition. These may include, for example, teachers' self-efficacy, teaching orientations, educational philosophies, motivational approaches, attitudes, values or, for example, how parents appreciate and support their children's schoolwork. When other factors are formed along the chain, the number of realizations of different chain combinations increases significantly. We can finally talk about *causal networks*, rather than causal chains.

Qualitative analysis focuses on the options of the process-like mechanism description, but it is also necessary to consider the perspective of generalization. The number of different combinations in the data – for example, inside the data of 200-300 cases – provides important information about it (also for the user of educational information), where the research may be focused in the future: whether mechanisms with essentially the same settings are examined or whether mechanisms with different settings are compared. This follows that findings can be generalized for specific cases. Yin (2013, 2014) mentions such an analytic generalization, which can be juxtaposed with statistical generalization (e.g., Halkier, 2011). Analytic generalization refers to situations which have produced key ideas that may be applied to many other situations (Yin, 2016). According to this form, it can be assumed that there are cases where there are some differences, but also commonalities between the same phenomenon.

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