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Imprevisibilidade nas Práticas de Planejamento de Aulas: Recomendações para o Design de Sistemas Colaborativos

Title: Unpredictability in Lesson Planning Practices: Recommendations for Collaborative Systems Design

Título: Imprevisibilidad en las Prácticas de Planificación de Lecciones: Recomendaciones para el Diseño de Sistemas Colaborativos

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Resumo

O planejamento de aulas é essencial para a prática docente, mas a falta de tempo, recursos e colaboração entre professores gera desafios. Esse cenário resulta em improvisações constantes e isolamento profissional, prejudicando a eficácia do ensino. O estudo investiga como os sistemas de planejamento colaborativo podem ser aprimorados para promover maior interação e suporte entre professores, permitindo práticas mais flexíveis e adaptáveis. A pesquisa utilizou uma abordagem etnográfica, com entrevistas semi-estruturadas e observações em escolas públicas. O objetivo foi entender as práticas de planejamento e como os docentes enfrentam desafios cotidianos. A colaboração entre professores é limitada pela falta de tempo e infraestrutura, com muitos utilizando ferramentas informais, como o WhatsApp, para compartilhar recursos e planejar. Sistemas de planejamento colaborativo devem ser projetados para facilitar flexibilidade, troca de recursos e colaboração entre professores, superando o isolamento e promovendo práticas mais eficazes e inovadoras no planejamento de aulas.

Palavras-Chave: *Planejamento de aula; Colaboração entre professores; Educação básica; Sistemas de apoio; Improvisação docente; Design de sistemas educacionais.*

Abstract

Lesson planning is essential for teaching practice, but the lack of time, resources, and collaboration among teachers creates challenges. This scenario results in constant improvisations and professional isolation, hindering teaching effectiveness. The study investigates how collaborative planning systems can be improved to promote greater interaction and support among teachers, allowing for more flexible and adaptable practices. The research used an ethnographic approach, with semi-structured interviews and observations in public schools. The objective was to understand planning practices and how teachers face daily challenges. Collaboration among teachers is limited by a lack of time and infrastructure, with many using informal tools, like WhatsApp, to share resources and plan. Collaborative planning systems should be designed to facilitate flexibility, resource sharing, and teacher collaboration, overcoming isolation and promoting more effective and innovative lesson planning practices.

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Keywords: *Lesson planning; Teacher collaboration; Basic education; Support systems; Teacher improvisation; Educational systems design.*

Resumen

La planificación de lecciones es esencial para la práctica docente, pero la falta de tiempo, recursos y colaboración entre los profesores genera desafíos. Este escenario resulta en improvisaciones constantes y aislamiento profesional, lo que afecta la efectividad de la enseñanza. El estudio investiga cómo se pueden mejorar los sistemas de planificación colaborativa para promover una mayor interacción y apoyo entre los profesores, permitiendo prácticas más flexibles y adaptables. La investigación utilizó un enfoque etnográfico, con entrevistas semiestructuradas y observaciones en escuelas públicas. El objetivo fue comprender las prácticas de planificación y cómo los docentes enfrentan los desafíos cotidianos. La colaboración entre los profesores está limitada por la falta de tiempo e infraestructura, y muchos utilizan herramientas informales, como WhatsApp, para compartir recursos y planificar. Los sistemas de planificación colaborativa deben diseñarse para facilitar la flexibilidad, el intercambio de recursos y la colaboración entre profesores, superando el aislamiento y promoviendo prácticas de planificación de lecciones más efectivas e innovadoras.

Palabras llave*: Planificación de lecciones; Colaboración entre profesores; Educación básica; Sistemas de apoyo; Improvisación docente; Diseño de sistemas educativos.*

1 Introduction

Considering the entire teaching process, lesson planning becomes the starting point and foundation of teaching, essential in determining the quality of education (COPPOLA, SCRICCA, CONNORS, 2004; LIU; ZOU, 2014; KOBERSTEIN-SCHWARZ; MEISERT, 2022). Clark and Yinger (1979) described planning as the invisible and lonely part of teaching. These conditions influence the quality of the planning process and educational outcomes (JALONGO et al., 2008). Often, the lesson planning activity begins with difficulties and limitations. Experienced teachers' tendency to distance themselves gives beginners the feeling of being the first to map the territory. Milkova (2020) reports that an adequate plan should provide an overview of teaching objectives, learning objectives, and the means to achieve them.

This study seeks to answer the following question: How do collaborative lesson planning (CLP) activities at the basic education level impact teachers' sense of isolation and overall teaching effectiveness? The primary objective of this study is to explore how CLP activities can influence teachers' professional development, their engagement in collaborative practices, and their feelings of isolation.

According to Jalongo et al. (2008), experienced teachers show no systemic willingness to share their knowledge. There seems to be a limited desire to stimulate the learning process for new teachers. Isolation also affects experienced teachers, who may regret never having had the opportunity to reflect on their work. Teachers may be reluctant to share their best work in a culture that rewards individual efforts. As one professional stated: "I did a lot of work on this project, and my grade-level group never does anything creative. Why should I give them all of my work to copy?" (JALONGO et al., 2008, p. 50). Teachers are blocked from answers to their questions, as well as opportunities to expand their subject knowledge and further develop their experience with content for students (FLINDERS, 1988). Thus, isolation is seen as a problem in a professional learning process that limits access to new ideas and external values (FULLAN; HARGREAVES, 2000).

Murph (2004) proposes a six-level progressive development model of collaboration between teachers. As collaboration progresses, the activities evolve from interaction to social presence collaboration, ultimately reaching the optimal shared artifacts level. At the first level, social presence, participants become aware of each other's presence and begin to relate as a group, thus forming group cohesion.

At the second level, teachers articulate individual perspectives but as monologues. They only observe others' presence but do not explicitly refer to their perspectives or seek feedback. At the third level, teachers begin to accommodate and reflect on others' perspectives. Participants are open to each other's viewpoints. This level is necessary for collaborative knowledge building.

At the fourth level, teachers co-construct shared perspectives and meanings, restructuring their thoughts through questioning, evaluating, and analyzing perspectives, beliefs, and assumptions. This aligns with O'Malley (1995), who affirmed that when an individual's perspective is challenged, they must work with others to create shared purposes. The fifth level is when participants start building shared goals. Common sense emerges, and they begin moving in unison toward a shared direction. At the highest level, planned artifacts are created, and both students and teachers start learning from each other (MURPHY, 2004).

In addition to teaching, teachers' routines include other responsibilities, such as planning and executing didactic work according to the school curriculum and, when necessary, considering the progression of educational technology. They also survey and interpret data about their classes' realities and collaborate within the school environment by attending meetings, councils, civic

participation, and other requests from the school board (CLARK; YINGER, 1977; SAMPAIO; MARIN, 2004).

Teachers require many hours to complete their planning tasks, often continuing these activities at home (SANTOS, 2016). Consequently, the quality of these activities may limit teaching and learning. As a result of recent developments, teachers have embraced various pedagogical practices related to information and communication technologies, thus adopting new professional approaches (CARVALHO; MAIA 2021; RODRIGUES et al., 2024).

This paper aims to answer the research question by reviewing existing literature on collaborative lesson planning in Section 2, presenting the study's methodology in Section 3, and discussing the findings and implications in Section 4 and Section 5.

2 Teachers' Collaborative and Individual Lesson Planning

The literature has discussed this topic since the last century, and it is highlighted in many discussions about educational change and teacher development (MOREIRA, 1997; BAKKENES et al., 1999; SPILLANE; SHIRRELL, 2018). Collaboration among teachers is crucial, as teaching practice is a social and most human activity (NIAS, 1998). Collaboration allows teachers to interact with more regularity, specificity, and depth to create new understandings and dynamics under the banner of teaching (HORN; LITTLE, 2010; YEH et al., 2021).

Lesson planning, individually, causes a sense of professional isolation, resulting in negative impacts on daily teaching and ongoing development, especially for young teachers (YUAN et al., 2018). A limited cognitive approach is perceived when teachers do not collaborate adequately at work, either quantitatively or qualitatively (PEPPLAU; PERLMAN, 1982). Individual work has become structurally and culturally incorporated into the work of teachers (VANGRIEKEN et al., 2015). For García (2010), the isolation of teachers is favored by the architecture of the school, where they are organized into independent modules, the distribution of time and space, professional capacities and privacy exists in relation to peers.

There are two sets of conditions to comprehend isolation as a condition that teachers experience. The first and most common set are the features of the work environment where the teacher would interact with colleagues and circumstantial aspects; the lack of them produces feelings of isolation. The second set of conditions involve the psychological domain and the absence of orientation to deal with working circumstances. The second orientation locates the workplace within the individual, as it is created and recreated using information filtering and processing (FLINDERS, 1988).

The first definition is a kind of collaborative lesson preparation. According to Badawi (2017), collaborative lesson preparation rests on the concept of collaboration, as defined by Friend & Cook (2016). They define this specific collaboration as a voluntary engagement between teachers when they share goals, resources, and responsibility in a mutual decision-making process. This innovation can include students as part of this activity to contribute to teachers' development (STANOVICH, 1996). The collaborative activities to prepare classes include sharing, reflecting, writing, implementing procedures and engaging in peer coaching (GUTIEREZ, 2021). As a result of the experience, professionals can construct functional and high-quality lesson plan activities (BADAWI, 2017).

A second definition of CLP activity associates it with effective planning, describing it as 'an essential element of good teaching and promoting student achievement' (JALONGO et al., 2008, p. 43). According to the authors, the lesson planning process has a significant impact. Its influence is seen in both short-term and long-term planning, providing a framework for selecting

objectives and developing activities and assignments that connect, expand, and extend identified knowledge, skills, and attitudes. It also includes appropriate learning assessments.

Teachers are required to prepare and teach classes, perform administrative and educational tasks, and engage in professional development activities. These tasks consume a significant amount of time relative to their workload, often resulting in insufficient time to complete all scheduled activities. The need for collaboration, as well as the limited time to overcome feelings of isolation, and the challenges posed by obstacles to effective teaching, highlight the complexity of collective professional teaching practices and the need for continuous improvement. In the next section, we present the Design Ethnography approach used to understand the meanings of users' CLP practices.

3 Method

We examine collaborative lesson planning (CLP) activities conducted by teachers in public schools at the basic education level. Appropriate methodologies and techniques were employed to understand the complexities surrounding these activities, including participants' creation of meaning and speculation about potential solutions for situated ethnographies (PINK et al., 2016; HJORTH et al., 2017).

Our goal was to generate insights into the nature of CLP activities. Following Pink & Mackley (2015), we adopted this approach to capture teachers' intentions when preparing for adverse scenarios and co-designing future solutions for their professional development. The epistemological framework draws on phenomenology, emphasizing how participants experienced and conveyed the phenomenon through their connection to objective (observable actions) and subjective (emotions, unobservable feelings, and sensations) phenomena (HUSSERL, 1990). This framework serves as a primary and structuring foundation for understanding the core questions of this research.

Ethnography is commonly used to capture the social and technical aspects involved in the development of activities (ANDERSON, 1994; IQBAL et al., 2005; ROBINSON et al., 2007). In this study, we employed digital ethnographic methods to explore CLP findings, propose design insights, and guide the development of a collaborative system for this activity (PINK et al., 2016). This approach aligns with a qualitative and projective design research paradigm (NELSON; STOLTERMAN, 2012), addressing existing challenges or deconstructing potential solutions.

We used design ethnography to capture the subjective dimensions of experiences, considering practices (what people do), experiences (what people feel), things (objects integral to our lives), relationships (intimate social environments), social worlds (groups and social configurations), localities (contexts people inhabit), and events (interactions in public contexts). These categories are broad enough to avoid biasing our interpretation and allow us to explore the meanings of practices for participants (PINK et al., 2016).

We view teachers as designers who adapt knowledge and artifacts to creatively fulfill their planning tasks. Drawing on the anthropological concept of creative improvisation (INGOLD; HALLAM, 2021), we investigate the improvisations teachers create to overcome situational constraints. In this context, we assume that artifacts emerge and are designed by teachers in educational settings, with particular focus on how they creatively address contingencies. Interpreting the phenomena of improvisation enables us to identify essential activities of teachers and provides valuable guidance for proposing solutions to challenges inherent in CLP activities.

3.1 Participants

For the study, there were inclusion criteria: a. a teacher with three or more years of teaching experience in high school; b. teacher in ongoing service at a public high school; c. willingness to participate in the research voluntarily (see Table 1). We assign fictitious names to each participant to protect their identities.

The following exclusion criteria were defined: a. participants who remained unwilling to sign the consent form; b. respondents who either deliberately provided false answers or did not respond to more than half of the survey items. In the sampling process, we asked fellow researchers if they knew teachers who met the inclusion and exclusion requirements. Eight participants were selected.

Table 1 - Profiles of participating teachers.

Participants	Academic Education	Teaching Time (years)	Age (years)	Environment
(PE1) Interviewed Participant 1 - José	Mathematics	Between 5 and 9	21 to 29	Virtually. The participant was at his home.
(PE2) Interviewed Participant 2 - Ana	Biology	Between 5 and 9	30 to 39	Virtually. The participant was at her mother-in-law's house.
(PE3) Interviewed Participant 3 - Francisco	Mathematics	Between 5 and 9	30 to 39	Virtually. The participant was at his home.
(PE4) Interviewed Participant 4 - Amanda	Biology	10 years or more	30 to 39	Teachers' room at school.
(PE5) Interviewed Participant 5 - Felipe	Physics	10 years or more	30 to 39	Teachers' room at school.
(PE6) Interviewed Participant 6 - Bruna	Physical Education	10 years or more	50 to 60	Teachers' room at school.
(PE7) Interviewed Participant 7 - Luana	Geography	Between 5 and 9	30 to 39	Teachers' room at school.
(PE8) Interviewed Participant 8 - Maria	Mathematics	Between 5 and 9	40 to 49	Teachers' room at school.

Source: The author (2022).

The researchers made requests via WhatsApp® messages. They asked their colleagues if they would like to collaborate in the research, answering a semi-structured interview, on an agreed day and at a time convenient for the interviewee.

All participants were appointed by the school management, except teachers PE1, PE2, and PE3, who were nominated by the researcher's colleagues; these interviews were conducted online, via Google Meet.

3.2 Title Data Collection

Semi-structured and narrative interviews were conducted to understand how creatively high school teachers collaborate while preparing classes, both at school and virtually. The questions included were:

1. What are the preparations usually done just before the start of a class?
2. What resources are part of these preparations?
3. How do these resources influence preparations?
4. Do you plan individually or in cooperation/collaboration with other teachers?

5. Do you follow any kind of guideline, for example, provided by your administration? Do you use any software to support the planning?
6. Do you use any main document as a reference to plan?
7. What elements do you consider in planning, such as student characteristics, available resources, and needs for other subjects?
8. At what level of detail do you elaborate your lesson plan, distinguishing between minimal detail and a highly detailed plan?
9. What types of resources do you include in the lesson plan? Options include textbooks, text documents, multimedia, software applications, electronic devices, materials invited to class, visits to sites outside the school, etc.
10. Do you include ICT activities for your students?
11. Do you share lesson plans publicly? If so, do you share them only with other teachers within your educational center, or more openly with anyone interested?

This set of questions was adapted from Caeiro-Rodríguez et al. (2016) to explore the practices and tools involved in lesson planning.

Interviews were held between April 2018 and April 2020. For each meeting, we organized the interaction as follows: (a) Participants were welcomed, completion of Consent Form, and Test Introduction: the research project and its objectives were presented. Then, the Informed Consent Form was declared to determine participation in the study. Once the terms were agreed upon, the data collection started; (b) A semi-structured interview was carried out to collect demographic data from the participants; (c) Narrative interviews were carried out to collect data from the participants' experiences; (d) Reenactment of the activity: participants were asked to explain how they would act, as well as to reenact significant episodes for the object of study. Also, we conducted a non-participant observation (MARCONI; LAKATOS, 2017). All procedures performed in studies involving human participants were in compliance with ethical standards. All interviews were carried out in Portuguese (PT-Brazil) and translated to English.

3.3 Data Analysis and Interpretation

We adopted the definition of scenario as "a relationship between active people and the areas relating to which they act." (LAVE, 1988). In this sense, we consider situated actions as "the activity of people who act in a unit of analysis", and the length of analysis is the relation between the person and the setting (Ibid.).

All audio and video data were transcribed using the transcribe tool and analyzed using the ATLAS.ti software. The categories were created by the researchers who authored this study. These emerged from the analysis and reflection carried out from the collected data (MERRIAM, 2015), including immersion of the researchers in the field context.

The unit of analysis of this study was the activity. The researcher interacts with the data using content analysis (BARDIN, 2011) with the aim of the researcher to immerse themselves once again with data. We followed the methodological criteria that were considered for this kind of data analysis (BARDIN, 2011): (1) Clear rules for inclusion and exclusion in categories; (2) The categories must be mutually exclusive (exclusivity); (3) The categories cannot be extensive. Or: that they do not put different things in the same bag (Homogeneity); (4) the categories must include all possible content, and "other" must be residual (exhaustiveness); (5) Objectivity, without subjectivism ("reliability"); and (6): It means verifying that the documentary source adequately corresponds to the analysis (Relevance). By the end, thematic narratives were produced as a third manner of data interaction. Those narratives aim to represent aspects of the complexity of collaborative lesson planning activities.

4 Results Everyday Collaborative Lesson Planning

In this section, we present eight thematic narratives (Table 2) to synthesize how CLP practices are carried out and make sense of physical and digital artifacts. The narratives are inspired from content analysis. The themes are: (a) physical work environment, (b) planning and plans, (c) individual and collective practices, (d) well-being, (e) lack of time, (f) improvisation, (g) knowledge and resources, and (h) information systems.

Table 2 - The eight themes generated from content analysis.

Theme	Definition	Representativeness	Keywords that originated this theme
Physical work environment	A place where the teacher performs lesson plannig activities.	All participants presented reports of experiences for this category, except participant PE6.	School, home, GRE (Regional Education Management)[1], activity, class, teachers, planning, time, Internet, books, and flash drive.
Planning and plans	The set of planning at different levels. These are the government level (annual), semiannual, bimonthly, weekly, and daily.	All participants presented reports of experiences for this theme.	Day, daily, annual, planning, teaching, preparing, bimonthly, and semester. Additionally, this category is backed by a pedagogical approach to teaching, that is, the 'teaching approach influences the students' way of learning'. Keywords that originated this category: approach, student, subject, content, dynamics, freedom, book, research, practice, class, and videos.
Individual and collective practices	The exchange of information and resources between two or more teachers by various means of communication.	All participants presented reports of experiences for this category.	Teacher, exchange, practice, GRE, sharing, planning, and experience. Additionally, this category is supported by the quality assessment, which is a negative or positive degree of excellence in the practice performed or artifact. Keywords that support this are: Better, perfect, bad, good, adequate, legal, and practical.
Well-being (subjective pole)	The processes by which an external or internal stimulus causes a specific reaction, producing a perception, thought, feeling, or emotion	All participants presented reports of experiences for this category, except participant PE6.	Happiness, sadness, frustration, desire, insecurity, ease, attempt, and fear.
Lack of time	Insufficient period for carrying out an activity.	All participants presented reports of experiences for this category.	Time, fast, fast schedule, free, class, and time.
Improvisation	Carrying out an activity without requesting preparation or knowledge.	All participants presented reports of experiences for this category, except participants PE1, PE6, and PE7.	Adapt, try, prepare, write down, check.

[1] GRE - Regional Management of Education (in Portuguese: *Gerência Regional de Educação*) is an organ that integrates the basic structure of the Secretariat of Education, which must exercise the following, at the regional level: actions of technical supervision, normative guidance and articulation and integration, with a view to improving the quality of education, etc.

Theme	Definition	Representativeness	Keywords that originated this theme
Knowledge and Resources	Information, knowledge, and palpable objects or results of software development.	All participants presented reports of experiences for this category, except participant PE6.	Information, knowledge, notebook, computer, projector, Internet, books, flash drive, research, questions, slides, smartphone, sound, tablet, use, and videos.
Information systems	A computer system that organizes, stores, processes, and transmits data.	All participants presented reports of experiences for this category.	Site (Website), SIEPE (Pernambuco's Education Information System), Google, YouTube, Internet, and WhatsApp. Additionally, this category is supported by the Internet, which allows the exchange of data and messages between geographically dispersed users. Keywords that support this are Internet, search, slides, video, YouTube, research, and experience.

Source: The author (2022).

These themes are present and inextricably linked to the narratives discussed below. In the next section, we organized two narrative descriptions. Their temporalities are associated with moments before going to the workplace and after leaving it. The first subsection explores the lesson preparation practices carried out by teachers while they are still at home or in environments organized for teachers' professional development meetings. In the second subsection, we will present the challenges faced at school and teachers' intentions when carrying out teaching-learning practices with higher quality.

4.1 Before Arriving at School

The temporality of collaborative lesson planning is ample. It starts even before teachers go to school. The teacher plans lessons at home for several reasons: lack of time, insufficient infrastructure to access the Internet, and a quieter place to work than at school. From home, they conduct searches and exchange knowledge and resources obtained with other teachers via the Internet. They utilize a wide variety of physical and digital artifacts.

Luana reports: "What class am I going to today? Oh, if I have a class where I have to take a book, or something else, I have to remember that (Luana displays the schedule)". Another example is given by José. He shows part of his work environment at home, using a laptop to organize digital artifacts, such as slides and text documents (see Figure 1). The use of the laptop enables him to organize and store digital educational resources. Due to the lack of practice and difficulties in accessing the Internet from school, it is necessary to search for materials at home.

When producing or downloading material from the Internet, he is used to transferring all digital stuff to a flash memory or sending it to his email box. Both, as mentioned by José: "Yeah! I had a flash drive with that saved, I just don't know where it is. But if anything happens to the computer, I'm lost! You have to redo it. I mean, some are saved in the email. But I think most of them are saved only on the computer." José reported that "Sometimes the material is already at the school, on the computer… we leave it there and let the other know that it is there. Or, for example, if I have it in my notebook, I go to its flash drive, check it in email, things like that...". Teachers creatively improvise ways to store materials, and design their instrumentation system (MUNOZ; BOURMAUD, 2012).

There is a dependency on digital devices that have memory functions. As they are physical items, they may be lost or may not work. If that occurs, it can cause workload or affect well-being.

Eventually, newly designed materials may not have the same quality as the original nor promote features to support the organization and management of resources.

While planning lessons annually, teachers consider the official Curriculum Parameters of Basic Education and the Pernambuco State Curriculum for Basic Education. They do so according to their respective area of teaching, according to the learning expectations, and based on axes/fields, and contents. They are aware that preparation to teach specific axes/fields must be bimonthly. However, due to daily demands and contingencies, improvisations emerge and teachings go on inside the realm of possibility, as is observed in the experience reported by Amanda: “It has to be! Thus, I cannot change it as I would like to because of the State’s provision of a curriculum. So, I got to have this subject in the first unit. We are not free or allowed to change the content. I don't have that freedom. I just have freedom about the approach I take. The way I will address it is my choice. There is no standard. ‘Ah! This school here has a constructivist model, a traditional model’… it doesn't have that. I take whatever approach I want. But I have no freedom at all.” The coordination between the state curriculum and its effective realization in each of the classes is a practice that requires organization and planning. Due to the daily contingencies, the activities are carried out, but differently from what was planned. Fickle performance is one of the factors that promote negative feelings, such as frustration and sadness.

Choosing and organizing media in flash drives is common among teachers, as mentioned by Amanda: “It's my life. Yeah, on the thumb drive! I don't have a printer at home. So, I just organize everything, put it in the flash drive, then get here… I go to the [sic] office, print it out and take it to photocopy.” Even though there is the possibility of using e-mail or any other information system for these purposes, the use of this artifact was presented as usual: "I don't have the habit of sending it by email. Only using the flash drive itself”, Amanda said. The teacher organizes the resources for each class and transfers them onto a flash drive. There is a considerable complexity to manage the correspondence of materials and class. Occurring an eventual problem or unavailability in the use of the flash drive, they improvise this management.

Amanda doesn't use cloud storage because she declares she doesn't have the skills for that. She reports that if there was an easy-to-use web system, she would definitely adopt it in her teaching practice. Such a system has to deal with all those overlapping contingencies. We can see that there is an emotional load related to the hardware, which is used as a file organizer, resource exchange facilitator and an extension of working memory.

Teachers register what they have to do in many distinct ways. Those vary from taking notes of what will be taught, what was taught in the classroom, scheduling for the resumption of the subject in the next class, observations of student behaviors, especially for reflecting on successful and unsuccessful practices. These registers are commonly made on paper, or in a notebook or an agenda, as reported by Felipe: "But I have a diary. I don't have it for the whole year, for the whole discipline. I have the whole structure: objectives, resources, evaluations, references. I have done all of those things, some, and it is in the diary at home. It is at home. I must have 4 or 5." The choice for these artifacts is due to the facility of handling and transport. There are subsequent efforts to index, search, and retrieve notes or records.

Notebooks are intensively used in the first months of the school year. Over the months, the number of activities in the teacher's routine progressively increases. Concomitantly, the recording frequency decreases. As this continues, there comes a time when there is no more time to take notes (see Figure 02). Thus, teachers try to memorize the data and information in their working memory. However, there are significant data losses, which could be relevant for action-reflection-action and lesson planning.

The notes are taken to compose a kind of report of the job, insights, and sticky notes, done by the teachers. Those records are stored for months or years until they are definitively discarded,

as reported by Francisco: “Tomorrow I do this [class]. So, there are more [notes]. A lot more than [classes] without registration or even, but like that: from the head, on scratch paper. I have to do that tomorrow.” Teachers create their own file systems, with rules and styles. Files are organized so they can be easily found and read or reused. However, part of the work memory executed is lost over the years.

Amanda reports: "I try to organize myself so I do not get lost. There are many classes that I do not write down, then when I note down, I do not remember, and I get confused. Sometimes, I write something generic on the computer. It was not what was effectively worked on, for example. What was actually worked on is not reported." Bruna stores parts of the information in her work memory. It is clear that there is a flaw in this "file system". These losses or frustrations can be mitigated by a system that is designed and suited to the complex relationships characteristic of planning activities. However, she considers this a handicap, not having the technological skills to quickly make records in digital format. Bruna has created a mental condition that makes an activity easy for some people, but difficult for her. The imposition of limits or resistance to the use of digital technologies already available may be due to lack of knowledge of the software or a consequence of the lack of time generated by the many planning and teaching activities. Research reveals that work overload can generate momentary working memory deficiencies and exhaustion among teachers (DIEHL; MARIN, 2016; TREVISAN, 2020; TABARES-DÍAZ; MARTÍNEZ-DAZA; MATABANCHOY-TULCÁN, 2020).

Figure 1 - Draft information sheet and laptop in a home office setting.

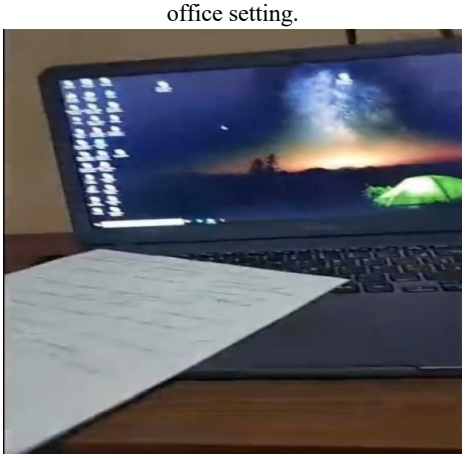
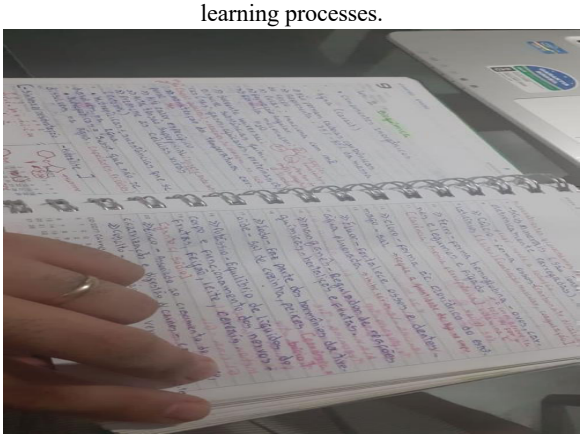


Figure 2 - Notebook used for documenting teaching and learning processes.



Source: The author (2022).

When preparing classes at home, teachers search on the web. These searches are performed weekly and, if necessary, daily. The most commonly searched items are exercises, videos, presentations, and content to be inserted into their lesson planning. For teachers, a few educational websites are references and provide those contents. Teachers search Google® for a specific subject. The search is continuous until they find satisfactory content. Therefore, the accumulation of searches allows the teacher to learn and improve a mental and individual system of searches for digital educational resources.

Searches present a degree of complexity. It is often necessary to search through different websites because teachers do not know specialized platforms that can be used as a reference for planning activities. In addition to the content, teachers look for resources that present reliability and quality. Reliability is related to the author of the content. If it is a recognized person, the decision-making for the resource selection is easy and fast. However, if it was created by a person he does not know, an alert is created, making the resource analysis more judicious.

Teachers use a quality filter for the process of searching and selecting educational resources. Furthermore, they customarily access YouTube® to view and learn from other teachers' shared experiences and practices (OLIVEIRA, 2016; NACAK; BAĞLAMA; DEMIR, 2020). From this self-directed learning experience, teachers incorporate and/or adapt to his planning everything that is considered pertinent and appropriate for their classroom context. Therefore, the search for resources could be facilitated through a specific filter system for the educational context. In addition, there could be elements that corroborate the quality of the digital resource and recognition of teachers who have their resources reused by other teachers.

When moments before going to class, teachers manipulate digital resources on their smartphones, they are used to consulting the digital books adopted in the classes. This usage complements the lesson planning activity, in the sense that it is a situational lesson planning practice. Despite not being a comfortable or desirable circumstance, they perform an action-reflection-action. They take a cursory look at the book's subject to recall the point where he or she left off in the last lesson. Sometimes, they take note of this point on paper or rely on working memory. In certain cases, teachers need to ask the students 'People, where did we stop in our last class?'. We can interpret those modes of registering as situated creative improvisations. The absence of even simple notes can be a source of stress and cognitive overload or frustrations. On the other hand, a simple and functional way to register and circumstantially recover this information can overcome or even avoid negative experiences.

The lack of time (SAAD, 2011), an unsuitable place to work and poor quality access to Internet are some reasons why teachers carry out their work activities at home. Amanda reported: "At home, I usually get a little better quality. First, I do it more calmly (at home) because here everything is very busy (at school). Secondly, here, for example, the Internet does not catch on. So, I have to use my Internet to be able to search on the Web. The Internet here sucks. And you can read more calmly with it, right? At home, I do a more elaborate job than here, since here it's very busy." Teachers in general receive low salaries. Thus, they are driven to have more than one job and increase the number of hours worked. They need to teach at more than one school and have other occupations, aiming to supplement their income (SCHMITT; VIEIRA; MARTINS, 2018). The links to various jobs increases administrative chores existing in the schools, among the other activities arising from the profession.

Teachers use WhatsApp as a channel to mediate knowledge and resource exchanges. It connects experienced to novice teachers. People mainly use WhatsApp only for communication. Due to the need and possibility of sharing documents and media, teachers improvise it as a platform for professional exchanges. Exchange of knowledge and resources occurs between teachers from different origins and levels of experience. José reports: "Oh! Yes, there is a way, we are math teachers like I said, we have the training, you know? Then we have a group on WhatsApp. This is the GRE Vale do Capibaribe. There is a WhatsApp group with almost all high school teachers from the GRE. There are frequent exchanges. There is a teacher mentor, right, who manages the group. But like this, there is always a teacher posting 'Look, such and such material', 'This issue here' (educational resource)". The whole group exchanges materials, websites, and 'interesting' works, and teachers continually learn from exchanged knowledge and reuse shared materials. Meanwhile, neither collaborative learning is structured, nor are the materials organized in a structured way.

Teacher Ana complements, "It's personal. Then, when we need to send it to another teacher, we use WhatsApp. Otherwise, I print and give them the content they want"; "It's more through WhatsApp © like... I was working on hormones once, and when I researched using the Internet, I found one [piece of material] that was very exciting, but it was all in English. When I took it, I had the idea to also work an English subject. Then I sent it to the English teacher, and we worked together. We set up a panel on hormones, and then all the information was presented

in English (...) then she worked with them in English and I worked the biology subject". Creative use of digital platforms allows coordinating new planning scenarios.

After exchanging resources, professionals use resources for different purposes. To complement, Francisco said: “So, then there is also an exchange of files exchange on WhatsApp with a group of teachers” The instant messaging software allows professionals to communicate effectively. WhatsApp fuzzily serves to mediate for personal and professional practices. Its good usability has led teachers to creatively appropriate it professionally. However, it is very complex to handle the complexity of communication channels, deal with urgencies, task prioritization, private communications, and manage materials for reuse using the same platform.

4.2 Improving Classes and Overcoming Challenges at School and Afterwards

As we have seen, the teacher's everyday life is filled with a plethora of personal and professional activities. In the middle of all these activities, he or she is faced with unforeseen moments, leading teachers to improvise or not complete the activities. All teachers want to give the best classes to their students. However, negative feelings and emotions (well-being) arise when facing reality, obstacles, and limitations to teaching and learning.

Amanda reports: “Today would be my time for planning. However, I have to teach chemistry, biology, and mathematics. That is, in practice, the time for planning doesn't exist.” These contingencies interfere with individual and/or collaborative practices. For this reason, it is frequently necessary to perform lesson planning at home, using their leisure time. Working at home struggles with time to rest, time to be with their families, or time for other personal duties. Besides, the teacher works overtime, for which he is not paid. As Francisco reports, lesson planning also occurs at the beginning of the class. He says, "it's less than an hour and I don't have time, so I'm running around, and I don't have time”.

In addition, Ana confirms "many things happen all at once." Combined with lack of time, work overload can decrease satisfaction with the balance between time spent at work and time spent on other aspects of life (FAGAN et al., 2012). The GRE is a sector associated with the Department of Education of the State of Pernambuco, Brazil, that promotes technical supervision, standardizing guidance, articulation, and integration. The performance of this administration sector aims to improve the quality of teaching; promote coordination and implementation of educational policy. Francisco evokes that "once a month, once or twice a month, we have training promoted by the GRE." This institution allows the meeting of groups and collaboration between teachers.

Nevertheless, the Regional Education Management (GRE) demands compete with class preparation and classes themselves. Luana reports: "So as we spend all day at school, we have these moments designated for studies. They are already allocated on the schedule. Ideally, we could plan at school, but we always bring work home, even if there are no conditions to do that. However, unfortunately, at some moments we still have to fill out the online academic system (SIEPE), for example, on the electronic notebook. And there are deadlines to fulfill. And we sometimes have to plan lessons, right? There are some official demands with deadlines (...) and then we are sometimes obliged, when there are deadlines, to plan at home." Considering the different commitments teachers experience, they must prioritize their schedules to keep tasks under control in their routines. The time to do the planning at school is seemingly almost always sacrificed.

Experience exchange and resource sharing took place during the meetings promoted by the GRE. Ana reports: “They are new models to dynamize or make games (in class), make a podcast, or record videos. In these meetings, we exchange information and ideas with other teachers. In this way, we keep up to date.” When re-enacting the planning practice, Ana mentioned

that “these here (games) I received from a colleague during a GRE training. (...) I found it interesting, and she passed it on to me. I talked about my experiences with her, and she reciprocated by sending me this game.” Face-to-face meetings naturally provoke collaboration, exchanges of experiences.

Insufficient physical infrastructure and inadequate equipment, as well as diverse requirements, are factors that limit the performance of teachers' work. Luana reports "If you are going to teach a class, maybe using images, for example, the ideal would be a classroom with a projector, with PowerPoint © and such. But, sometimes it's not possible [sic]. School doesn't have enough equipment, anyway (...) you know.

The equipment needs to be reserved in advance (...). So, these kinds of things end up weighing on planning. So, I can't say that I will be using a projector in all my classes. There is no way. So, it weighs heavily on the planning itself and the execution of the planning." And, "It's bad, it's bad! Because, at least for me, silence is important. Here (in the teachers' room) there are always people moving, it is abuzz. People come in, talk to you, then you lose focus. I prefer a quieter place."

Based on these circumstances, teachers are usually being creative to deal with contingencies. Creative improvisations involve experiences and knowledge acquired during professional development (HALETA; BALANUTSA, 2021). For Francisco also, "the school does not offer adequate space for you to be able to do activities. Many other people stay in the teachers' room, even if this room is for teachers. All the time, they (...) disturb our concentration. It also doesn't work well to work in the library. There will be someone studying there. There are places, but there is no access to a computer and the Internet. You must do the planning, conduct a quick search, and use personal resources at the school on a smartphone or computer." (See Figure 3 & Figure 4). It is not always possible to deal with the previously mentioned limitations. Thus, teachers need to deal with the desire to teach and produce better classes, and the feeling of frustration of not having been able to carry out plans according to the lesson plan (SKINNER; BEERS, 2016).

Besides, the preparation takes place in the classroom, and teachers use smartphones to search contents and lesson samples. There is a trick to using the smartphone in-class preparation. As Felipe states: "Even in the classroom, I frequently pick up my smartphone during class, take a look, choose an exercise and use it. I look at some… some details during the class. No, no embarrassment about using the smartphone, no embarrassment." It was incorporated into teachers' practices, from planning to teaching in the classroom.

The teacher researches and finds resources on the Internet through the smartphone. Urban violence influences smartphones over personal computer usage due to the home-school-home commuting, as reported by Felipe: "Everything is on my smartphone, I do not touch it (the textbook). I’d rather not lecture with a book in my hands. I developed an aversion to paper books. Smartphones and tablets are my things. I do not use a tablet here because I take many buses, and I prefer not to risk being mugged. But I have an iPad Mini at home." Teachers deal with difficulties like these daily.

Figure 3 - Laptop and notebook used for recording information at school.

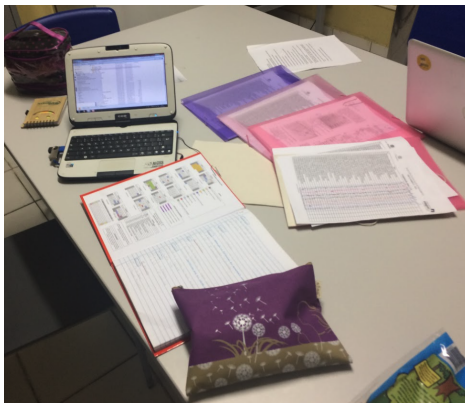


Figure 4 - Cabinet containing books, notebooks, and a stereo, arranged in the room.

Source: The author (2022).

In addition to the teaching responsibility, besides the school's physical infrastructure, there are also time limitations, audio and visual equipment unavailability, and the professional detachment of the teacher. PE6 reports that he has to carry out isolated activities in the classroom because there is no other teacher in the area to share practices and resources. He explains that: "we review, and planning is dynamic, right? Because you do the planning for one class. Each class is not similar to another. Moreover, unforeseen events also happen. For example, (...) suppose there is no water at school. That sometimes happens in the neighborhood here. Then we check it out. Then students cannot stay at school, in class. Then, I was supposed to teach [sic]... I did not teach, so I redid all the planning. Usually, planning is dynamic. There is one Physics teacher for the 2nd and 3rd year of the secondary level. So, I had to plan by myself". Such contingencies directly interfere in planning practice and teaching-learning. Unforeseeable frustrations are common in planning and teaching practice.

Collaborative lesson planning occurs when the teacher is not as isolated. Teachers carry out collaborative lesson planning. The purpose is to discuss and share ideas and knowledge (see Figure 5), as reported by Maria: "In this case, we are at the start. We sat down, and generated ideas, right, Luana? However, like this, we sat down to start a planning process. We see what would be necessary concerning the textbook's content, which we are browsing through now. We see, thus, what would be necessary. So, the textbook is a kind of guide. As this elective is a new thing, we are trying to put down something like this, still simple, which is the beginning. First, for us to see the meaning of what we want to do in this practice of Physical Education." When there are available times, resources, and interests, planning also occurs during the teachers' vacant hours or at a fixed time in their class schedule. They are not just writing down traditional lesson plans, but they are planning. Collaborative lesson planning is seen as desirable and dynamically performed, despite all constraints.

Students are active agents, and they can influence lesson planning. José reports: "Many times, there was even a student saying: 'teacher, look, see what I found; See what I learned there. It is really cool.' So, I say 'Okay! Let's show the other students how you do it and how you work it'. (...) It is notorious that some learn one way, the others learn differently, so I think it is very positive to make for a new way." From interactions with students and diagnoses made by teachers, it may be possible to plan classes for specific contexts and people.

Figure 5 - Teachers engaged in interdisciplinary collaborative lesson planning.

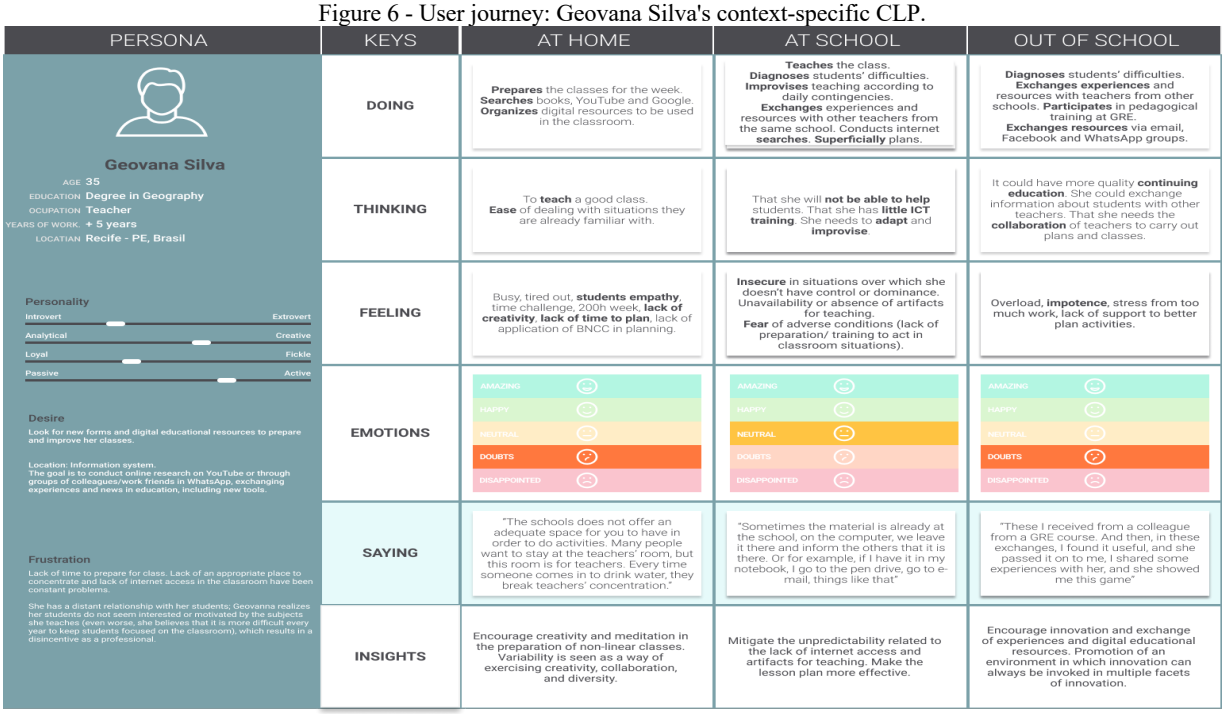
Source: The author (2022).

Teachers strive to offer the best teaching and learning possible. José had to teach a subject that he was not proficient with. Without the proper training, it happens that teachers accept such a challenge to teach the entire school year. He reported: “I'm not good with Physics. Last year I taught Physics for the first year. It was “Oh”. This year I teach the same group of students only Mathematics. I received some positive comments from them along the way. I was insecure. I even said to them, ‘Guys, I have difficulties in Physics. I'll be very honest with you, but I will do my best.’ So, they even recognized me, saying 'You are the teacher!'. This year I teach Math classes. Then they sent me very positive comments again: ‘Teacher, you are good at Math’. Sometimes, teachers need a ready-made plan to serve as a starting point for a challenging situation like this. A good teacher-student relationship can positively influence teacher motivation. In this case, good feedback can stimulate teachers to improve planning.

Teachers wish to exchange experiences and educational resources with peers. Amanda stated that planning together with colleagues would be ideal. Ana reported that she would be motivated to carry out CLP because it helps her to enrichen classes: "The experience was good, right? Because there was a lot of material available, right? I got examples of exercises, tests, and simulations from there, right? Moreover, they had updated video lessons, which we would then watch and add some information to my classes there, so it was very significant." The role of peers in a planning activity has specific mutual values. Collaborative lesson planning allows teachers to help and support each other in daily activities. Ones' teaching experience can be shared with colleagues, promoting community exchanges and knowledge construction (SCARDAMALIA; BEREITER, 1994).

In Figure 6, we synthesize the main findings on CLP activities described above. We could create a persona to represent typical participants (FERREIRA et al., 2015). The PERSONA is named Geovana Silva, 35, who graduated in Geography with over five years of experience. A client journey structure describes how teachers spread work between home, in school, and outside. It was also deployed using empathy chart dimensions (BLAND, 2012; FERREIRA; CONTE; BARBOSA, 2015) to illustrate what teachers do (DOING), think (THINKING), feel (FEELINGS), experience (EMOTIONS), say (SAYING) and perceive (INSIGHTS).

Figure 6 - User journey: Geovana Silva's context-specific CLP.



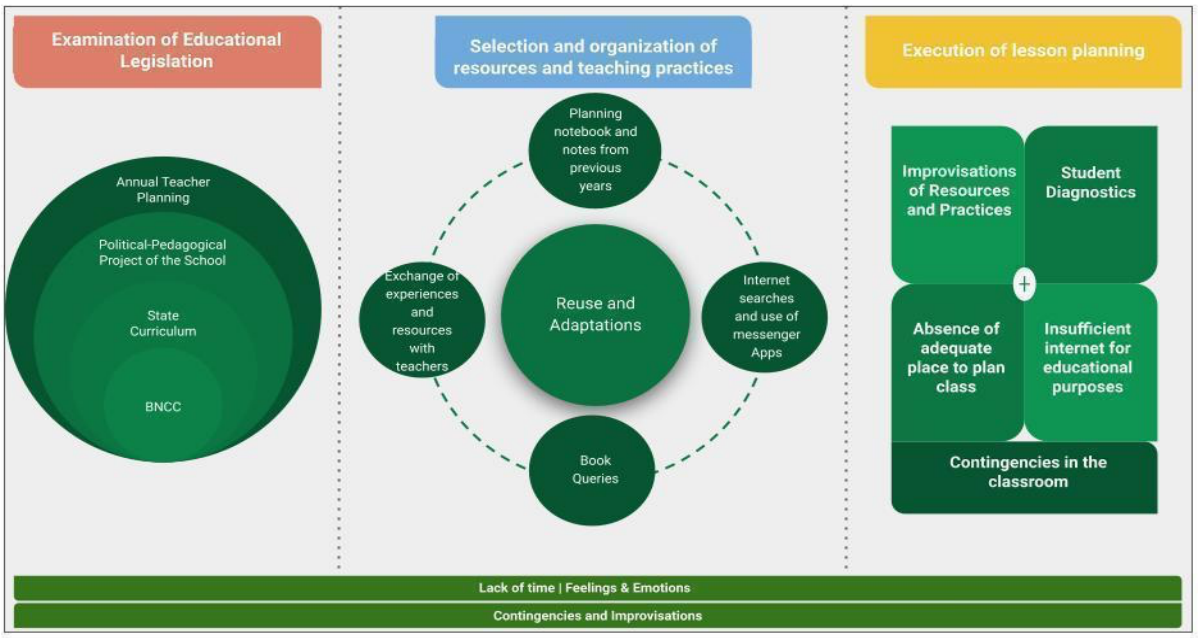
Source: The author (2022).

In a second effort to synthesize, in Figure 7, we present an illustration of CLP activities distributed over time: the Common National Curriculum Base (BNCC), educational legislations, documents, physical space, people, organizations, contingencies, improvisations, and well-being. Formally, planning practice is regulated and supervised and teachers are aware of that. In the column 'Examining Educational Legislation' of this figure, we schematize the intrinsic logic that teachers must follow to develop their planning in accordance with national (BNCC) and State official documents. The BNCC is a normative document for the school system. It is a mandatory reference for school curricula elaboration. One finds the objects of knowledge (content) and the skills students are supposed to develop. Teachers find pedagogical proposals for their teaching according to the level of education in which they work. The state Curriculum extends the national one, integrating the State Educational Systems' particularities.

In the same logic, every local school must produce its own Political-Pedagogical Project (PPP) document, contemplating both national and state guidelines and incorporating regional and local cultural practices and nuances. Teachers should develop their annual teaching plan based on PPP at the beginning of the school year. The teacher seeks to externalize learning expectations consecutive to the annual teaching cycle. He or she prescribes which methods can be used to obtain the expected results. Personal planning must consider the goals and objectives of the school in order to guide the achievement of the expected results. Teachers continually realize short-term lesson planning throughout the year according to the circumstances (SILVA, 2020).

The teachers' practices of 'selection and organization of resources and teaching' encompasses orchestrating the availability of artifacts and situational conditions. The reuse and adaptation of teaching materials are standard practices among teachers. The reuse of a resource is guided by the teacher's need.

Figure 7 - Improvised collaborative lesson planning activities.



Source: The author (2022).

According to the planned circumstance, the teachers adapt resources and present them coherently to the immediate reality. Practices are carried out. Teachers use applications connected to the Internet, search and exchange resources, share knowledge and guidance on teaching.

Practices are adapted to the class in which they will be performed. The teacher uses the textbook as a guide resource (GAK, 2011; KNIGHT, 2015), an artifact considered reliable. Teachers trust textbooks as a reference to plan with. They consult specific subjects to be addressed. Following the initial planning, teaching takes place in the chaotic environment of the school. Multiple activities intertwine.

Many contingencies arise from the inadequate physical structure, individual students' needs and lack of availability of educational artifacts. Those events alter teachers' planning. Teachers experience isolation because of these circumstances. In the next section, we discuss how collaborative practices are limited due to those contingencies. We advocate how those digital technologies can be rethought to promote better possible digital futures for CLP.

5 Discussion

In the last section, we tried to depict CLP as a collective and distributed activity, a situated action-reflection-action collaborative practice. Collaborative lesson planning is distributed among environments and shared artifacts. It contributes to the professional development of educators and students and improves interpersonal relationships between them. Collaborative lesson planning is paramount for effective and quality teaching-learning. Teachers do not have enough time, support, or adequate guidance for class building. The time and space boundaries of these practices are fuzzy. The teacher's experience includes undesirable contingencies, frustrations, and creative improvisations when carrying out the CLP.

Due to constant unpredictability, they frequently fail to attain the planned learning experience. Effective collaboration is unstructured and non-sequential. They seem to continually need inspiration for creativity and innovation. After discussing the themes that synthesize

collaborative lesson planning, we reflect upon the implications of the results for the recommendations design of collaborative lesson planning systems.

5.1 Action-reflection-action Practices

According to Konno, Higuchi & Mitsuishi (2009), action-reflection is a practical approach to improving teaching skills and lesson plans. Teachers' reflection allows tacit, professional, and collective knowledge building. It directly impacts current teaching-learning practice and guides future lesson planning. Action-reflection allows teachers to appropriate pragmatic and scientific knowledge.

As described in the literature review and corroborated in our results, teachers deal with constant contingencies and improvisations. Therefore, the scenarios at school influence how teachers dedicate themselves to reflecting on some subject. Students' develop as a consequence of the interaction between them and the teacher; and more broadly, between the school institution and society (ALARCÃO, 2005). With lack of time and workload, teachers prioritize activities that impact actions in the present. When reflection-action is carried out at home and in reasonable time, teachers plan and collaborate closer to their desired goals.

Action-reflection-action practices lead to the need for recording or taking notes so that there is articulation between experiences and available time, to plan in the present or anticipate future experiences (PETKO et al., 2019). This practice is not limited to reflecting on present class performance, but allows for reflection on action and reflection in action to fuse the temporality of the planning-acting activities. Taking notes seems to support and contribute seamlessly to the teachers' professional development. They contribute with the designs of possible new learning experiences.

Matured professionals take notes to register and support reflections on planning. Practices' completeness and quality are progressively less considered. Records are more and more 'registered' in their own memories. Carmo (2015) identifies that memory can act as revisiting voluntarily and involuntarily. This process requires the direct involvement of teachers. The remembrance process proves to be important for the present and future performance. Planning occurs correctly when thoroughly and explicitly detailed. The teacher feels better and the teaching corresponds to what was planned.

Be they aware of it or not, teachers mobilize a design mindset. Over time, several experiences impulse learning and reflection on action. Based on his or her own experiences, the teacher designs lesson plans (LEVIN; ROCK, 2003; BAHNG; LEE, 2017). Previous experience is recalled in the present when preparing lessons.

5.2 Constant Unpredictability, Contingencies, and Creative Improvisations

Teachers aspire to and know that CLP practices can contribute to their teaching development (XIAOFENG; QI; LING, 2015). Meanwhile, the evidence reveals that making in-school CLP is challenging, complex, and makes serious collaboration with other teachers outside the school difficult. Teachers are used to handling constraints and frustrations, creating situated improvisation strategies in the ongoing activities. In this section, we tried to bring together some examples of how they overcame adverse situations and inadequate conditions.

Notably, frustration is constant among the interviewed teachers (DIEHL; MARIN, 2016). The lack of time to carry out their activities provokes frustration because they cannot perform the planned classes and guarantee the desired quality. They wish to perform high-quality teaching-learning experiences. Meanwhile, they face numerous barriers to their professional practices.

How can teachers overcome all constraints and perform a quality learning experience? Teachers usually try, but they constantly become frustrated. Overall, students' educational performance is objective evidence that achieving the expected educational impact is difficult. The dynamics between well-intended attempts and becoming frustrated can enter an iterative cycle. Teachers continue trying to perform acceptable practices, creatively balancing their frustration with experience generated in previous years. This evidence is a relevant aspect to be considered when designing individual or collective digital support, as we will consider in a later section.

Participating teachers have declared that CLP makes their teaching-learning preparation more prosperous and efficient. This corroborates with what we have stated above: that collaborative class preparation is a collective action-reflection-action feat distributed among people and environments (VANGRIEKEN et al., 2015).

The connections are initiated during the regional administrative office (GRE) institutional and educational meetings. Those events boost collaboration, since teachers use the occasion to exchange experiences and tools with peers. After each meeting, those exchanges of experience continue through information systems, such as Facebook ® and WhatsApp ®. In addition, digital platforms mediate communication and digital media sharing.

Collaboration is essential for professionals. It allows for expertise and successful practices in exchanging and learning. It can trigger the development of new teaching-learning approaches. Continuous participation in teaching practice communities raises teachers' well-being, security among peers, work satisfaction, and feelings of accomplishment concerning the preparation of classes and before carrying out teaching (HAKAMI; HERNANDEZ-LEO, 2021).

Lack of time causes teacher isolation. Teachers do not have enough time to communicate and exchange experiences with colleagues. Teachers' time is dedicated to teaching classes, creating activities, or reusing other teachers' educational resources. The activities are frequently performed in a limited time slot. Quite often, there are no free or flexible moments for carrying out an innovative activity, perhaps in the form of a fun exercise, requiring time and creativity to plan. So, lack of time is a significant cause of dissatisfaction and frustration for the teacher.

Teachers' collaborative practice follows a particular routine. It is used to being supported by digital platforms to exchange resources and build knowledge. This type of practice does not follow any fixed process. All teachers are used to experiencing moments of creativity when preparing their classes, but mainly while teaching classes. We observed the significant impact of constant lack of time related to lesson preparation. This factor leads teachers to improvised actions, such as adaptive reuse and the use of digital media. Teachers improvise when no devices connected to the Internet are available at school.

In spite of institutions' having a role in maintaining educational systems, teachers do not fill in forms based upon formal lesson plans in those systems (at least not hastily) because they do not have enough time. They use the official electronic system as much as possible. They fill out the forms, but there is no reflection on the activity performed, carried out instinctively.

Teachers use many devices and design others. The computer is a fundamental instrument in the lesson planning activity and is used for the school's collective use. At the same time, digital educational resources are stored on the computer or flash drive. These resources are organized into folders divided into subfolders and school years, and the teacher's classes. In each class, the teacher accesses the files. Sometimes, it is necessary to plan the lesson on the personal computer at their home.

Even though there are technological resources on the computer, the teacher does not give up on their physical notebook, handouts, printed-out attendance role, and even the year calendar, printed out and pasted on the cover of the notebook with important dates. The usage of a physical

organizer is crucial in lesson planning activities. The cabinet in the teachers' room is a unique place where books, notebooks, paper drafts, audio equipment, and a projector are kept. In addition, the physical space is shared with other educators at the school.

The teacher enters lesson planning in the Education Department of the State of Pernambuco's Information System (SIEPE) (https://www.siepe.educacao.pe.gov.br/). On the web-based platform, information about the classes carried out is inserted. The teacher also uses the smartphone as an instrument for teaching practice.

Teachers use the textbook as a guide for their lesson planning activities. Additionally, the teacher seeks to carry out collaborative planning, but it is necessary to improvise on interactions with other teachers due to the lack of time. Teachers store information in their memory, even though they consider it non-reliable. In general, teachers do not have the technological skills to create more complex registrations in digital format.

Additionally, relationships with other people influence their activities (CHARTERIS et al., 2021). Manifestations by other teachers, principals, school staff, mothers, fathers, or guardians of students, and other factors in the school's social context, further increase the teachers' responsibility to carry out the preparation of efficient classes.

Teachers deal with unpredictability in their daily routine. How can they transcend in situ, dynamic, and unpredictable contingencies in professional situations? To deal with unpredictability, they must have the ability to confront complex events. Therefore, the complexity involved in the socially and historically established circumstances, including subjective and sensorial aspects, must be considered in the design process (PINK, 2015).

Unpredictability is an essential condition of the complexity of collective lesson planning practices. It is distributed among people, spread over time, and arbitrated by multiple artifacts. In this sense, it should be understood as a sequence of non-linear sequences of hybrid events that require action-reflection-action.

Temporality: past forwards the future. How does one anticipate the way students receive further teaching? The teachers challenge themselves to predict the near future in order to anticipate teaching-learning, including possible contingencies (PINK et al., 2017). The prediction may or may not be confirmed, requiring adaptation, improvisation, and emotional control (EVEN, 2020; WIERCINSKI, 2020). It is not possible to foretell how the student and the teacher arrive at school. All are constantly changing, immersed, and subjected to random and non-linear events (FAUCON et al.,2020). They strive to deal with feelings and emotions. Teachers need to manage alternative strategies, curated materials, digital educational resources, and teaching instruments based on these.

In consideration of design recommendations, we can imagine requirements to (i) deal with unknown events, (ii) relate to feelings and emotions, (iii) relate to digital technologies, and (iv) the school environment.

Temporality: the contingencies that present themselves and the improvisations. The unpredictability of the unknown leads to numerous contingencies during the execution of teaching activities. However, predicting or trying to anticipate an action is a challenge, which can be simple but is often complex at school. The multiple nuances and pace of events generate the unknown, in which the teacher tries to understand and act while there is time. When he arrives in the classroom, his beliefs and plans are tested. Currently, teachers improvise while teaching in the classroom.

According to the conditions of activities, postural reactions, and reasoning, the unpredictability of feelings and emotions eventually arises. "More thoughtful reactions characterize feelings; therefore less instinctive, emotional reactions are of the occasional,

instantaneous and direct type" (ALMEIDA, 2001, p. 52). How can a teacher diagnose a student, when the interpretation occurs alongside almost four hundred other students? The teacher faces waves of students' feelings and emotions. Therefore, the teachers need to register, organize, and visualize the student data.

The school is in an environment full of unforeseen events, such as unavailability of the Internet, sudden preparation to replace an absent teacher, or even the unavailability of digital educational resources, generating unpredictability in digital technology.

5.3 Unstructured and Non-sequential Collaboration

When there is an opportunity for collaboration, staff interact with other teachers and recognize the practical value of professional development. Even though experiences are circumstantial and individualized for teachers, digital platforms allow mediation in synchronous and asynchronous communication, organization, and the reuse of media used in sharing.

Teachers have the professional capacity to deal with unstructured and non-sequential collaborations. Collaboration occurs when two or more teachers work independently or together to share information and knowledge, plan and solve problems, and improve the educational process and results (OECD, 2009).

Teachers cooperate in formal and informal ways, including team teaching, peer observation, coaching, general collaborative research, team planning, and joint activities between classes (TICHENOR; TICHENOR, 2019). We noted that participation in unstructured and non-hierarchical collaboration during work situations could be fundamental. Collaborations promote exchanges and learning. When collaboration is direct, straightforward, and non-sequential, interaction is possible. In those situations, engagement is more productive, and there is tolerance for unexpected events.

In addition, the collaboration between teachers should enable young and experienced professionals to learn from each other. There is latent intergenerational knowledge among teachers. Moreover, respectable exchanges can take place between veterans and beginners. It can be highlighted that professional development is based on trustworthy relationships among peers. However, the time spent at school is insufficient to carry out teaching work. It is common to cooperate during class breaks.

The state-of-the-art literature on CLP activity is valid, though some gaps exist to guide the process of the collaborative platforms' project. (VANGRIEKEN et al., 2015; DUFFY; GALLAGHER, 2017; CHARALAMBOUS et al., 2021; GARCÍA-MARTÍNEZ et al., 2021). Cooperation can promote collaborative creativity with other teachers; and multiple experiences and inclinations for different themes. Groupware platforms are alternatives to support group collaborations. They promote peer co-creativity, exchange, and digital educational resources (PIMENTEL; FUKS, 2011). We do not find satisfactory evidence to conclude that groupware supports unpredictability. Experience, with the time available, encourages creativity, innovation, and non-sequential collaborations. Furthermore, students participate in the preparation process. Therefore, it is an opportunity associated with unstructured and non-hierarchical collaboration.

5.4 Seeking Inspiration for Creativity and Innovation

Teachers search for inspiration to promote creativity and innovation (LIU; LU; YIN, 2022). Contemporary professional demands require teachers to improve traditional teaching methods and employ innovative teaching practices (SONIA et al., 2017). Teachers can design creative and innovative solutions. Those are essential skills in complex environments and with scarce resources.

Therefore, how do we innovate in the process of lesson planning? The most common lesson plan model adopted by teachers and curriculum consultants was proposed in the middle of the last century by Ralph Tyler (1949); the model is still used today, with minor changes. It is noteworthy that the static model has become more of a bureaucratic element than an effective educational tool in lesson planning. Furthermore, this same model disregards reality and context, based on formalist and technocratic planning in the educational field (NUNES, 2015).

Variability is seen to exercise creativity, collaboration, and diversity (CRAFT, 2003). Individual creativity can be stimulated by an external agent, a human, or a system. Artificial systems can display content and data to inspire teachers, generate positive results, and allow their professional and, consequently, their students' growth.

Teachers are creative and improvise. Innovation can be generated by incentives. Recently, DICTs have been adopted at the global level in the most diverse areas of education. As a result, educational materials are transformed in the same way that didactic adoption can be planned, developed, distributed, and evaluated (BLASCHKE; HASE, 2016; BALAKRISHNAN et al., 2016).

Educators require further resources and information to expand and develop their knowledge (CALDWELL, 2018; ELLIS et al., 2019). Encouraging innovation can occur by triggering or awakening innovation triggers and insights. Providing suggestions and recommendations based on teachers' experiences can be helpful to make desirable, though unexpected, planning decisions. In this sense, innovation and creativity can be promoted to deal with the complexity of teachers' hurdles by advocating formats that supplant traditional teaching practices, involving students and teachers within the same classroom and with the classic teaching materials (BALAKRISHNAN et al., 2016).

5.5 Reflections for Further Design of Collaborative Lesson Planning Systems

Based on the evidence discussed above, we can reflect on how to design systems to support CLP. Furthermore, we can reflect on the design process itself in a way that can lead to meaningful systems for the participants in their respective contexts.

During the design process, designers must consider how activities occur and how a possible new digital system might make sense for teachers, given the complex circumstances in which individual and collaborative planning occur. As an example, based on the themes discussed in the preceding sections, we could say that a future artifact must meet the challenges of dealing with constant unpredictability, helping teachers manage experiences and entrepreneurial time, supporting unstructured and non-sequential collaborations and inspiring teachers' creativity and innovation capabilities.

Recommendations for Constant Unpredictability indicate that an information system should support teachers in anticipating teaching situations. This functionality of a system can be materialized through questions that provoke reflection or action to anticipate possible unforeseen situations. Interaction styles are needed that support lesson planning in the midst of contingencies that the teacher did not anticipate. From this recommendation, we can imagine requirements to deal with unknown events to be welcomed in situations involving isolation, depending on receptivity among teachers. Such issues could be mitigated by designing unexpected solutions based on making sense of improvisations. It is necessary to design based on the creative solutions of the teachers.

When we anticipate that 'Action-reflection-action practices' is a design recommendation, we anticipate that a collaborative planning support system should allow the capture of experiences lived over the teaching period. This capture can allow and support teachers in activities that involve action-reflection, information recording, and organization of digital educational

resources, working memories, support in generating ideas and transforming them into actions. In addition, it must allow the insertion of what can be done in the future.

Possible collaborative systems to support these activities must present, provide or suggest content and data that inspire teachers in activities for teaching. These recommendations are related to 'Seeking inspiration for creativity and innovation.' As a result of this functionality, one could allow teachers to generate positive results, allow for their professional growth, and consequently, the growth of their students. Personalization can be allowed, as it is a motivating element of pedagogical practice. Innovation can be promoted to enable teaching-learning relationships and interpersonal communication.

We envision that a collaborative system can allow for unstructured, non-hierarchical collaboration. We call this recommendation 'unstructured and non-sequential collaboration'. This recommendation can support the dynamism of collaboration between teachers, including unpredictability, experiences, and time management, encouraging creativity and innovation. The hypothesis is that cooperation can promote collaborative creativity, promoted by multiple experiences and inclinations towards different themes. It is unstructured because the traditional plan does not meet the needs of the school context that teachers face. Non-sequential collaboration exists so that planning can be carried out according to the needs presented, synchronously and asynchronously, between teachers from different contexts, in teaching time, and in different formats of educational resources.

Thus, reviewing, reflecting, and learning from experiences can be challenging when professionals are faced with a lack of time, a consequence of the workload and concomitant professional activities. Thus, collaborative lesson planning systems can support them, capturing grades and elements of teachers' experience over time. In doing so, digital systems can support the collection of notes, records, and resources such as memories, ideas, photos, sound recordings, and summaries of practices for further reflection and learning.

Digital systems can support teachers in time management, promoting collaborative work, co-creation, and mutual support. Ultimately, planning takes place in teachers' spare moments during the day. However, as already mentioned, unforeseen events are frequent. Thus, contingencies are designed to overcome all these unstructured and non-sequential events.

Thus, digital systems can support innovation and inspire teachers' creativity. To act beyond the traditional lesson planning model, they can complement local models with variability and adaptation. Personalization can be allowed because it is a motivating element of pedagogical practice. However, innovation must be promoted to impact the physical and digital structure, teaching-learning relationships, and interpersonal communication.

As the study contributes to the CLP literature, we need to consider the constant changes in the world (PINK, AKAMA, & SUMARTOJO, 2018), which impact teaching-learning, people's relationships, and the use of technologies. Therefore, collaborative systems design recommendations can play a role as possibilities for designing solutions for uncertain and situated contexts.

6 Conclusions

In this study, we seek to build knowledge about the phenomenon of collaborative lesson planning carried out by basic education teachers. We take a situated design approach to understand and describe the meanings of practices and technologies adopted in collaborative lesson planning practices.

The study contributes to the literature with the description and definition of collaborative lesson planning. Our interpretations allowed us to identify contingencies and consecutive creative improvisations in essential activities.

The evidence concludes that collaborative lesson planning occurs in three physical locations: at each teacher's home, school, and out of school. Teachers choose to plan at home. After all, they perceive they are more efficient when the preparation takes place in the home environment because they consider that they can remain more concentrated at home, as the environment is quiet. It has access to the Internet, making it possible to carry out content and media research, exchange experiences, and organize educational materials.

At school, teachers carry out collaborative planning activities. However, the planning is carried out quickly and superficially in this place. The reasons are related to lack of time for planning. This lack of time to collaborate in the workplace creates a feeling of isolation even when surrounded by colleagues.

Teachers creatively overcome the contingencies of lack of time and inadequate infrastructure and create improvisations. The interpretations of these improvisations allow us to speculate on design recommendations from eventual collaboration platforms. Hence, as one of the results, we defined groupware design recommendations according to the four themes applicable in collaborative systems or possible arrangements of mediators for lesson planning. They are Action-reflection-action practices; Constant unpredictability, contingencies and creative improvisations; Unstructured and non-sequential collaboration; and Seeking inspiration for creativity and innovation.

Design recommendations are advanced in understanding essential aspects of how Basic Education teachers carry out collaborative lesson planning. We highlight some limitations in this study. First, the limits are placed on the sample composed of teachers from a single state of the Brazilian federation.

As future work, the study can be used as a foundation to conduct a new literature review to identify relevant and updated contributions that contextualize the identified issue and promote new recommendations for collaborative lesson planning (CLP) for teachers through the use of emerging technologies, including collaborative systems, cloud storage platforms, and Generative Artificial Intelligence platforms, among others. Furthermore, it is important to propose guidelines for the design of new platforms based on the identified needs. It will also be valuable in future studies to consider teachers who teach classes at other educational levels and work in different regions of the country.

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