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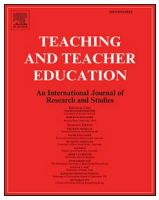

Research paper

# Expanding adaptive teacher expertise in higher education: using breakdowns and repairs to reinterpret teachers' improvisation as a sociomaterial practice

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ABSTRACT

This study explores adaptive teacher expertise in higher education, using heuristics of breakdown and repair from the sociology of knowledge to situate this concept in a sociomaterial exploration of classroom teaching practices and institutional environments. Data were collected through a four-month ethnographic research study including both observations and interview with university teachers in a Chinese university. It was coded and analysed to identify examples of breakdown and repair. This research shows that adaptive teacher expertise extends beyond responding to students; it also involves untangling tensions with the practices of the institute, which may lead to actions that could be regarded illegitimate.

## 1. Introduction

In today's fast-changing professional landscape, adapting to new challenges and environments has become a critical skill. Work environments are complex settings where people with different interests are accommodated through forms of negotiation (Engeström, 2004). Professionals engage in negotiation while interacting with physical and digital artefacts, knowledge, and people (Argyris, 2003). These interactions foster forms of relational agency, defined as the "capacity to work relationally with others on complex problems" (Edwards, 2010, p. 8), which enables professionals to integrate resources and collaborate with others to support how they learn and how they adapt their work.

The concept of teacher expertise in educational contexts shares this view, with over 40 years of research in education attempting to go beyond checklists of desirable qualities or stable lists of useful knowledge, to account for teachers' knowledge, attributes, professionalism and pedagogic ability, including their ability to improvise in response to the needs of learners as well as being able to plan and structure lessons carefully (Anderson & Taner, 2023). These responsive, improvisational qualities, when linked to the development of practice theories and a change in focus from self to students, led to the proposal that teachers should be viewed as adaptive experts (Anthony et al., 2015). From this perspective, expertise is understood as situated in practices and as being relational, shifting the focus away from inherent qualities of teachers and towards the emergent qualities of their relationships with learners. This adaptive expertise is usually acquired through everyday work activities, and involves a dynamic and flexible approach to problem-solving, underpinned by a deep understanding of the underlying principles (Hatano & Inagaki, 1986; Bransford et al., 2005).

While some papers (Lambrev, 2024; Selvik & Herrebrøden, 2024) discuss adaptive teacher leadership or expertise as a response to the exceptional need during the pandemic to move teaching online, we propose instead that it is important to better understand adaptive teacher expertise as an ongoing part of teachers' daily working experience. Existing work tends to focus on adaptive expertise as it relates to student needs (Männikkö and Husu, 2019; Bowers, Merritt and Rimm-Kaufman, 2020; Kua et al., 2021; Suh et al., 2023), but more attention is needed to understand this concept more broadly, as education requires teachers to make continuous and situated judgements not only to facilitate students' learning but also to maintain their own professional resilience if they work within a system that increasingly undermine their autonomy and discretion (Biesta, 2009).

Therefore, in this paper, we argue that adaptive teacher expertise must be understood as more complicated than only being about adapting to different students' needs and behaviours (Männikkö and Husu, 2019; Bowers, Merritt and Rimm-Kaufman, 2020; Kua et al., 2021; Suh et al., 2023); it also involves navigating and adapting to tensions that arise between teaching and systemic influences. While the previous

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research has explored adaptive teacher expertise as the improvement of the teaching and learning process, this research introduces the idea that adaptive teacher expertise is also important for the maintenance of the process of teaching and learning when breakdowns happen in practices. In addition, instead of treating adaptive expertise as a cognitive quality that teachers possess irrespective of the practices they are engaged in, part of the contribution this paper makes is to re-theorise adaptive expertise as a more situated achievement, emerging out of specific local educational practices. Using a sociomaterial theoretical perspective from the sociology of knowledge, this paper seeks to advance the concept of adaptive expertise by focusing on the everyday practices of teachers working in Higher Education.

## 2. Literature review

To locate the conceptual and empirical developments undertaken in this paper, we will contextualise them not only in relation to existing research in education about adaptive teacher expertise, but also in relation to studies in sociology which explore how knowledge practices emerge into forms of "expertise", both within and outside formal institutions.

### 2.1. Sociology of knowledge: three waves of research on expertise

In the discipline of sociology, Collins & Evans (2002) describe three waves of research about expertise dating back to the 1970s. In the first phase, sociologists focused on the distinctive practices through which scientific institutions make knowledge (Collins & Evans, 2019). In the second phase, the focus shifted to understanding how scientists decide which claims to accept or reject, showing how "expertise" involves the social recognition that comes from group consensus rather than solely from individual achievements. This raised concerns about whose knowledge was included and excluded from such expert 'groups', and sociologists began to study political questions about involving wider publics in science. They proposed a third phase of work in which different kinds of expertise are distinguished as arising from different forms of life, and characterised in terms of what individual proficiency is demonstrated, how esoteric they are (limiting social access to the knowledge), and the extent to which expertise demands access to tacit knowledge.

There were (and continue to be) controversies about the relationship between 'expertise' and wider public recognition – that is to say, there can be clashes amongst "scientific experts" and "experience-based experts" over whose knowledge matters (Collins & Evans, 2002). Responding to sceptics and conspiracy theorists who sought to undermine the credibility of "experts", Latour (2004) introduced the concept of "matters of concern" to study these controversies, arguing that expertise emerges from networks of relationships not only between people (i.e. the "social"), but between people and things (i.e. the "material). In other words, Latour argued that expertise from any "form of life" – scientific or otherwise – is built through *sociomaterial* connections and thus constituted as "actor-networks" or assemblages of humans and "non-humans". This "Actor-network theory" (ANT) has been adopted widely and extended by researchers such as Puig de la Bellacasa (2011), who introduced the concept of "matters of care" to add ethics, affect, and reflexivity into sociomaterial accounts of how different expertise emerges and becomes entangled in political contestations.

The work in this paper aligns with this understanding of expertise as a sociomaterial matter of care, foregrounding the actor-network or assemblages through which expertise emerges. By focusing on how things are achieved through sociomaterial practices, we aim to enrich theories on adaptive expertise by offering a detailed description of practices, rather than new abstractions of psychological states. Following Mulcahy (2012, p. 10), what we aim to develop here is "an *assemblage* account of accomplished teaching" that is different from a cognitive one. As a consequence, this work does not attempt to define expertise in terms of cognitive models (treating adaptive teacher expertise as a stable quality of individual teachers) but adopts instead the philosophical stance that adaptive expertise is a situated achievement enacted in practices and emerging through networks that are sociomaterial (i.e. involving not only humans such as teachers and learners, but also non-humans such as resources, buildings, etc). The ontological consequence of this shift is that instead of abstracting from observed practices to present something that appears to offer a stable cognitive model, we are more interested in describing the contextual conditions that make adaptive teacher expertise possible. Elements of this may be more or less stable (e.g. room layouts are durable, pedagogic repertoires may develop, but feelings may arise and disappear during sessions).

This also commits us to pursuing a second feature of sociomaterial analyses: the principle of symmetry, demanding explanations of the failures and limits of expertise, as well as its achievements (Callon, 1984). This position opens up the possibility of studying the unfolding of expertise in the everyday practices of teachers, including the day-to-day struggles that might characterise the development of the kinds of experiences and tacit knowledge Collins & Evans (2002, 2019) argue are central to contemporary debates about expertise. This includes the ways teachers draw on both formal, cognitive knowledge (e.g. curriculum content, pedagogical strategies, and institutional policy) as well as tacit, embodied knowledge (e.g. interpreting classroom dynamics, responding to student behaviour in the moment, and negotiating competing demands).

### 2.2. Educational studies of teacher expertise

#### 2.2.1. Theorising routine and adaptive teacher expertise

In some studies of education (Kua et al., 2021; Suh et al., 2023), including research conducted in elementary schools and systematic reviews across both school and university contexts, the expertise of teachers is conceptualised into two categories: routine and adaptive expertise. Teachers with routine expertise understand how things work in a specific and particular way and show efficiency and proficiency when performing common tasks in teaching and work. In other words, routine teacher expertise involves applying core sets of skills and routines with enhanced efficiency and fluency. Routines represent the predictable elements and certainties within teaching, and as such can be anticipated and integrated into a knowledge framework for learning how to teach (Anthony et al., 2015). However, routine teacher expertise might encounter challenges as teachers try to apply a deep understanding of the subject matter or struggle with transferring analogical reasoning to solve unfamiliar or unconventional problems (Suh et al., 2023). This type of expertise is constrained by functional fixedness, leading to reliance on established problem-solving scripts that might not have been optimised for addressing unfamiliar problems. Therefore, routine teacher expertise ensures that performance is "highly competent, as long as the issues the individual deals with fall within the realm of the familiar" (Schoenfeld, 2011, p. 332).

However, in the process of developing their teaching practices, teachers need something different from routine expertise to enable them to "innovate when necessary, rethinking key ideas, practices, and values in order to respond to nonroutine inputs" (Lampert, 2010, p. 24). The relative importance of routine and adaptive teacher expertise arises from their applicability and suitability in specific environments (Timperley et al., 2017). Timperley et al. draw from research on professional learning to suggest that routine expertise fits more stable environments where teachers can achieve high efficiency, relying on established procedures without needing deep conceptual understanding of their behaviours (2017). This view regards teaching as the mastery of standardised practices. However, environments characterised by constant change and complexity typically need adaptive teacher expertise. Given the changes and complexities affecting education (from policy, technology, curriculum politics, etc), we argue that many teachers face complexity every day, requiring them to be responsive to the diverse

needs of students in uncertain contexts, shifting learning environments, and broader systemic influences, in ways that draw on deep professional knowledge. Teachers must continuously make decisions, troubleshoot problems as they arise, manage competing priorities, and address simultaneous and sometimes conflicting student needs (Timperley et al., 2017). Routine expertise needs knowledge of "what", "how", and "why" of practice. Adaptive expertise adds to this the "when" of practice, and is distinguished by its emphasis on flexibility, enabling educators to generate new solutions to existing challenges and innovative solutions for emerging ones.

There is a large body of education literature that seeks to define and understand adaptive teacher expertise theoretically, much of which discusses the cognitive dimensions and abilities required for this form of expertise. For example, a recent synthesis of literature in teacher education delineates key features of adaptive expertise, such as adaptive dispositions, metacognitive skills, and cognitive skills (Wetzel et al., 2015). Broadly, adaptive dispositions are about anticipating and embracing complexity, fostering a willingness to ask questions, seek feedback, and obtain new insights beyond existing knowledge for problem-solving. Metacognitive skills associated with adaptive teacher expertise include self-assessment and reflection characterised by the continual evaluation of prior knowledge and the understanding of one's role as both learner and problem-solver. Further, adaptive teacher expertise demands the cognitive flexibility to balance adaptive and routine approaches when navigating challenges (Wetzel et al., 2015). Parsons et al. (2018) has conducted a systemic review of such literature in school contexts, summarising that adaptive teacher expertise has been described as the ability of teachers to adjust their instructional practices in response to student needs, contextual factors, and various teaching challenges, and that this concept includes some key components such as teacher knowledge, beliefs, experience, and thinking. As Bale (2022) discusses, the "improvisational brilliance" of teachers is not simply about making something up at a given moment; rather, it involves extensive experience and expertise to understand what is happening and then to respond and adapt to an unfolding situation.

Nevertheless, it has been noted that drawing categorical distinctions between adaptive and routine expertise risks creating a misleading dichotomy, as routine expertise often requires adaptation in response to situational demands and adaptive expertise relies on proficiency in specific routines (Timperley et al., 2017; Wyse et al., 2015). Thus, the adaptiveness of teachers appears to be a blend of innovative and routine instructional practices, as previous experience often leads to functionally fixed behaviours (Männikkö & Husu, 2019).

#### 2.2.2. Adaptive teacher expertise in practice

In addition to the research described above that provides a theoretical discussion of the cognitive dimensions and abilities necessary for adaptive teacher expertise, another significant body of literature in teacher education (e.g. Bowers et al., 2020; Ramey & Stevens, 2023; Soslau et al., 2018) focuses on the practical applications and visible actions of this expertise in practice. These studies seek to illustrate what adaptive teacher expertise looks like in real-world educational settings, and consequently, most of these studies are empirical in nature.

While such studies avoid a dualistic gap between cognition and action, one limit of these studies is that they concentrate primarily on the teacher's relationship to the student. For example, Bowers, Merritt and Rimm-Kaufman (2020) conducted an empirical study in elementary schools, involving content analysis of teachers' reflections and transcripts from videos. They proposed a conceptual framework of adaptive teacher expertise, including knowing students' developing cognitive understanding, facilitating student-centred discourse, and supporting student agency. Franyo and Dorner (2024) conducted interviews with 31 university teachers and then theorised three core dimensions of adaptive teacher expertise including openness (teachers' willingness to engage with external environments and students' needs), abilities (specific skills to be adaptive) and actions (practical actions teachers take to address needs). However, these constitute relatively minor elements in their analysis of the way that teachers navigated dilemmas or tensions in their practice. The consequence of this focus is that these studies cannot account for how teachers navigate broader complex networks, such as interactions with students, technologies, physical classroom designs, and institutional policies.

Moreover, there is limited empirical research on adaptive teacher expertise in Chinese contexts through empirical research. On notable study by Xiang et al. (2022) focused on an EAP class in a university in Hong Kong, which shows that adaptive teacher expertise includes empathy and affective engagement. This drives teachers to understand and respond to the diverse needs of learners, especially in emotionally sensitive situations. It also requires cognitive flexibility, allowing them to quickly adjust to students' needs, such as varying language abilities, academic goals, or learning styles. Jiang (2016) conducted mixed method research in China, which showed that adaptive teacher expertise involves the ability to apply knowledge flexibly, to adapt teaching strategies to diverse and evolving contexts, to engage in continuous learning, and to reflect on one's own teaching practices. However, similar to studies mentioned earlier, these two studies focus on adaptive teacher expertise in terms of students' needs and classroom-level practices.

### 2.3. Synthesising two literatures on expertise

To summarise, our review of the literature in teacher education suggests that the majority of theoretical research on adaptive teacher expertise adopts a cognitive perspective, viewing it as a personal quality or characteristic inherent in the teacher's mind. Because this dualist view tends to separate the cognitive from the practical, educational researchers have argued that conceptualisations of adaptive expertise simplify the complexity of adaptive teacher expertise by not accounting for how cognition and action are embedded within specific social, material, and institutional contexts. This has led to a sizable body of practice-based studies of adaptive expertise in teacher education research. However, we argue that these empirical studies focus mainly teachers and students and do not adequately take into consideration how other individuals and educational artefacts might shape the practices adaptive expertise. While focusing on students' needs is important, it neglects the complexity of teaching practices and expertise, which are situated within a larger ecological system, being influenced by both classroom-level practices, institutional practices, and national practices (cf. Biesta, 2009).

This suggests that current conceptual frameworks in teacher education research may be too narrow in scope to study adaptive teacher expertise in practice, and there is a risk of overlooking important work that teachers do in wider contexts, such as solving challenges and problems related to institutional demands or other ethical, affective, and professional tensions within the ecology of teaching. To contribute to teacher education research of adaptive teacher expertise, we therefore pursue a fundamental ontological change, shifting from a purely cognitive understanding to a sociomaterial perspective and undertook an empirical study that draws on how "expertise" has been theorised and researched in sociological studies of knowledge as the theoretical foundation (e.g. Callon, 1984; Collins and Evans, 2002, 2019; Puig de la Bellacasa, 2011, 2017; see also Law and Mol, 2002). A sociomaterial description of adaptive expertise not only extends practice-based studies in the teacher education literature, but can also inform theorisations of adaptive teacher expertise by showing how adaptive teacher expertise is enacted through sociomaterial assemblages of human and non-human elements (such as classroom layout, institutional policies, and student-teacher interactions) in wider contexts which taken together, shape enable, and constrain teacher agency.

The definition of adaptive teacher expertise in our work is not only about responding to students' needs, but also about responding to the complexities of broader educational contexts such as the demands and

resources of the institution that they are teaching within.

## 3. Theoretical framework

To frame our exploration of adaptive teacher expertise as a sociomaterial assemblage of humans and non-humans, we draw on the concept of breakdowns from Actor-network theory (ANT). Breakdowns are defined as unanticipated disruptions that interrupt the seamless flow of practices in teaching and learning; in doing so, they provide valuable opportunities to examine the overall education system, revealing aspects that have become taken for granted in routine practices (Wu, 2022).

Rather than studying breakdowns, many studies have used the concepts of dilemmas and contradictions to examine teachers' experiences in the classroom and how they solve these challenges (e.g. Ramey & Stevens, 2023; Suurtamm & Koch, 2014). For example, Ramey and Stevens (2023) explore the cultural, pedagogical, and political dilemmas faced by teachers when they are facilitators in a student-centred STEAM learning environment (Science, Technology, Engineering, Arts, and Mathematics) and investigate the strategies that these instructors use to solve these dilemmas.

However, focusing on breakdowns from a sociomaterial perspective provides analytical moments where sociomaterial relations between people and things such as curriculum, technology, institute become more visible in the data (Adams & Thompson, 2016), whereas dilemmas and contradictions may not immediately apparent to the researcher. These breakdowns are not just random occurrences; they often reflect deeper issues within systems that are otherwise taken for granted, such as conflicting pedagogical demands in a teaching environment. Therefore, breakdowns can serve as an entrance point for tracing back to underlying dilemmas, contradictions, or tensions (shown for this study in Table 1). This approach allows us to also explore how teachers navigate and resolve these breakdowns, revealing the adaptive strategies and expertise as they emerge.

Since the aim of this paper is to develop a more expansive account of adaptive teacher expertise that incorporates theoretical developments on expertise from the sociology of knowledge, we use the sociomaterial concepts of breakdown and repair to explore adaptive practices, underlying tensions, dilemmas, and contradictions, and the emergence of expertise as achieved in practice, within complex educational settings that extend beyond the teacher-student relationship. Therefore, this theoretical framing guided us to two specific research questions: 1) What can be the specific teaching practices in adapting to breakdowns? 2) What adaptive teacher expertise emerges from repairing breakdowns?

**Table 1**
Summary of breakdowns and repairs.

| | Breakdown | Underlying tensions (cause of breakdown) | Repairs |
|---|---|---|---|
| Teacher 1 | Breakdown in students' engagement during teaching | \ | Changing pedagogical approach to verbal instruction to engage students |
| Teacher 2 | Breakdown in relations and communications between the teacher and the institute | Tensions between professional identity and institutional requirements | Passing all the students without the consideration of their assessment quality |
| Teacher 3 | Breakdown in communications between the teachers and the institute; breakdown of computer use | Tensions between teacher's desire and the institutional requirements | Changing pedagogical approach to teaching online but meeting face-to-face |

## 4. Methodology

This qualitative research explored how teachers adapt their practice to solve and repair breakdowns in their teaching practices. To achieve this, we focused on observing their actions in teaching practices and interviewing them to understand their reasons for these actions. This research followed ethical guidelines for data collection and analysis, and ethical approval for this research was obtained from the author's university; permission to undertake the study was also granted by a senior administrator where the study took place.

### 4.1. Context of the study and participants

This study was conducted at teacher education institute in a Chinese university. The empirical study and data analysis were undertaken by the first author.

Teacher education in China focuses primarily on curricular and pedagogical issues. Particularly, subject knowledge is considered the most crucial component in teacher preparation (Ye et al., 2019). This focus often neglects critical aspects of teaching practices, such as addressing the social and emotional dimensions of teaching, or challenges such as heavy workloads, limited institutional support, fear of confronting challenges, and inadequate training in managing student behaviour and diverse learning needs (Wang, 2021). All of these have the potential to cause breakdowns in teaching practices, leading to increased stress and a compromised learning environment for students. Furthermore, the enthusiastic adoption of information technology in Chinese teacher education has influenced various fields including the teacher education curriculum. Seeking to revolutionise traditional teaching and learning methods, nearly all teacher education institutions have established a curriculum of information technology education, teaching both theory and practical skills for technology-based instruction. Given this national context, a course about teaching technology for courseware making was chosen as the setting for this study.

Data collection started at the end of the pandemic in 2023. Lockdown was still in force in China, and so convenience sampling resulted in the selection of a university in the same city where the first author lived. The university campus was partly closed, requiring pass cards for entry. However, teaching and learning activities continued in person on campus, much like they did before the lockdown. The first author obtained access by gaining consent from a senior administrator to conduct the study, and from individual teachers for classroom observations. This research involved four teacher educators who taught the course about technologies for courseware making. The participants were all qualified and professionally trained to teach this specific course. Their working experience varied from 10 to 21 years. The classes took place in a computer lab, which could accommodate 50 students, though each graduate class was attended by around 30 students. To protect the anonymity of the teachers and their students, this research replaces all names with pseudonyms, and all teachers are referred to by the female pronoun 'she', irrespective of their gender. In this paper, we focus on describing three teachers' teaching practices (teacher 1, teacher 2, and teacher 3). Although data were collected from four university teachers, the situations observed involving teacher 4 overlapped significantly with those involving teacher 1. Consequently, teacher 4's data are not presented here; teacher 1's data were selected for inclusion in this paper due to the richness of the adaptive strategies that she enacted.

### 4.2. Data collection

To explore how adaptive teacher expertise is enacted in day-to-day teaching practices, a four-month ethnographic research study was conducted. This covered the second term (February 20, 2023 to June 13, 2023, 16 weeks in total). As an ethnography, this research was exploratory in nature; it involved exploring this cultural group and their social interactions over a sustained period of time through immersion in their

activities (Reeves et al., 2013). The cultural group explored in this ethnographic research is higher education teachers within a Chinese university context, where teaching practices are shaped by both institutional practices and broader cultural expectations around academic authority, success, and adaptation. Data collected included observations for all teachers' teaching practices in the computer lab, and interviews with them. Immersive observation enabled insights into the fluid and dynamic features of teaching practices in the classroom (Pischetola et al., 2021). In this computer lab, the teacher typically used a central computer at the front of the classroom to conduct real-time demonstrations of digital software. Each student was assigned an individual computer to follow the teaching broadcast to screens from the central computer. The first author went to campus on Monday, Tuesday and Friday for observations every week. Each class lasted 1 h 40 min. During the observation, the first author wrote fieldnotes describing the teachers' teaching practices and their behaviours and interactions with students, and took detailed photos for specific situations of interest.

After each observation, the first author conducted semi-structured interviews with teachers about that day. Teachers were encourage to interpret their teaching practices during these interviews, to clarify their behaviours or intentions (see Gourlay et al., 2015; Meyer et al., 2021). Interview questions were open-ended, such as "During the observation, I noticed [specific behaviours], why did you choose to implement this approach during teaching practices?". Most of the interviews with teachers were informal and happened either at their offices or on the way as we walked home, and the first author recorded these discussions in her fieldnotes. The interviews lasted approximately 15–20 min. All the interviews were conducted in Chinese and were translated into English after the coding stage.

### 4.3. Data analysis

The whole data analysis had two main phrases. Firstly, Nvivo was used by the first author to generate descriptive codes based on Spradley's dimensions (2016) including Actor, Objects, Spaces, Activity, Event, Time, Goal, and Feeling, which helped avoid the problem of overlooking important dimensions of data. The subsequent coding process was inductive to generate sub-codes within the Spradley dimensions, as it involved identifying emerging patterns from the data. For example, under the Objects dimension, sub-codes such as computer software, computer lab, teaching materials, and policies emerged. Similarly, under the Actor dimension, sub-codes like Chinese Ministry of education, university, teacher education institute, university teacher, students were identified based on emerging patterns in the data. While the first author led on the coding process, the developing codes were discussed and refined through regular meeting with the other authors. After this process, these codes were transferred into a sociomaterial map, to streamline the data and provide a brief overview of practices and the relationships among teachers, students, and other elements. A sociomaterial map describing social and material elements of teaching practices of teacher 1, teacher 2 and teacher 3 is shown in Fig. 1. Orange ovals correspond to "Actors" in macro and meso-level teaching practices and green ovals are "Actors" in classroom-level practices. Blue rectangles are "Objects" and orange lines are "Activities", "Goal", "Event" and "Feelings" in the Spradley dimensions. Time and Space such as campus, teacher education institute are written on this map.

Secondly, instances of breakdown and repair were identified as a heuristic methodological device to provide an entrance point for data analysis. This allowed me to select significant moments to understand how adaptive teacher expertise emerges through repairing breakdowns during teaching practices. As shown in Fig. 1, large red crosses over a

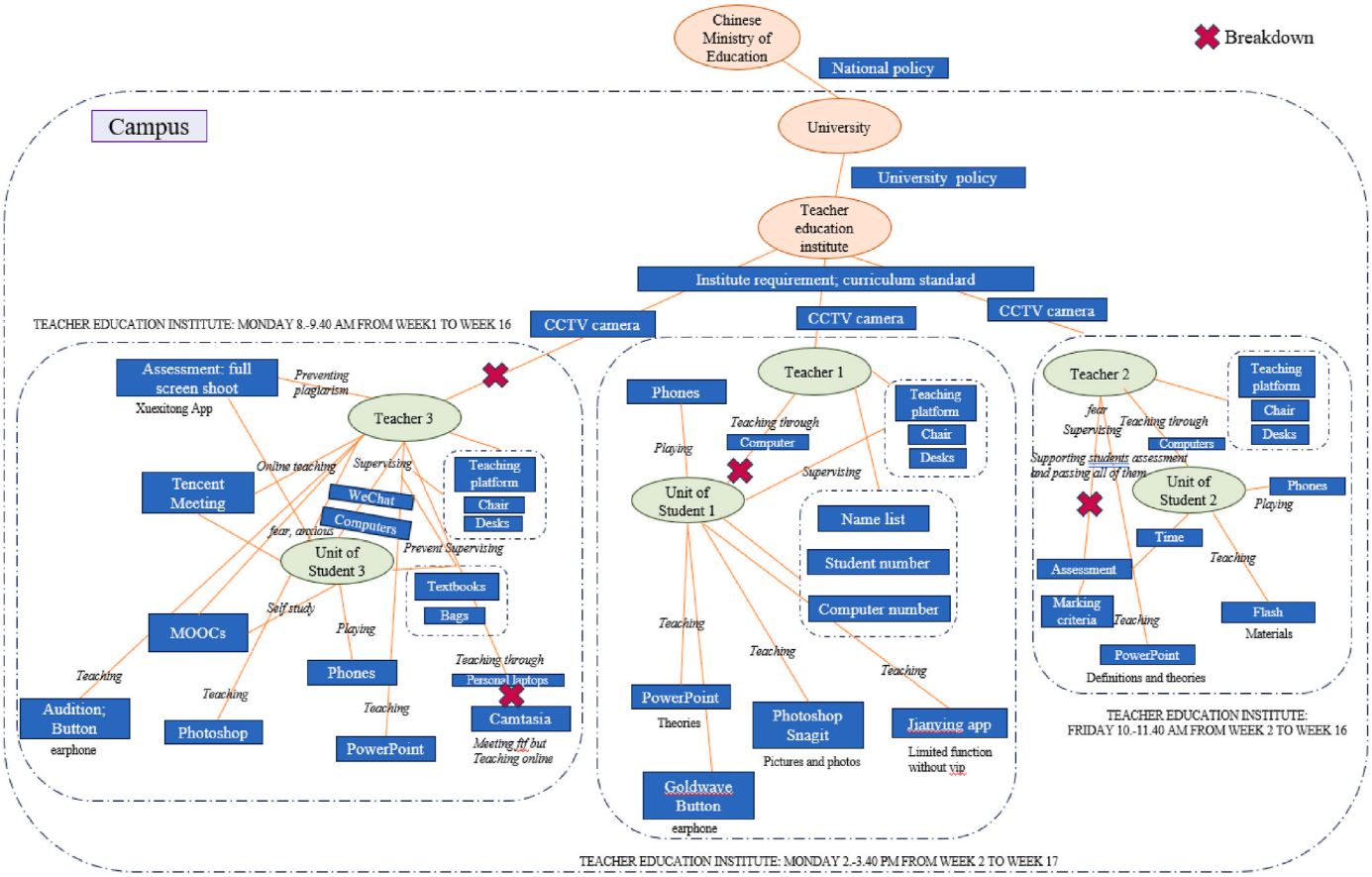


**Fig. 1.** A sociomaterial map, representing the practices of teacher 1, teacher 2 and teacher 3.

relational line indicates that a breakdown happened in that part of the teaching practice. As shown in Fig. 1, the red cross for teacher 1 indicates a breakdown in the interaction between the teacher and students within the classroom. For teacher 2, the red cross highlights a breakdown in the relationship between the teacher and the institute, which impacts the marking practices. In the case of teacher 3, the red cross represents both a breakdown in the communication between the teacher and the institute, and a subsequent breakdown in the use of computers in the classroom. The network around the red cross then became the main focus of my analysis and findings, with other elements being considered less relevant. Specifically, we zoomed in on the practices and data surrounding the breakdown to trace how the teacher responded, adapted, and reconfigured their actions and relations, thereby shedding light on how adaptive expertise was enacted in situated moments of breakdowns.

As mentioned before, breakdowns are kinds of disruptions, including both temporary and partial disruptions, which invite sets of repairs to maintain the working of the system. One way to repair a system involves 'untangling tensions', referring to the process of managing conflicts to achieve a balance (Thompson, 2010, p. 89). It is critical to pay attention to these moments (repair and untangling tensions) during pedagogical encounters as they are important locations of knowledge production. The kinds of knowledge made visible through engagement with breakdowns and repairs is produced within specific pedagogical encounters, and so cannot and should not be pre-determined before their emergence. Three breakdowns and corresponding repairs are summarised in Table 1 and will be specifically discussed in the findings section, highlighting the adaptive teacher expertise that emerges from these repairs.

## 5. Findings

This study focuses on three cases of adaptive teacher expertise, including repairing students' disengagement in the classroom, untangling tensions between professional identity and institutional requirements, and untangling tensions between a teacher's desires and institutional requirements (shown in Table 1). We demonstrate how adaptive teacher expertise emerges from different repair strategies. In each case, we briefly describe the situations of breakdown, followed by discussion of how teachers repaired the breakdowns (re-mobilisation) and how they prevented subsequential breakdowns (re-stabilisation) (Ebeltoft & Beck, 2023).

As context for the findings that follow, it is important to recognise that university teachers in China often face high expectations and pressure both from their institutions and society, balancing the demand for student success with the value of maintaining academic integrity. Inevitably, teacher education practices vary widely depending on the institution, region, and specific education contexts. The situations described reflect the unique institutional culture of this particular university at a specific moment in time, rather than representing a universal characteristic of Chinese higher education.

### *5.1. Adaptive teacher expertise when repairing students' disengagement in the classroom*

This case shows that one form of adaptive teacher expertise involves responding to students, for example when they become disengaged in the classroom.

During the observation, all the students sat at the back of the classroom, which was far from the teaching platform. The whole class was silent, and there was limited interaction between teacher 1 and the students. The teacher sat on a chair on the teaching platform and used the central computer to broadcast the software Photoshop. As teacher 1 needed to watch the computer when demonstrating, it was difficult for her to supervise students while teaching. Therefore, students displayed a lack of engagement, diverting their attention to phones, videos, doodling, and even dozing off during teaching, indicating a breakdown in engagement.

To repair this, teacher 1 employed a single teacher-led interaction as the pedagogical approach to reengage students. The teacher required that student whose student number is 1 use the first computer, which meant students need to sit at the respective computer according to their student number. The teacher generated the name list of this class with both student name and student number on it. When broadcasting, the teacher frequently used the name list to call on students to answer questions. After that, the teacher recorded each student's performance on the name list (Field note, March 20, 2023). As teacher 1 explained in the interview:

> "If students fail to answer the question, this means that they do not follow my teaching. In contrast, if they answer my question very well, this means that they follow my teaching. Then, I record their performance on the name list and I keep calling those students who cannot answer before to check whether they follow my teaching. As students are not sure whether I will ask them to answer the question and they do not want to be recorded on the name list, so they will focus on my teaching" (Interview transcript, 27th March 2023).

The configuration of name list, student number, and computer number allowed teacher 1 to monitor and assess students' engagement without constantly supervising them visually. It also made it difficult for students to conceal themselves from teacher supervision, since every student had equal opportunity to be called upon to answer the question, which created great uncertainty for students. The unpredictability of being called upon by teacher 1 created a sense of accountability among students, making them stay attentive. Furthermore, by linking student participation to public questioning, teacher 1 established a form of auditory presence and surveillance (Gallagher, 2010): both she and the rest of the class could hear and assess each student's answers. In other words, students and their answers were surveilled and judged by both teacher 1 and their classmates. This practice not only reinforced students' accountability but also created a peer-monitored environment, where students were motivated to avoid the unwanted judgement from both the teacher and other students and the embarrassment of being unprepared. To further stabilise this network, teacher 1 also chose to summarise students' performance from the previous class at the start of each new class, to prolong the effectiveness of the teacher-led interaction in generating engagement, stabilising the way that it helped remobilise this particular breakdown. In other words, the teacher kept repeatedly reminding students before each new class that their performances were being continually monitored and recorded on the name list, to counter the possibility that students might not consistently engage in learning.

In this case, adaptive teacher expertise emerges from adapting her pedagogical approach to solve the breakdown of students' disengagement in this classroom, moving from a passive broadcasting method to a teacher-led interaction. This is achieved by forming a sociomaterial assemblage that includes the name list, computer number, student number, and affects within the classroom. The name list in this case reflects the teacher's enacted knowledge of students, created during teaching practices. This enacted knowledge becomes inscribed knowledge as it is captured and encoded in the name list. Then, this inscribed knowledge guides the teacher's choice in orchestrating pedagogical approaches such as reflection and repetition before every class to ensure that students remain engaged. This cyclical process of observation, documentation, and reflection also exemplifies adaptive teacher expertise in practice, as the teacher continuously refined her approach based on real-time feedback from students' performance and needs. Although this adaptive teacher expertise raises ethical questions about the pedagogic appropriateness of inducing students' fear and anxiety, it was nevertheless successful as a strategy to improve students' engagement in their learning, given the lesson plan and a classroom layout that constrained the teacher's body to a teaching platform and directed her gaze onto the screen of a central computer.

### 5.2. Adaptive teacher expertise when untangling tensions between professional identity and institutional requirements

This next case moves beyond the understanding of adaptive teacher expertise as merely responding to students, highlighting how it also involves navigating and adapting to tensions with the institute.

The institute had criticised teacher 2 because some students failed their assessments. These students' failures were interpreted by the institute as teacher 2 not working hard enough and not giving students enough support, rather than as a reflection of students' work. Therefore, a breakdown in relations happened between the institute and teacher 2:

> If I fail students in this course, the institute will question my teaching abilities and whether I am responsible for this class and students. They will question me like, "why do students in your class fail? If you know they are struggled in learning, why don't you offer help through their learning process but you wait until the end?" I will be questioned by the institute that I do not work hard to teach and help students. (Field notes, 2023).

The above field note revealed a complex and challenging situation for teacher 2 that the decision to fail students has potential consequences on her professional standing. She faced the tension between being objective about students' assessment and expectations from the institute. To address this, she untangled the tensions by passing all the students irrespective of students' work quality and hid this from the institute. Despite this, she offered more help to improve student's assessed work compared to other teachers, to make this fake success look more "reliable". Therefore, alongside hiding her marking practices from the institute, another way for teacher 2 to untangle the tensions was to improve the quality of students' work, in case she was subjected to further challenges from the institute or external examiners to check students' assessments and their marks. As such, the pressure from the institute made teacher 2 prioritise assessment work, so she used scheduled class time flexibly by finishing teaching earlier, leaving more time for students to work on their assessments in the classroom. For the final assessment, which constituted a substantial part of the final mark, the teacher allocated whole class sessions for students to work towards assessment completion.

By being physically present in the classroom, teacher 2 could offer immediate help to students who encountered difficulties in their assessments. This support enhanced the quality of their work, making the assessment process more effective than if students were left to complete it independently. Additionally, her monitoring of students' progress by walking around the classroom, while well-intentioned, created an atmosphere of pressure that made students anxious, as they were unaware of her intention to pass them all. From the students' perspective, they believed that the teacher was assessing their progress and performance, which might determine their final grade. Therefore, pressures from the teacher and feelings such as fear further motivated students to treat their assessment carefully in the classroom.

This case illustrates a nuanced form of teacher expertise that goes beyond simply responding to students' needs. Instead, it involves navigating and adapting to institutional pressures while maintaining a focus on student learning outcomes. Adaptive teacher expertise emerges from adapting her marking practices (passing all the students) to fit with the expectation of the institute while hiding her marking practices from scrutiny. This reflects an adaptive response to external pressures. Meanwhile, she adapted her teaching practices to leave more time for students to complete their assessment in the classroom under her supervision to help improve the quality of their assessment. This is a form of adaptive expertise that is therefore achieved through a pedagogical assemblage consisting of the physical presence of teachers, teacher help, teacher supervision, and students' feelings such as fear, to make students focus seriously on their assessment. This demonstrates an adaptive approach to balancing institutional pressures with the need to maintain some level of academic integrity, but also points to how some forms adaptive teacher expertise might be rejected by peers or managers and therefore be considered illegitimate. Although this case of adaptive teacher expertise could be considered illegitimate and arguably undermines academic integrity, it helped the teacher to navigate the competing demands between students and the institute. It was also pedagogically effective, in that it helped make students improve their assignments, albeit through certain levels for fear and anxiety.

### 5.3. Adaptive teacher expertise when untangling tensions between the teacher's desire and institutional requirements

This case further discusses adaptive teacher expertise in untangling tensions between the teacher and the institute, but with a specific focus on how the teacher navigated the tensions between her own teaching desires and institutionally pre-determined teaching content.

In this case, teacher 3 taught Camtasia (a software package used for creating and editing video) as a new part of the curriculum due to her desire to ensure the programme remained relevant and up to date. However, the course syllabus, as agreed by the institution and all teachers, did not include Camtasia. Despite recognising this, she did not engage in discussions with the institute or other teachers to check whether this software should be added as teaching content for the students. This absence of discussion and consultation raised questions about the appropriateness of introducing Camtasia as digital software for teaching. Therefore, a breakdown in communication happened between teacher 1 and the institute, which led to a more significant infrastructure breakdown: the computers had limited capacity to support the Camtasia software for teaching, as the institute had not upgraded the computers in the computer lab for several years.

To address these breakdowns in a manner that would allow her to still teach Camtasia, teacher 3 adapted her pedagogical approach to "teaching online but meeting face-to-face". As the institute required every teacher to teach in the classroom, with a strict policy penalising teachers for absence (Field notes, April 24, 2023), to avoid pedagogical risks, she could not swap to fully online teaching. To get around this, teacher 3 required the students to bring their personal laptops to the classroom and download Camtasia. They then participated in the class using Tencent Meeting. Teacher 3 shared her screen via Tencent Meeting to demonstrate the teaching, allowing her to teach her desired software while the class met in-person. This conformed to policy requirements for physical attendance while allowing her to teach online and work around the limited capacities of computers in the lab. Despite untangling these tensions, however, teacher 3 transferred some pressures to students, as not every student had their own personal laptops.

However, teacher 3's new pedagogical approach caused further breakdowns in the classroom, which immediately involved her in further adaption to solve them. For example, as students brought their own laptops, they were easily attracted by games and other online activities that distracted them from learning. In contrast, when using the desktop computers in the lab, the broadcast system could lock students' computer screens, so they could not play games while the teacher was broadcasting. When using Tencent Meeting, students could minimise the shared screen to engage in non-academic activities on their personal laptops, which distracted them from learning. Meanwhile, teacher 3 sat on a chair on the teaching platform while teaching. Therefore, the teaching platform, chair, and teacher 3's laptop stabilised her body and directed her attention mainly towards her screen, which make it difficult for her to supervise students during teaching. To reengage students in their learning, teacher 3 gave up broadcasting via Tencent meeting. Instead, she changed her pedagogical approach to verbal instruction.

> During teaching, she just describes what students should do by "clicking the …", using language without actually demonstrating with the computer. Students need to listen carefully to follow her instruction to practice. When conducting, the teacher walks round the classroom to check whether students follow her instruction to

practices. Therefore, if students cannot follow, it is obvious for her to realise so she can offer help in time (Fieldnote, 2023).

When walking around the classroom, her close physical proximity enabled the establishment of eye contact between the teacher and students' screens, which meant it was obvious to the teacher who had not followed her instructions by looking at their screens. Even though the surveillance from the teacher to each student may be discontinuous, students gradually developed self-surveillance as they were never totally sure if they were being observed at any given moment. Therefore, teacher 3's physical presence and movement in the classroom were important, acting to induce students' feelings such as uncertainty and fear to help maintain their engagement and participation.

This case demonstrates another form of adaptive teacher expertise by focusing on the process of untangling tensions between the teacher's desire and the institute's requirements, particularly adapting to her strong desire to change the pre-determined teaching content and the limited capabilities of computers in the lab while still trying to meet part of the institute's requirement (being present in the classroom for teaching) through "abnormal" pedagogical approaches. In other words, adaptive teacher expertise is not only about adapting to students and the institute's needs, but also reflects the teacher's *autonomy*, including what the teacher decides to teach or what the teacher thinks students needed. This form of adaptive teacher expertise emerges from the sociomaterial assemblage of teacher's teaching desire, institutional policy, computers in the computer lab, and students' laptop.

However, this case also shows that there are limits and boundaries to certain forms of adaptive teacher expertise, which are not always successful in navigating complex contexts, compared with adaptive teacher expertise in the other cases, where solutions were more immediately effective and stable. Here, the teacher was constantly forced to repair new breakdowns. Although the adaptive expertise she demonstrates could be considered illegitimate because it changed the pre-determined syllabus and tested the limits of her ability to respond to new issues raised by her practice, teacher 3's adaptive teacher expertise nevertheless emerges out of her pedagogic decision to move around the classroom and instruct students verbally, which resolves this breakdown promptly and stabilised the students' engagement in their learning.

## 6. Discussion

The findings presented here answer the research questions "What can be the specific teaching practices in adapting to breakdowns?" by describing the practices associated with three types of adaptations to breakdowns (see Table 1). These breakdowns invited sets of repairs which show the improvision and adaptation involved in teacher expertise, answering the second research question, "What adaptive teacher expertise emerges from repairing breakdowns?" The forms of adaptive teacher expertise that emerge from the sociomaterial teaching practices described in this research involve responding to students' disengagement, getting around the tensions with the institute's pressure, and untangling the tensions between teacher's teaching desire and the institute's requirements.

Studies in teacher education (e.g. Bowers et al., 2020; Kua et al., 2021; Männikkö & Husu, 2019; Suh et al., 2023) have proposed that teachers need to be adaptive in their classroom teaching in order to respond to students' emergent understanding and to facilitate students' agency. The first case of this research confirms that adaptive teacher expertise does include being able to respond to students, although our study focuses more on solving students' disengagement rather than responding to their specific cognitive needs or to evidence of their emergent understanding (as studied in previous research). In addition to responding to students' emergent cognitive understanding, (see Bowers, Merritt and Rimm-Kaufman, 2020), this study also highlights adaptive expertise in terms of knowing students' *affective* situations, and using this to establish their authority to solve breakdowns. For example, teacher 1 recognises that questioning can provoke anxiety in students, and strategically uses this to establish her authority and re-engage students in the learning process.

However, in our studies, adaptivity is much more complicated and extensive; it cannot only be considered in terms of responding to students, but also involves how teachers respond to tensions between classroom practices and broader contexts, such as the institute. This is important if education is not only about facilitating students' learning, but also about maintaining their own professional resilience within a system that increasingly undermines their autonomy and discretion (Biesta, 2009). Therefore, a contribution of this research is in further illuminating aspects of adaptive teacher expertise that reveal forms of autonomy. Although studies (Ben-Peretz & Flores, 2018) give examples of several tensions faced by teachers in schools, such as "the paradox of implementing external policy versus using professional autonomy (p.203)", and "the tension between obtaining results and preparing students for multiculturalism in schools (p.207)", those studies primarily identify tensions in terms of influences and decisions as inputs and outputs; they rarely pay attention to how teachers negotiate those tensions through their practices, or how teacher expertise is constructed through those tensions.

Therefore, this study fills this gap in the literature by showing how tensions generate particular forms of teacher expertise. To get around tensions, teacher 2 passed all the students and teacher 3 changed the teaching content without informing the institute and other teachers. As such, part of adaptive teacher expertise is enacted and developed through untangling tensions such as those that arise between teachers, students and the institute. However, some might argue that both of these teachers used what might be described as a 'quick fix', which alleviated the immediate pressures or conflicts, but at a cost, which was that this type of adaptive teacher expertise – however pragmatic – could be judged by others to be illegitimate and therefore unethical. The teacher expertise in these cases were described as illegitimate because the practices lacked the formal professional approval that is normally conferred through peer recognition or institutional policies related to credentialling and career advancement within a particular institutional and cultural setting. However, in our research we avoid conflating of this illegitimacy and unethical teacher conduct. Rather than assuming that adaptive expertise should always conform with the expectations of the institute, our sociomaterial study adopted the theoretical principle of generalised symmetry (Callon, 1984) and Puig de la Bellacasa's scholarship on the knowledge politics of care ethics (2011, 2017) to foreground conflicting viewpoints in the same terms as each other, mindful that "agencies of care are not reserved for a particular practice, occupation or expression" (p. 93). This means that a sociomaterial account of adaptive teacher expertise must recognise and explain practices that *may* be judged to be unethical, as well as those that conform to ethical conventions. In doing so, this sociomaterial description of adaptive expertise opens up new lines of research, debate, and imagination about what ethical and/or professional teaching practices should look like in relation to the actual resources, constraints, affects, and desires in contemporary educational contexts.

It is important to clarify that this sociomaterial study did not unveil a simple case of moral failure on the part of the teachers. Our descriptive analysis instead surfaced forms of illegitimate expertise aimed at improving professional autonomy and/or students learning outcomes, illustrating how the practical ethics experienced on the "frontlines" of teaching and learning are rarely simple enough to reduce to an uncontested binary of 'good' and 'bad' actions. This challenges traditional notions of teacher professionalism that categorise teachers as either competent or incompetent, ethical or unethical. We describe how teacher expertise is more nuanced, involving sociomaterial knowledge practices that emerged in order to "successfully" navigate the tensions of specific educational environments. This involved complex practices of compromise and negotiation that hold together competing ethical possibilities – what Mol et al. (2010) describe as "practical tinkering". In our

study, the teachers decided what should be hidden and what should not in ways that prioritised some ethical outcomes (such as preserving the reputation of the course by passing all the students, but only after providing extensive additional formative support during class) over others (such as applying assessment standards fairly).

Limited research thus far has explicitly explored the kinds of adaptive expertise that teachers might need, but which may not be officially recognised. Some studies (e.g. Yıldırım, Albez and Akan, 2020) have pointed out that teachers need to possess ethical knowledge and skills required by their profession. Teachers' choices in pedagogical decisions, course development, classroom management, activities, assessment methods, daily social exchanges with students and all other elements have the potential to deeply influence others both morally and ethically (Yıldırım et al., 2020). In one of the few studies of unethical behaviours of school teachers, Demirbilek's (2023) found that such behaviours range from favouritism towards successful students to exploitation of students for personal gain. In our study, unlike overtly unethical behaviours such as favouritism or exploitation, illegitimate teacher expertise – strategies that are successful in achieving their aims, even if those aims may resist or subvert institutional policies – involved *covert* actions that raise new ethical questions. This can be seen in the examples where adaptive teacher expertise motivated by the tensions teachers experienced in this study led to controversial actions, such as how teacher 2 satisfied the institute's expectations for marking. Few studies in teacher education have explicitly explored the kinds of adaptive expertise that teachers might need, but which may not be officially recognised. We therefore contend that adaptive expertise should be understood as a situated ethical practice that should be further studied and acknowledged by researchers, teacher education programmes, professional bodies, and credentialing agencies.

Furthermore, our study connects with existing studies in teacher education (Tamir, 1991; Verloop et al., 2001) which argue that teacher's personal knowledge guides their teaching practices, teacher work, and curriculum making. However, those studies do not explore teacher expertise as being influenced by their desires, and how this desire can move adaptive expertise beyond current constraints by reconfiguring contexts. Teacher 3 used the pedagogical approach we described as "teaching online but meeting face-to-face" to get around the limited computer capacities and meet the attendance requirements of the institute while teaching the software that she wanted. This does not mean that adaptive teacher expertise transcends contextual factors so that the material constraints of contextual factors simply fall away. Instead, this recognises that teacher agency also involves the ability to reconfigure things, altering the system in which they teach – for example by requesting changes from managers, asking students to bring in new resources (their laptops), or by connecting their class to other settings (by using online systems). From this perspective, teachers not only respond to constraints by adapting to them personally (i.e. changing themselves to make their actions possible by, for example, learning new techniques), but also by adjusting the situation that they operate in (i.e. changing the educational context).

Meanwhile, the third case shows that adaptive teacher expertise is not always successful in repairing breakdowns once and for all; instead, as in this case, it can cause more breakdowns. Existing literature about adaptive teacher expertise does not explicitly address its limits, or explore the characteristics of situations that are so challenging that they are beyond the teacher's ability to adapt or repair them. However, acknowledging such situations is important, because without recognising the limits of adaptive teacher expertise, teachers may be set up to fail: the limits on their ability to solve problems or help students will appear to be their fault, rather than a systemic issue. The reconceptualisation of adaptive teacher expertise as a sociomaterial achievement developed in this paper challenges the idea that teacher expertise means an individual knows everything and always successfully does something, or else they fail or lack professionalism as a teacher. Instead, reconceptualising adaptive teacher expertise as a sociomaterial achievement shows how it tests situational limits. It allows adaptive teacher expertise to be understood in terms of using current knowledge and resources to overcome the constraints imposed by the limits or boundaries of an educational system. Rather than framing such cases as straightforward failures, it may be more productive to see them as part of an iterative learning process, one in which a particular "repair" strategy proves inadequate in the moment, but nonetheless contributes to the teacher's evolving understanding of what works and what does not in complex, situated contexts.

## 7. Conclusions

Anthony, Hunter, and Hunter (2015) argue that adaptive teacher expertise is a worthy goal of teacher education, but that there is limited understanding of how to cultivate this expertise within teacher education. The conceptual developments and empirical analysis in this paper make two contributions to discussions about adaptive teacher expertise. First, as our empirical evidence demonstrates, adaptive teacher expertise is not only about responding to students' needs, but also about responding to the complexities of broader educational contexts such as the demands and resources of the institution that they are teaching within. While the previous research in teacher education has explored adaptive teacher expertise in terms of *improving* the teaching and learning process, this study shows how adaptive teacher expertise can also be used for the maintenance of teaching and learning processes. Second, following discussions of expertise in the sociology of knowledge, we argue for an ontological change in the way that adaptive teacher expertise is conceptualised, moving away from viewing this in terms of an individual teacher's cognitive ability to also account for it as a situated sociomaterial achievement that emerges in practices. One benefit of this ontological shift is to avoid a dualism between cognition and practice, offering instead an account that explores how cognition and action are both embedded within specific social, material, and institutional contexts.

Rather explicitly than orienting our conceptual contributions towards an instrumental aim such as addressing institutional challenges, enhancing teacher adaptability, or improving student learning outcomes, our intention here (following Mulcahy, 2012) has been to develop "an *assemblage* account of accomplished teaching" that highlights how adaptive teacher expertise is an actor-network of teachers, students, administrators, and a host of non-human educational artefacts. In doing so, this descriptive study of practices makes its contribution to the field by filling gaps in the teacher education literature on expertise and raising new questions about what innovative teaching, professionalism, and ethical teacher conduct should look like, given specific ecology of people, resources and policy constraints. Nevertheless, we believe that our findings do also inform the design of teacher education programmes because it has highlighted the importance of providing social and emotional support for teachers and developing ethical guidelines to guide their practice.

Corcoran and O'Flaherty (2022) claim that prospective teachers worry about their social and emotional expertise when they encounter academic, social, and emotional difficulties when teaching. Although current literature (e.g. D'Emidio-Caston, 2019) encourages teacher educators to prepare teachers not only for delivering the academic curriculum but also to provide social and emotional development for learners, some literature (e.g. Bowers, Merritt and Rimm-Kaufman, 2020; Kua et al., 2021; Männikkö and Husu, 2019; Suh et al., 2023) focuses solely on the teacher's ability to understand students' well-being. This overlooks the importance of teachers developing their *own* social and emotional capacity in a way that would help them to navigate and adapt to the pressure, tensions, and conflicts that they face in their teaching practices. While such forms of support and development for self-care were not the main focus for those articles, we believe that such interventions are important and necessary so that teachers are able to cope with the tensions they experience. Such support could, for

example, be provided by educational developers within the institution. Thus, this work provides insight into how teacher educators might promote the social and emotional growth of teachers through the development of adaptive expertise. This would help teachers develop their ability to manage stress, conflicts, tensions and cultivate resilience more effectively and sustainably through their everyday teaching practices.

In addition, this research has surfaced forms of "illegitimate" teacher expertise, that may address immediate issues, but may not be sustainable or officially recognised. These findings suggest that teacher education programmes need to acknowledge this reality and provide frameworks for understanding how professional expertise involves relationships that extend beyond teacher-student interactions. This might include developing ethical guidelines and reflective practices that help teachers balance practical adaptations with adherence to professional standards. For example, reflective practices should encourage teachers to critically evaluate their action, understand the ethical implications of their decisions, and reflect on how their adaptations impacts students, colleagues, and institutional integrity.

As well as having implications for the design of teacher education programmes, this work opens up possibilities for further research. Given that forms of adaptive teacher expertise were identified in this study that might be understood as being illegitimate, further research could be undertaken to explore whether such forms stabilise, are challenged, or evolve over time, for example in response to institutional reforms or shifts in sociomaterial contexts. The consequences of illegitimate practices on teachers, students, and the education system could also be explored. Longitudinal studies would be needed to provide insights into how teachers negotiate the tensions between institutional demands and their adaptive practices over extended periods. Such studies could reveal if and how 'illegitimate' adaptations become normalised or integrated into institutional practices; are contested and eventually marginalised or ended; or are maintained in secrecy as a parallel practice.

Finally, we end by reflecting on some of the limitations of this research. As the study took place during China's COVID-19 lockdown, travel restrictions and partial campus closures limited research opportunities to a convenience sample at a local university. It was not possible to compare multiple universities or explore other sites. In addition, we wish to emphasise that teacher education varies widely within China, meaning that the situations presented here should be understood as being specific to the institutional culture of this particular university rather than representing general characteristics of teacher education in China. This reflects an inevitable consequence of the methodology adopted here. This qualitative ethnographic research focuses on complexities and contextuality of specific contexts, and is not intended to enable the direct transfer of findings to other cultures or settings. Therefore, the specific findings described in this research might primarily resonate within those teaching in or researching contexts similar to this study's focus, such as teacher educators in higher education environments. Further theoretical development are needed to relate these examples to practices in other disciplines or educational contexts. Nevertheless, we hope that in describing the tensions, dilemmas, and contradictions that arise in the everyday practices of these particular Chinese teachers, this sociomaterial account of adaptive expertise inspires readers to examine the interplay of humans and non-humans that make up their own educational contexts and reflect on the expectations and desires that are placed on the next generation of teachers.

## CRediT authorship contribution statement

**Hanlin Zhang:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Martin Oliver:** Writing – original draft, Supervision. **Allison Littlejohn:** Supervision. **Jade Henry:** Supervision, Writing – review & editing.

## Declaration of competing interest

I have nothing to declare.

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## Data availability

The authors do not have permission to share data.

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