Describing and Understanding Changes in Learning Practices During a COVID-19 Lockdown

Bernadette Charlier[1], Joris Felder[1], Laura Molteni[1] & Katharina Baran[1]

Abstract

This chapter presents the results of exploratory qualitative research (n = 19) exploring the transformations of learning practices as experienced by learners at each level of education, from primary to university, during the first lockdown due to COVID-19 in canton Fribourg in Switzerland. The concept of a personal learning environment underpins the theoretical approach used to describe learning practices. These practices are depicted with theoretically based categories describing the learning practice and representing it visually as a system. This method makes it possible to compare the practices of different learners or those of the same learner over time. The transformations described in this way are related to teachers' changes in the design of the learning environment and learners' perceptions of these changes. Beyond the diversity of learning practices, research results highlight how a rapid transition from one learning environment to another may be either a risk leading to the deterioration of learning practices or an opportunity to develop new learning practices and projects, depending on students' self-regulation. In conclusion, the contributions of this research in terms of methodology will be presented, making visible and understanding the transformations of learning practices and avenues to support the management of transitions in learning environments.

Keywords

Transitions, Personal learning Environment (PLE), Distance learning, COVID-19, Learning practice

1 University of Fribourg, Higher Education Center, Fribourg, Switzerland

Corresponding author: Bernadette Charlier (bernadette.charlier@unifr.ch)

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1 Introduction

This book examines the effects of the abrupt shift to distance learning around the world with the emergence of the COVID-19 pandemic. This involved having each learner continue to learn and participate in courses from home with learning resources that were, if not limited, at least transformed. In this context, describing and understanding the changes in learners' learning practices seems essential. What were the changes experienced by primary, secondary and university students and how can these changes be understood? What are the needs that emerge from these analyses? What are the avenues of research?

During the urgency of the crisis, the need to describe and understand what was happening motivated our research team to explore this phenomenon in the context of their particular region. Beyond the interest in this event, understanding the effects of transitions to new learning environments is a particularly relevant research topic in a world of constant change. Every learner will, in the course of his or her life, have the opportunity to experience such transitions by moving from one school level to another, by being confronted with innovative learning environments, or by developing lifelong learning activities.

Adopting the point of view of the learners, each level of education, from primary to university, was taken into account, with 4 to 5 students per level, in canton Fribourg in Switzerland during the first lockdown from March 2020 to June 2020. In that region, schools were suddenly closed, forcing teachers to reinvent their teaching environment in a hurry to ensure a certain school continuity. At that time, schools, teachers, and learners had generally no experience with distance education, except some practice with hybrid teaching at the university. The major part of the educational environment and resources was physical and rarely mediatised (supported by the uses of media), except to some extent at the university level. Furthermore, on the digital level, the policy was to equip schools rather than learners (no Bring Your Own Device) and school use of social networks was prohibited.

The theoretical framework provides the background needed to highlight the originality of this research in relation to recent work undertaken during the pandemic, to adopt a relevant approach to describe learning practices, to categorize the changes and to understand them in relation to the transformations observed with the move to home-based learning. It also defines the central concepts involved in this research: transition, learning practices, personal learning environment (PLE) and learning design.

The modelling of personal learning environments with the MEPA method, previously presented in an article (Felder, Molteni, Baran & Charlier, 2021) illustrating its use with a single case, shows that this method make it possible to achieve the main research objec-

tives – describe the learning practices and understand the transformations that occurred during the first lockdown.

This chapter presents all of the research results, beginning with analysis of two cases. The results observed at the four levels of education – primary, secondary I, secondary II and higher education – are then presented, compared and discussed. Finally, the conclusions come back to our research questions and open up perspectives for research and supportive practices for learners and teacher training.

2 Theoretical Framework

2.1 Effects on Learning of the Unanticipated Transition to Distance Learning

The concept of transition, which has been recognised to be vague and diversely defined (De Clercq, 2017), has been applied in the field of education in particular to understand the effects of moving from one school level to another, such as from secondary school to university (Coertjens et al., 2017). Based on the literature review by Kovač (2015), De Clercq proposed the following definition of transition: "A period of instability and rupture determined in time which will lead to a qualitative evolution of the person in his or her knowledge, skills, identity, roles and daily functioning" (p. 83). It is therefore a sensitive timeframe, during which changes in the individual can occur at different levels: cognitive, affective, epistemic, relational. We should add, with Nancy Schlossberg (1981), the need to distinguish between anticipated transitions (such as entering university), non-anticipated transitions (such as the abrupt transition to distance education during the COVID-19 pandemic) and non-events (such as expecting a change and not experiencing it). However, studies on the effects of the transition to a new learning environment are rare. Recently, De Clercq et al. (2021) considered the impact of the perception of the new learning environment for students entering the university before the COVID-19 crisis on the student's success in higher education. They highlighted the significant impact of the perception of the learning environment as focused on mastery learning goals as well as the validity of the systemic perspective considering the complex relationship between psychological factors, contextual factors and the student's perception (Bronfenbrenner, 1992).

Regarding recent research conducted during the COVID-19 crisis and thus the effects of an unanticipated transition, peer-reviewed articles have mainly reported quantitative research reporting on higher education students' satisfaction (Beltekin et al., 2020), or more complex analysis of the determinants of their satisfaction and perceived learning outcomes (Baber, 2020). In this perspective, the quantitative study by Besser et al. (2020), which was interested in characterising the adaptability of college students in Israel to their new online environment, investigated the students' perception of changes in their learning practices in terms of stress, loneliness, positive or negative mood, learning, moti-

vation, performance and reliability experiences, mattering and belongingness. The results clearly showed negative impacts, with emphasis on the predictive effect of adaptability associated with personality factors. However, transformations in students' learning practices have not been precisely characterised or explored in relation to a more detailed analysis of the learning environments offered and their perception by students.

Moreover, the little work that has been done on this issue has mainly focused on students in higher education. The mixed-method study by Zuo et al. (2021) represented a significant exception, as it analysed the learning experience of Chinese primary to secondary school students during the school at-home period beginning in mid-February 2020. The authors used the concept of online learning pattern to describe the practice of online learning at the classroom level (taking into account the average length of on-line classes, the devices used, the frequency of the type of on-line interactions and the frequency of the type of learning activities). This approach allowed them to differentiate between the practices experienced according to the school level and the rural or urban context. This comprehensive research did not, however, address in detail the transformations in individual students' learning practices. The recent review of the literature on home-based learning for K-12 learners by Wen et al. (2021) showed that there is a need for research on this topic at this level of education, including the role of parents and the design of digital learning resources.

2.2 Describing Changes in Learning Practices

Goodyear (2020), citing Kemmis et al. (2014), defined a practice as a form of human activity for which the individuals and the objects employed are distributed in characteristic arrangements in a particular project (p. 4). The project of the activity (what one wants to do), its pattern (how one does it and with which tools), its performance (the doing of it at a given moment and the evolution of this practice) and its architecture (the arrangement of the project, pattern and performance discourse) characterise a practice (p. 5). Moreover, this approach is consistent with a representation of the learning activity as not totally determined by the individual or by the environment, but constructed in the interaction between the individual and the environment. As Goodyear demonstrated the theoretical and empirical validity of this approach for describing and capturing continuity and changes in students' activity of designing learning spaces, it seems well suited to describe the components of learner learning activity and its changes at the time of lockdown, during which learners had to reconfigure their own learning spaces. This approach can be operationalised by making use of research on personal learning environments (PLE) and their design by learners.

From a subjective perspective (Henri, 2014), a PLE is conceptualised as the learner's individual representation of a learning project and of the set of learning instruments employed to achieve it (Väljataga & Laanpere, 2010). In line with this conception of a PLE,

adoption of Rabardel's (1995) instrumental perspective (Fluckiger, 2014; Roland & Talbot, 2014) enabled the analysis of patterns of use of digital or non-digital tools and resources (technical artefacts) constituting students' learning instruments, as well as their organisation into a system of instruments. In order to grasp the learning activity beyond this technological vision, Felder (2019a, 2019b) integrated the epistemic (didactical artefact: knowledge and skills), cognitive (pedagogical artefact: cognitive and metacognitive strategies) and social (social artefact: individuals, rules and values) dimensions into the concept of a PLE. A PLE thus illustrates learning practices according to the approach proposed by Goodyear (2020). Using the MEPA method to describe learning practices enables the highlighting of their structures as well as their changes in relation to the changes of teaching and learning environments. In the field of educational technology, modelling techniques have been used in pedagogical engineering (Paquette, 2005), to study and design PLEs (Trestini, 2016), and more recently to analyse PLEs as an indicator of learning practices (Felder et al., 2021). As the method of modelling PLEs (Felder, 2019b) is central to our study, we present it and define the notions on which it is based in the section dedicated to the method used in this research.

In addition, a state-of-the-art paper (Vermunt & Donche, 2017) focusing on research carried out between 2004 and 2016 made it possible to characterise the transformations of learning practices when the learner is confronted with a new environment, for example, in the passage to a new level of study or the progressive or brutal confrontation with an innovative learning environment. The authors spoke of congruence or friction. The occurrence of congruence or friction was associated by Vermunt and Verloop (1999) with the compatibility of the extent of the teacher's external regulation of learning with the learner's self-regulation. The authors distinguished between constructive and destructive friction. Constructive friction represents a challenge for the learner, who develops new skills, strategies and tools for learning. In contrast, destructive friction leads to a reduction in learning skills or a failure to use strategies or tools. Abrupt transitions to a new learning environment have been associated with destructive friction (Baeten et al., 2014, quoted by Vermunt & Donche, 2017).

2.3 Situating Changes in Learning Practices in Relation to the Transformation of the Learning Environment and its Students' Representations

Entwistle (2018) provided a good overview of the research findings demonstrating the relationship between students' learning experiences and characteristics of the learning environments designed by their teachers. However, we still lack an evidence-based framework for the conception of teaching and learning environments, learning designs (Boud & Prosser, 2002) or pedagogical patterns (Laurillard, 2013) or systems of methods (Reigeluth & Carr-Chellman, 2009) that could lead to a better learning experience, that is, be congruent or lead to constructive friction, according to the learners' characteristics.

The recent literature review by Bower and Vlachopoulos (2018) on "technology-enhanced learning design showed that only one of the 21 models analysed was developed on the basis of empirical research" (p. 991).

For this research, we rely on the HY-SUP typology developed by the European project HY-SUP, which is one of the few typologies based on empirical results, and which has been used to study the relationship between types of environments and their effects on learning as perceived by students and teachers. This typology describes 6 types of hybrid teaching and learning environments. Within the theoretical framework for HY-SUP research (Deschryver & Charlier, 2014), hybrid teaching–learning environments are defined as follows:

> A hybrid teaching and learning environment is characterised by the presence in the environment of innovative dimensions linked to distance learning. The hybrid teaching and learning environment, because it involves the use of a techno-pedagogical environment, relies on complex forms of mediatisation and mediation. (Charlier et al., 2006, p. 37)

The 5 innovative dimensions representing the pedagogical pattern or learning design of a hybrid teaching and learning environment in this definition are: 1. presence-distance articulation, 2. human accompaniment, 3. openness, 4. forms of mediatisation, and 5. forms of mediation. Using these dimensions, mixed-method research studying about 200 higher education hybrid teaching and learning environments distinguished 6 types or learning designs of hybrid environments:

- The scene (type 1) – focused on teaching and characterised by the mediatisation of textual resources;
- The screen (type 2) – focused on teaching and content-oriented, characterised by the mediatisation of learning resources;
- The lodge (type 3) – focused on teaching, characterised by the integration of resources and experts from outside the academic world;
- The crew (type 4) – focused on learning, characterised by the support of the knowledge-building process and interpersonal interaction;
- The metro (type 5) – learning-centred, characterised by openness, freedom of choice and support for learning;
- The ecosystem (type 6) – learning-centred, characterised by the exploitation of a large number of technological and pedagogical possibilities offered by hybrid learning environments.

Research has shown that the learning-centred types were perceived by students as having greater effect on learning. The HY-SUP research showed that 70% of students did not recognise the type of environment as described by their teachers, their different representations being associated with their approaches to learning. When students recognised a learning-centred type of environment, they perceived greater effects on their learning. This mediating effect of students' representations of the learning design of the learning environments being offered has been demonstrated in subsequent research (Charlier et al., 2021).

In this research, the typology developed for the HY-SUP research is used to describe and characterise the teaching and learning environments and their changes due to the distance learning situation. When the information was available, the teacher's representation was compared with that of the student.

3 Research Questions

In order to understand the changes in learners' learning practices at the time of the abrupt transition to distance learning, a detailed description of their learning practice before the lockdown and during the lockdown appears necessary, in order to support a comparison and to go beyond satisfaction questionnaires. The concept of PLE allows us to approach a practice as Goodyear proposed, that is, as a human activity in which the individual and objects are distributed in characteristic arrangements. It is changes in these arrangements that can be firstly identified. Secondly, in order to understand the conditions of these changes, research has shown the importance of students' representations of the learning design of the learning and teaching environments, on the one hand, and, on the other hand, the role played by the compatibility between the degree of regulation imposed by the teacher and the students' self-regulatory competence. These theoretical frameworks lead us to envision the following research questions for the study:

1. What transformations in learning practice can be observed? Do we observe congruence or friction? Is it constructive or destructive?

2. How can we understand these transformations?

The analysis of 19 cases of learners from different levels of education – from primary to higher education – will open avenues for further research and initial recommendations for future teaching.

4 Method

As a consequence of the research questions mentioned above, the objectives of this qualitative research are

1. To characterise transformations in learning practices.
2. To understand these transformations in relation to:

    2.1 Learners' characteristics.

    2.2 Learning designs of teaching and learning environments designed by teachers.

    2.3 Learners' representations of their teacher's teaching and learning environment.

We used the MEPA's modelling method to represent the personal learning environment of learners as an indicator of their learning practices first before in their normal condition and then after the change to distance education. In order to characterise the learning designs of teaching and learning environment designed by teachers, we used the HY-SUP self-positioning tool. Finally, qualitative interviews with learners were done to identify both their characteristics and their representations of their teacher's teaching and learning environment.

4.1 Sample

A sample of five primary, four lower secondary and five post-secondary students, all in the final year of their respective educational level, as well as five university students (two bachelor's students, three master's students) was selected in April 2020 at the heart of the first semi-lockdown in Switzerland. With the permission of the educational authorities in the canton, learners in primary and secondary education were contacted directly by the researchers through their networks. Permission was also sought from parents. At these levels, the researchers were not allowed to contact the teachers of these students, in order not to disturb them during this period of crisis. For university students, the sample was drawn from the network of teachers involved in a faculty development program, who gave access to their students.

4.2 Data Collection

An explanatory interview (Vermersch, 2019) was conducted with each of the learners by video conference. During this interview, the researcher led the student to discuss his or her learning practice before and then during the period of distance learning due to the COVID-19 crisis. To help them describe their learning practices in a precise and detailed

way, students chose a course that they liked. They also had the opportunity to describe the learning environment offered by the teacher. The interviews were recorded.

To characterise teachers' changes in the learning design of the learning environments, the research planned to contact the teachers of each learner, asking them to describe their teaching before and during the forced distance teaching due to COVID-19. However, permission to do so was only obtained for teachers at the upper secondary and university levels.

An interview was conducted with those teachers, during which the HY-SUP questionnaire was used (14 items, French-language version). Each before and after learning environment was described and situated in relation to the typology.

4.3 Data Analysis

The PLE modelling method (Felder, 2019b) was then applied in three procedures: 1) reformulating the data to integrate it into the model, 2) representing the model, 3) validating the model. This approach is based on a generic model of a PLE (an ontology) and on a system of graphic and textual symbols, presented in Figure 1 below.

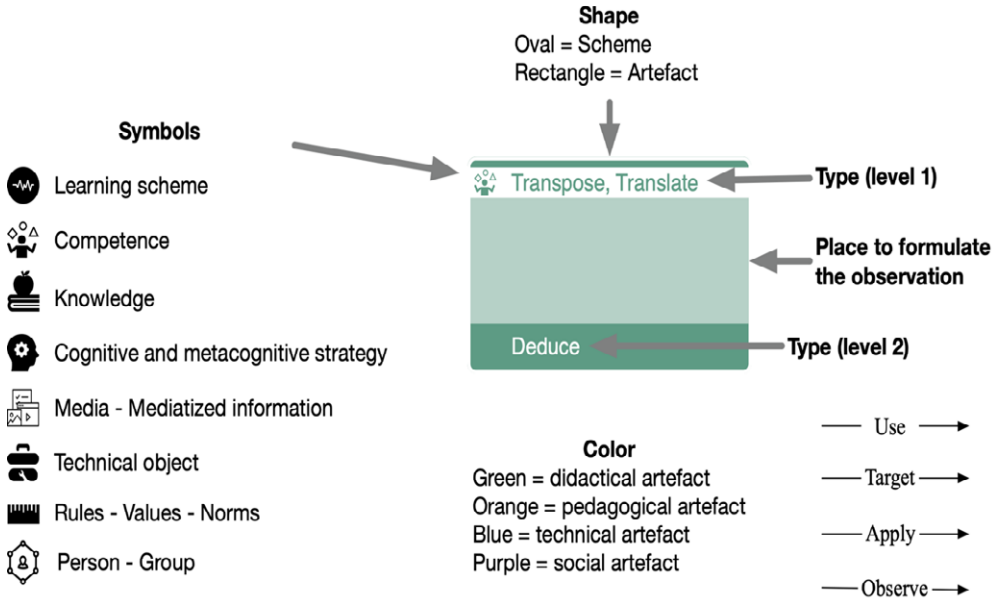

Figure 1: Summary of the modelling elements of MEPA's method (Felder, 2019b, p. 14, design according to Yepa®)

This modelling language makes it possible to express a learning practice in an intelligible, plausible and fruitful way (Felder, 2019c) by associating the discourse of the participant (the learner) with the elements of the ontological model of the PLE. The architecture of practice is expressed by means of four kinds of links connecting a learning scheme to a technical artefact (link: uses), a didactical artefact (link: aims), a pedagogical artefact (link: applies), and a social artefact (link: observes). The following table summarizes the conceptual elements, in which artefact refers to products transformed by human activity, whether material, digital or symbolic.

Table 1: Summary of the definitions in the PLE ontological model

Notion	Definition
Instrument	An instrument is composed of a scheme and an artefact. "The same pattern of use can be applied to a multiplicity of artefacts [...] conversely, an artefact is likely to fit into a multiplicity of patterns of use which will attribute different meanings and functions to it" (Rabardel, 1995, p. 4, our translation).
Learning scheme	A learning scheme is the general outline of an activity and its intention, "which can be reproduced in different circumstances and gives rise to various achievements" (Rabardel, 1995, p. 74, our translation).
Technical artefact	Technical artefact refers to digital and non-digital tools, functionalities or devices used to learn.
Didactical artefact	Didactical artefact refers to "the disciplinary objects taught" (Marquet & Leroy, 2004, p. 2, our translation) and "structured knowledge" (Vázquez-Cano et al., 2016, pp. 67–68, our translation). MEPA's method uses Paquette's (2005) taxonomy of knowledge and competence.
Pedagogical artefact	Pedagogical artefact refers to two types of objects: The cognitive and metacognitive strategies employed to learn described with the typology of Bégin (2008). Specific uses of mediated resources in learning activities.
Social artefact	Social artefact refers to "the set of interactions or relationships between individuals and persistent social objects such as institutions, roles, laws or unique interactions such as decisions" (Vartiainen & Tuunanen, 2016, p. 1268, our translation).

In this way, MEPA's method made it possible to use a longitudinal approach to compare the models produced about learning practices before and during the lockdown, thus rendering visible the changes that occurred at different levels of the model (instrument, scheme, artefacts).

Each model was then studied and revised by the research team, returning to the raw data where necessary. In a second step, the research team identified and described transforma-

tions in learning practices by comparing the PLE models at two levels: intra-case (between the same participant before and during the lockdown) and inter-case (between participants at the same level of study). In a third stage, these transformations were analysed on the basis of the descriptions produced according to the categories of the PLE ontological model (cf. Table 1; objective 1).

Then, when possible, an analysis relating each of the learning designs of the learning environment offered by the teachers and their transformations to changes in student learning practices was carried out (objectives 2.2 and 2.3.). Finally, adopting an inductive approach, the observed transformations were related to the qualitative data obtained during the interviews about students' individual characteristics (degree of self-regulation, self-representation, and so forth; objective 2.1.). These approaches led to the 19 case analyses presented in the full report, available on-line.

5 Results

In this section, two cases are briefly presented, the case of Denise, an 11-year-old learner at the primary level, and the case of Barbara, a 20-year-old student at the college level. The two cases were chosen for their illustrative power and to give access to two contrasting situations. The results first provide a brief presentation of the case, then the changes in practice are analysed according to the main dimensions of PLE and are concluded with an analysis of the congruences or frictions observed. The inter-case analysis then makes it possible to answer the two research questions by characterising the changes in learning practices and interpreting them with regard to the learners' self-regulation, their level of study and teaching environment characteristics.

5.1 Case Analysis

5.1.1 Denise

Links to the PLE models: BEFORE / DURING

Presentation

Denise presents herself as a curious student with a great desire to learn. She is able to express the learning objectives prescribed in the course she has chosen to discuss, her geography course and also to define her own cross-curricular objectives, such as speaking in front of an audience during an oral presentation or working with other children to prepare it. She enjoys learning at school and interacting with other people, as well as receiving explanations from teachers who, in her opinion, explain things well. During the lockdown, she said that she did not learn many new things in geography and that she regretted the lack of the teacher's presence. The teacher had only assigned one exercise so far (at the

time of the interview). She keeps herself busy with activities prepared by her parents, especially her father, who has studied geography. According to her, these activities allow her to review the subject and to maintain a certain level of motivation. However, Denise says that her parents do not explain as well as the teacher does, and in the absence of guidance from the teacher in all classes, she devotes much of her time to a personal learning project related to gymnastics.

Learning Schemes and Instruments

During the lockdown, there is a certain amount of responsibility on the part of the student and her parents. Denise has to go to school to find documents or corrections of homework. At the time of the interview, the only learning tool built in the learning environment is the one for searching for information online about the lakes and rivers of Switzerland.

Denise says that she feels that she is not learning anything new, but rather reviewing what she already knows. With regard to instruments that are not related to the teacher's prescribed tasks, Denise watches explanatory videos that she finds on YouTube or other videos on various topics and disciplines recommended by the teacher. With the help of her parents, Denise uses other activities to learn geography. In the absence of other stimuli, Denise develops a personal learning project to improve her gymnastics skills by practising in her garden.

Technical Artefacts

Denise's technical environment has become digital. To communicate with the teacher, she uses SMS. This transformation results from the teacher's choice. Denise chooses to use YouTube to find explanatory videos and thus gain new knowledge. However, some videos are recommended by the teacher. To view the videos, Denise uses a tablet. The use of Google to search for information was already present before the lockdown. The teacher's documents and corrections remain in paper form, because the teacher chose to distribute the materials to the children and their parents directly at school.

Didactical Artefacts

Knowledge representations in written form have a greater place in the student's practice. The teacher's decision to provide written answers and to limit interactions to the transmission of the material is a major factor in this decision. Denise deplores a lack of explanation from her teachers in general. To remedy this, she looks for explanatory videos on YouTube, which constitutes a self-regulated transformation.

Pedagogical Artefacts

No specific comments can be made for this category.

Social Artefacts

Denise's parents take on a more important role in her PLE by acting as a pivotal social artefact. This seems to be explained by a certain empowerment of the student and her parents.

Social interactions with other children are reduced to the other children in the family.

Didactical Artefacts – Skills and Knowledge

Both didactical artefacts related to geography and didactical artefacts related to cross-curricular competences are disappearing. The only didactical artefact related to geography concerns the theme of the exercise given by the teacher. This seems to be attributable to the transformation of the learning environment, which presents only one activity. The other skills that Denise targets are related to gymnastics (self-direction).

Congruence – Friction

This seems like a case of friction linked to the transition between the two learning environments. There is a destructive effect with regard to the school environment (reduction of the didactical and social artefacts). Constructive effects appear for learning activities outside the school sphere (development of a new learning scheme).

5.1.2 Barbara

Model references: hyperlinks : BEFORE / DURING

Presentation

Barbara says she is competent in mathematics the course she chose to talk about and has no difficulties in learning and achieving the objectives. She presents herself as an organised learner who participates in class and likes to do the exercises individually. She likes her mathematics teacher and her lessons, while during the lockdown she deplores the use of the chat system to communicate, as she would have preferred to interact with her teacher via video conference to ask questions directly and spontaneously. She said that she enjoys learning at a distance, as she is able to maintain her usual work pace.

Transformation of the Learning Environment from the Mathematic Teacher's Viewpoint

In his own view, the mathematics teacher initially designed a type 5 learning environment (the metro). The teacher adopted a pedagogical approach to getting students active by offering them exercises to be carried out in class individually or in groups. In the transition to distance learning, the training system became mainly a type 4 learning environment

(the crew). Indeed, the teacher now uses a chat system to communicate with the students and provides the correct answers for the exercises through videos.

Learning Schemes and Instruments

An important transformation in Barbara's practice is related to the introduction of a learning instrument to organise the tasks to be performed, a function that the student must now control. This change is regulated by her desire to maintain motivation and avoid procrastination. Another transformation is related to reviewing the subject matter: no longer having to prepare for class tests or written exams, Barbara is self-testing, rereading old summaries and practicing with mock exams. This change is regulated by her desire to do well in the final exam. Finally, in the absence of corrections of exercises by her teacher in class, she completes her practice by watching YouTube videos made by her teacher to do self-correction. This change is co-regulated by the teacher's choice to provide the solutions on his YouTube channel.

Technical Artefacts

Barbara's technical environment has become more digital. She uses the computer and the Microsoft Teams chat system to interact with her teacher. This transformation is induced by the teacher's choices. In addition, Barbara uses the "teacher's platform" more frequently than she did before the lockdown, because it is on this digital space that the teacher now gives the instructions for the tasks to be carried out. In addition, in the absence of synchronous video conferencing sessions, Barbara incorporates her teacher's YouTube channel into her practice in order to have more complete explanatory videos. Finally, course materials are being converted from paper to a digital format. However, it is Barbara who decides not to print the documents (downloaded from the online platform) and thus keep them in digital format.

Pedagogical Artefacts – (Meta)Cognitive Strategies

An important transformation in Barbara's practice is her use of the metacognitive strategies of self-regulation and anticipation. The first relates to planning and managing of tasks. The second involves trying to imagine the questions that might be asked in the oral maturity exam (exit exam for secondary school). The implementation of these two strategies is probably due to a constraint in the learning environment, insofar as it does not support these functions. It is also made possible by Barbara's self-directedness, insofar as she aims to avoid procrastination and to come well prepared for the final exam.

Pedagogical Artefacts – Forms of Knowledge Representation (Mediatisation)

The form of knowledge representation has shifted from oral explanations by the teacher to a variety of types of knowledge, in the form of video recordings (YouTube channel) or written information (via MS Teams chat and the teacher's website).

Social Artefacts

During the lockdown, Barbara's social environment has become more restricted. She now only interacts remotely with her close peers. This seems to be justified by the fact that Barbara claims to be competent in mathematics and does not need the help of others. Instead, she sees it as her responsibility to support her friends. The teacher's presence is maintained, but Barbara deplores the lack of spontaneous interaction with her.

Didactical Artefacts – Skills and Knowledge

Through this transition, Barbara perceives that she is developing her ability to adapt to a new teaching–learning modality: that of distance learning.

Congruence – Friction

There seems to be a case of friction related to the transition between the two learning environments. This effect appears to be constructive: development of new learning schemes and new pedagogical and didactical artefacts.

5.2 Cross-case Analysis

The inter-case analysis enables the two research questions to be answered by combining characterisation of transformations in learning practice with their understanding according to learners' characteristics and transformations in the teaching environment.

Out of 19 cases across all levels of education, 13 cases of constructive friction were observed. This phenomenon is particularly interesting. Based on the definition by Vermunt and Verloop (1999) cited above, we identified as cases of friction those where the transition from one learning environment to another created a rupture, an incompatibility that challenged learners to develop components of their learning practices (schemes, cognitive and metacognitive strategies) and their self-regulation. This progress seems to be associated, on the one hand, with good control of self-regulatory skills on the part of learners, and on the other hand, with accurate perception of changes made by teachers to the learning environments, for those teachers for whom we have data. This seems to confirm the work by Vermunt and Verloop. The cases of destructive friction appeared mainly at the primary level. This also confirms previous research findings highlighting the importance of pupils' initial self-regulation. Congruence only occurred at the university level, where students are more often confronted with learning-centred learning environments and highly mediatised training systems. These facilitated the abrupt transition to distance learning.

Regarding hetero-regulation and self-regulation, we observed a shift from teacher regulation to regulation by the media (e.g. written instructions, questions, and videos), by the student (e.g. getting organized, and asking questions if necessary), by the technical artefact (e.g. taking handwritten notes because the screen is occupied by the videoconfer-

ence, changing types of interactions with peers via the videoconference), and by peers (e.g. feedback, cognitive support).

In the case of primary school learners, the increase in regulation by parents (hetero-regulation) was prevalent, while self-regulation was higher at all other levels. It should be noted that the predominance of parental regulation at primary level underscores the need to consider problems due to a potential digital divide.

It is interesting to note that, during the lockdown, 11 out of the 19 learners engaged in learning activities (self-regulation) in response to a need to learn new things or to improve themselves, either in relation to the subject concerned or in relation to personal interests. This can be understood by the degree of openness suddenly offered by the teaching environment, leaving more freedom for the learner to choose learning objectives that are specific to him in his or her PLE.

In all cases, we observed a digitalisation of the learners' technical environments. This transformation was due to changes in teaching environments, with the introduction of tools such as video conferencing (Jitsi, Zoom, TEAMS), communication tools (WhatsApp, Gmail, SMS), and online learning and sharing platforms (Moodle, Fribox, Educanet2). It should be remembered that through the introduction of online platforms, students' practices underwent a form of instrumental hybridisation (e.g. the use of the internet; Roland & Talbot, 2014), where documents provided by the teachers went from paper to a digital format.

We observed varying development of digital skills in primary school pupils, with parents often taking charge of the use of new tools. But more generally, although we observed a large increase in the use of technology and the addition of new digital artefacts to the learners' PLE, we have little data on the development of digital skills. While it was not an object of this research, we note that we did not observe any cases in which a learner say on his or her own, that she or he had developed new digital knowledge or skills. It seems that such learning is not recognized by the learners.

The social dimension of learners' PLEs during the lockdown ended up becoming impoverished, despite an increase in digital communication artefacts. Learners deplored a lack of contact with their teachers. In all likelihood, it is not enough to have the means of communication for the learner to make it a social instrument of his PLE.

6 Conclusions

The inter-case analysis highlights a trend common to the different school levels considered in the specific context of one Swiss canton. Despite the digitalisation of the learning environments offered and the efforts made by some teachers to maintain a social relation, all learners deplored the impoverishment of their relationship with their teachers.

The majority of the cases showed constructive friction (13/19). This confirms the work by Vermunt and Verloop (1999), insofar as these cases were observed when the learner had a high level of self-regulation before the transition. However, this may have been the case at primary level insofar as part of the regulation of learning was taken over by the parents. Finally, the question of the development of digital skills can be raised, insofar as these were not mentioned in any of the learning schemes described.

Before proposing some avenues for research and practice, it is necessary to recall the limits of this exploratory research. Conceived during the crisis, it did not benefit from research funding that would have allowed more data to be collected. Nor was it possible to obtain permission to interview all of the teachers involved. Finally, a more robust theoretical framework at the outset would have allowed us to use a mixed-method research design that combined the use of validated research instruments with qualitative data collection.

6.1 Avenues for Research

Future avenues of research were identified in terms of methodology, research topics and unresolved questions.

First of all, at the methodological level, as mentioned in our article (Felder et al., 2021), the method used has strong heuristic power to describe in detail the components of a learning practice and its transformations, when applied to data collected at different moments in a learner's journey. Changes in practice can thus be described in a precise and systematic way by considering changes in artefacts and their relations. In addition, the analytical perspective (modelling PLE) combined with a perspective linking the described transformations with individual characteristics and the characteristics of environments ("learning design") enables highlighting configurations associating these sets of variables. It opens the way to a better understanding of the diversity of teaching and learning practices and their effects.

Our theoretical and methodological framework leads us to question the use of the notions of hetero-regulation, self-regulation and co-regulation. From the perspective of a personal learning environment, distinguishing between self- and hetero-regulation appears inappropriate. Instead, one could speak of a distribution of regulation between the person and others and between the person and the symbolic, tangible or digital artefacts. This reveals the need for a study of the conscious evolution of distribution of regulation.

The concepts of friction and congruence, taken from Vermunt and Verloop (1999), seemed heuristically very interesting. However, it would be necessary to specify the indicators of the effects of the corresponding transitions particularly with regard to constructive or destructive frictions, so that the analyses can be reproduced by other researchers.

The framework for describing hybrid learning environments was produced for higher education by Deschryver & Charlier (2014) more than ten years ago. In addition to an update to this framework, similar frameworks should be produced for other levels of education.

Thus, the study of transitions between learning environments should be continued in order to understand under what conditions institutional environments can enable learners to meet the challenges at hand. In this respect, there are many implications for practice.

Finally, other research avenues are open, in particular:

- to describe and analyse the conditions for the development of self-regulation or distributed regulatory skills in relation to institutional learning environments throughout the learners' lives;
- among these conditions, for primary school pupils, to better understand the role of parents;
- to describe and understand under what conditions the new learning practices constructed during the abrupt transition to distance education will be maintained and for whom;
- to describe and understand under what conditions the uses of digital artefacts might correspond to the development of skills in that area;
- to understand the conditions for the emergence of new non-formal learning patterns.

6.2 Avenues for Practice

In several cases, especially in higher education, the learning environments designed by teachers were learning-centred and adaptable to distance learning. Efforts to train teachers at all levels in this direction should be continued.

However, beyond this need, the social deficit was extremely marked at all levels. Of course, we can hope that a lockdown as experienced in March 2020 does not happen again. However, there are questions about the ability of teachers to provide a cognitive, educational and social presence for their learners at a distance (Jézégou, 2010). This skill should also be developed for the future, regardless of the learning design chosen.

The cases studied were relatively privileged because of the opportunistic sample, the role of parents, especially at the primary level, and the learners' initial digital skills. Particular attention should be paid in the future to addressing these potential sources of inequality through concrete actions.

This exploratory research, prompted by the abrupt and forced transition for all pupils, students and teachers to distance learning, highlights the need to prepare teachers and learners for the many transitions they will have to face as they learn throughout life.

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Electronic Supplementary Material

Hy-Sup questionnaire
Full research report (available in French) (Felder, Molteni, Baran, Charlier, 2021)