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Teaching in Flexible Spatial and Digital Conditions: Re-evaluating Teaching Designs in a Synergi between Space, Actors and Resources

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This study explores teaching in flexible spatial and digital conditions in a newly built school. It analyzes how teaching is organized, how furniture and classroom space creates different meaning-making opportunities, and what resources and practices are offered to stimulate students' meaning-making. The analyses of a teacher team's planning and teaching of the thematic work project "About Space" in Years 2 and 3 (eight- to nine-year-old children) reveal a linear character dominated by permissive and contemporary activities in the digital space. Students read, watched, and wrote through a multimodal experience of the content on their tablet computers, and they used workspaces in the classroom they prefer according to the activities. The teachers' spatial framing allowed both free movement and static arrangements, providing possibilities for diverse relation-building and requiring teachers' preparedness to re-evaluate teaching designs to match the learning activities. It is the combined synergy of space, actors, and resources that provide a powerful tool for understanding the complexity at play, maintaining a balance between structure and free exploration.

Keywords: digitalization, learning environment, multimodal texts, spatiality, educational design

1. Introduction and Literature Review

More than a thousand schools will be built over the next fifteen years in Sweden to compensate for a school shortage. By the year 2024, the number of students in primary school in Sweden is estimated to increase by 16 percent due to high childbearing and extensive immigration (HUI, 2014). A good and flexible learning environment along with a digitalization of education are at the forefront of the building plans (Building School Forum, 2021). Educational systems are challenged in this building project to incorporate the needs of an evolving society characterized by cultural and linguistic diversity, as well as the rapid advancements in technology, to ensure that education remains relevant and future oriented (UNESCO, 2019). Architectural designs of newly built schools in the 21st century adhere to visions of making learning modern and effective, “mitigating the risks associated with uncertainty of educational change” (Wood, 2018, p. 96). Cleveland (2018) argues for the necessity to consider schools as “complex adaptive systems” capable of self-organization and regular adjustments to respond more effectively to increasing globalization and to remain relevant in a rapidly changing society. Further, a majority of EU countries are currently reforming their educational systems towards digitalized forms (Eurydice 2019), including Sweden, which recently launched a national strategy for the digitalization of education (Ministry of Education, 2017) along with a revised curriculum for compulsory school that aims to strengthen students’ digital competence (Skolverket, 2017, 2018; Godhe et al., 2020).

These changes in the learning environment of schools challenge teachers on multiple levels concerning the involvement of new learning spaces and materials that require not only new pedagogies but also new beliefs about what represents relevant education, what should be taught, and how (Fullan, 2007; Nieveen & Plomp, 2018). Spatial design enables dynamic, socio-spatial interactions in hybrid (blended) learning environments, promoting connection and flow in the transition between physical and digital media “associated with contemporary ideas about pedagogy, integrated curricula, individualization of learning and learning through collaboration” (Cleveland, 2018, p. 75). Integrating in-class (physical) and out-of-class (virtual/online) activities can be highly engaging for students, breaking down boundaries between learning at school and at home. However, the flexibility of a learning environment requires identifying what is educationally desirable, which in turn implies resolving the ambiguities of flexibility and space as beliefs of

permanent adaptability (Wood, 2018). Classroom design affects how the “didactic interaction environment evolves” (Kress & Sidiropoulou, 2008, p. 112). Likewise, movements and positions have an effect on relationships, content, and linguistic choices in the classroom (Lim et al., 2012; Hipkiss, 2014). Although the built-in traditions of the school building are an expression of the educational beliefs of designers (Veloso & Marques, 2017; Wood, 2017), the reproduction of traditions can be broken when designs are changed (Leijon, 2010). Different settings mediate different forms of interactions in the arrangement and types of furniture and media. How space makes a difference and how it might be flexible, when, and for whom is here a question of the relationship between space, actors, and resources (Wood, 2018).

The current curriculum’s student-centered focus has been shown to have an impact on school design by assuming links between learning and spatiality (Wells et al., 2018). However, research on schools with open floor plans find it difficult to unambiguously demonstrating the role of design in learning (Woolner et al., 2007). Furthermore, studies show that new learning spaces in school layouts appropriate specific learning activities for reflective or individual work, collaborative or active work, or group tutorials, and they employ large spaces for collective experiences and meetings that provide a flow of access and opportunities to shift between learning modalities (e.g., Cleveland, 2018).

In addition, the conditions for knowledge development and meaning-making have shifted in forms, uses, and technologies in society, giving rise to new communicative practices (Warschauer, 2008). Students are nowadays involved in meaning-making activities in schools using a wide range of physical and cultural tools available to them (Wertsch, 1991; Walsh, 2008). Learning and communicating using this rich variety of resources and communication channels (words, images, videos, sounds) in which information and texts are spread and received today add to the complexity of a learning environment. The process of reading and writing is hence a process of constructing and reconstructing different, often multimodal resources and being an interpreter, participant, user, and analyst of texts and information (Freebody & Luke, 2003; Serafini, 2012). With that follows developing an awareness of how to evaluate existing digital texts, how to construct and interpret multimodal texts (Jewitt & Kress, 2003; Jewitt, 2006; Kress, 2010; Sofkova Hashemi, 2017), and how to notice and consider issues of how power and inequality are communicated in texts (Janks,

2010). These changes in how we communicate, make meaning, participate, and learn not only relate to skills and technologies but also bring in a need for new meta-concepts as well as educational tools for teachers (Jewitt et al., 2009; Cloonan, 2011; Bearne, 2017; Sofkova Hashemi & Cederlund, 2017; Cederlund & Sofkova Hashemi, 2018; Sofkova Hashemi et al., 2020; Sefton-Green, 2021). What students communicate needs to be acknowledged and met by a pedagogy that recognizes all the communicative means that the student uses to view and organize ideas, thoughts, and knowledge (Bearne, 2017; Bezemer & Kress, 2016).

Current research suggests that there are opportunities and limitations built in school designs. They are related to space, actors, and resources separately, but the combined synergy of these elements needs to be further explored, which is the goal of this study.

2. Aim and Research Questions

This study is carried out in a newly built school that strives for pedagogical innovation through a flexible design in the learning environment, bringing in variations of spaces and furniture combined with a high degree of digitalization, all in alignment with what is thought that the future of learning and knowledge-building might hold. The aim of this study is to explore the emerging teaching and learning in the flexible school design: What does it entail to teach and develop knowledge in such flexible spatial and digital conditions? We focus our research on one teacher team's planning and teaching of a thematic work project "About Space" with a mixed-age group of primary school children (Years 2 and 3). We investigate the emerging teaching and learning from the perspectives of planning the design (RQ1) and the situational flexibility of space, actors, and resources (RQ2 and RQ3). Thus, we ask the following research questions:

1. How is the teaching organized, and what curricular genres can be discerned?
2. What framing, relations, and accessibility occur through the flexibility of furniture and classroom space?
3. What resources and practices are offered to stimulate students' meaning-making?

3. Research Methodology

The study is an initial phase of a larger practice-developing research project *DigiFLEX: didactical design in collaboration*, which applies design-based methods to systematically and over time study and improve educational practice (McKenney & Reeves, 2012/2019). This implies carrying out an iterative design and redesign of teaching sequences that involve spatial and digital resources and testing these educational designs in real teaching situations, leading to contextually-sensitive design principles and theories (Design-Based Research Collective, 2003; Barab, 2006). The newly built school involved in the study has been equipped with various types of furniture in order to create flexibility in relation to different activities and in relation to individual students' needs, which is also an ongoing meta-reflective activity in the school: How and where do I learn best? The school's homepage and external communication highlights its aspiration to develop creativity, critical thinking, collaboration, and communication based on OECD's key competencies (21st century skills). Textbooks are complemented with digital learning platforms and resources. Staff and students are equipped with laptops and tablet computers.

3.1 Material

The data collected for the study concerns a teaching sequence of an interdisciplinary thematic work project, "About Space," in Years 2 and 3 (eight- to nine-year-old children). A team of four teachers combined the contents of the school subjects Science, Swedish, and Arts to teach students about the solar system ("The Moon", "The Sun", "The Earth" and "The Planets"), constellations, and the seasons (see Table 2). The teaching sequence that forms the foundation for this research consisted of eight lessons, one lesson per week, and a detailed content and time schedule for the eight weeks of thematic work. Divided into four mixed-age groups with approximately 20 students per group (83 students in total), the students took part in the thematic work through a loop—digital lesson material the teachers prepared in advance. *Loops* is a digital platform with the opportunity to create and distribute teaching material within a school and between schools (www.loopseducation.com). The platform provides a visual map of the learning material on a specific topic, which in turn may consist of uploaded or linked texts, pictures, and videos, as well as embedded media. The platform facilitates creating word/concept lists, quizzes, question-answer tasks, logbooks, or other assignments.

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The collected data material for this particular study consists of the teacher team's lesson plans, digital lesson material uploaded or linked on the school's platform *Loops*, field notes and photographs from participatory observations of a selection of five lesson sessions (10 hours), and the students' work. The data was collected based on the Swedish Research Council's (2017) ethical guidelines, including requirements for confidentiality, consent, information, and autonomy. In the beginning of the *DigiFLEX* research project, all teachers and students were informed about the aims of the project, the purpose of the data collection, and the process of data analysis. The students' parents signed authorized letters of information, which contained information about voluntary participation, the right to end the participation at any time, the safe-keeping of the data, and the anonymization of all participants. Further, ethical considerations also concerned being responsive to occasions when participants show signs of not wanting to be documented, such as being photographed during classroom work.

3.2 Analysis

The collected data has been analyzed using a multiple analytical framework (Figure 1) investigating the emerging teaching and learning from a macro, meso, and micro level. We analyzed the planning of the design (RQ1) and the situational flexibility of space, actors, and resources (RQ2 and RQ3).

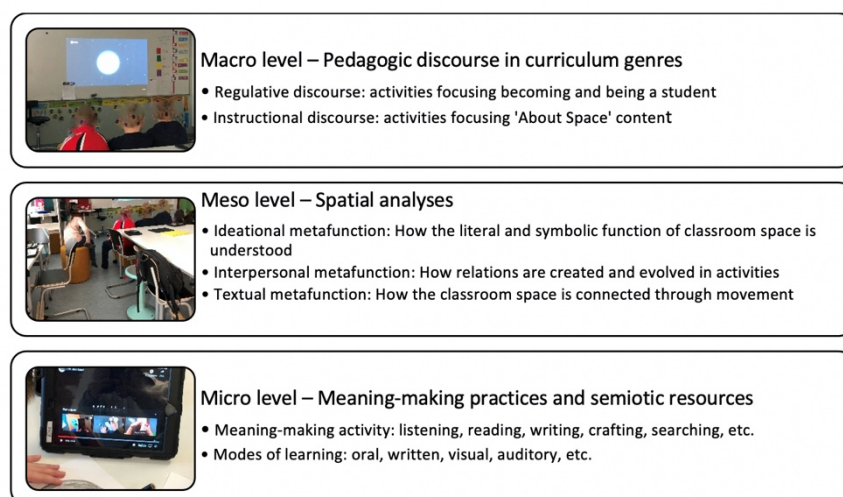


Figure 1. Analytical framework.

Starting at the macro level, we analyzed the organization of teaching from a pedagogic discourse perspective (Bernstein, 2000) through the concepts of regulative and instructional discourse. Namely, we distinguished between activities that intend to regulate behavior (becoming and being a student), as in *regulative discourse* (RD), and activities that intend to present content and develop knowledge, as in *instructional discourse* (ID). The macro level also includes analyses of the theme work as a whole and individual lesson structures, based in Christie's (1995) application of macrogenre theory. Christie (1995) describes lesson structures as either *linear* or *orbital* curriculum macrogenres. A project theme work as a whole could be an orbital curriculum macrogenre; the students have a core content they all need to focus on, but the road to completing the work can consist of different activities and contents. On the other hand, each lesson within the project theme work might be a linear curriculum macrogenre; it has a clear starting point (initiation genre), continued work in groups or individually (collaboration genre), and a defined end point (closing genre).

At the meso level, we focused on a spatial analysis of teaching activities in the previously identified curriculum genres. Our analyses of the classrooms are based in three-dimensional social semiotics, which is based in applications of Systemic Functional Linguistics (SFL; Halliday, 1994; O’Toole, 1994; Ravelli, 2008 and many others). We applied ideational, interpersonal, and textual metafunctions to how teachers and students use their classroom areas during the thematic work project. The analyses of the ideational metafunction looked at the functions of classroom spaces (O’Toole, 1994; Ravelli, 2008) through the concept of *framing* (cf. Kress & van Leeuwen, 1996/2006). Analyzing functions enabled us to learn, for example, whether and how students are allowed to make (creative and individual) interpretations of their classrooms or whether teachers create the framing. For the analyses of the interpersonal metafunction, we chose to focus on *involvement* and *distance* (Ravelli, 2008). Both these aspects helped us understand how the use of space creates different affordances for students to engage either with the contents or the other participants. Finally, for the analyses of the textual metafunction, we focused on static and dynamic usage of space (Stenglin, 2008). The analyses also include aspects of *change* (Björkvall, 2009; van Leeuwen, 2005) to identify whether and how changes in the classroom take place to, for example, make way for new venues of engagement.

Our micro level analyses focused on the digital flexibility in the particular learning materials available and teaching activities the students encounter during lessons, identifying the offered meaning-making practices and semiotic resources (verbal, visual, auditory, spatial, etc.). Informed by the theoretical perspectives of social semiotics and the understanding of meaning-making as a material, social, and textual practice (Kress, 2010; van Leeuwen, 2005; Sofkova Hashemi, 2017), we were able to understand the affordances of the learning environment and how different educational designs and resources are used to stimulate students’ meaning-making.

4. Results

In the following sections, we present the results of our analyses of the design of the teaching sequence in regard to pedagogic discourse and curriculum genre in the planning of the design (macro level); the framing, relations, and accessibility occurring through the flexibility of furniture and classroom space (meso level); and the digital flexibility of practices and semiotic resources to stimulate students' meaning-making (micro level).

4.1 Pedagogic discourse and curriculum genres

The thematic work as a whole is constructed as an orbital curriculum macrogenre. The visual design in this particular loop (Figure 2) is made to look like a constellation (the Plough) with a starting point (“About Space,” green dot, bottom left) from which there is a route to the different parts of the theme (e.g., “The Sun” and “The Moon”). What makes it an orbital macrogenre is that these parts are all dealt with as individual lessons and do not build on one another, so different student groups can work with different knowledge contents each week with different teachers. The four teachers had distributed the contents between each other so that they each performed two different lessons and met each student group twice. For instance, Teacher A taught about “The Sun” and “The Moon” and teacher B was responsible for “The Planets” and “The Constellations.”

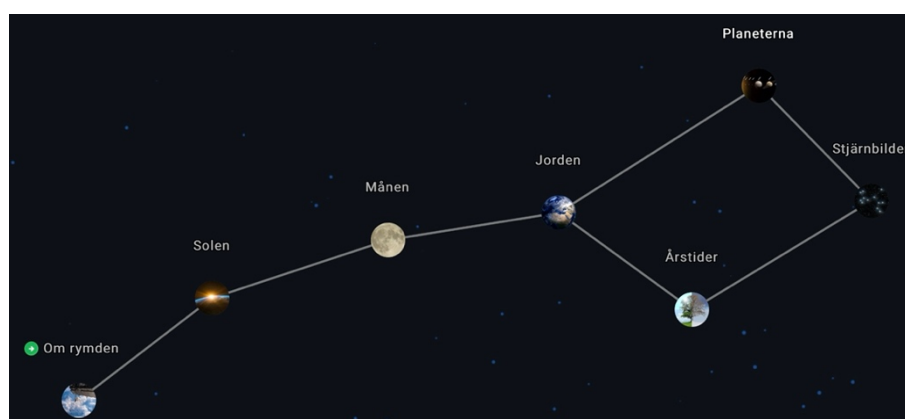


Figure 2. Loop for the thematic work of “About Space”: the overall structure and content areas.

Each individual lesson is constructed as a linear curriculum macrogenre (Figure 3); namely, students are expected to carry out tasks in a certain order. However, the design is visually a central node (in Figure 3 an image of the planets' order) surrounded by “destination” posts of different resources and tasks (in this example films, facts, quizzes, or a link to a webpage). These destinations are not presented in reading order (i.e., from the top and read clockwise).

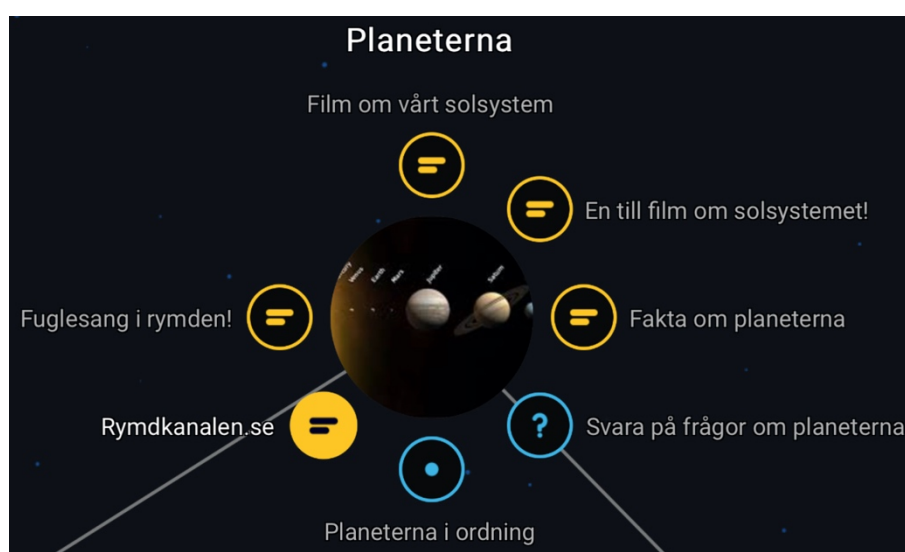


Figure 3. The lesson loop titled “The Planets.” It consists of the tasks “Film about our solar system,” “Another film about solar system,” “Facts about planets,” “Answer questions about planets,” “The order of planets,” the link “Spacechanell.se,” and “Fuglesang in space” (translated clockwise).

The teachers’ lesson plan and the observed activities from one of the lesson sessions (Table 1) reveal the recurring pattern of the linear curriculum macrogenre design, consisting of an initiation genre followed by a collaboration genre and a closing genre (cf. Christie, 1995). The different genres are recognized by foregrounding either regulative (RD) or instructional discourse (ID).

The initiation genre starts with students getting ready after a break by fetching the tablet or other material, teachers taking attendance, and students finding or being assigned their designated place in the classroom. The regulative discourse (RD) is prominent in these early school years because

these young students are new to thematic work, the digital platform *Loops*, and the mixed-age collaboration with a different school year, and some of them are also working in an unfamiliar classroom. Once the students have settled in their seats (on the floor, on benches or chairs), the teacher presents the content of the lesson as a teacher-led introduction on what activities the students are to carry out and what the students are expected to do and how, continuing the RD and making sure the students all know what to do to be successful.

Table 1. Teachers’ lesson plan for “The Planets” combined with a transcript of the observations from the corresponding lesson.

Excerpt from teachers’ lesson plan	Transcript of observation of lesson work with time indications
<p>The session starts with a joint gathering and a roll-call so that we see that everyone has come in after the break. After this we start the Loop and go through the first hub which is an introduction to our theme ‘About Space’.</p>	<p>10.00: Start of the lesson The teacher greets, takes attendance, briefly informs about the theme and starts to introduce the Loop on the big screen: - logs in, shows where to enter, explains what Loops are, reads the introductory text in the Loop. The teacher continues and shows a film with an astronaut eating sweets in Space: "Do you know about Christer Fuglesang? Do you know who he is?", the teacher asks. 10.15: Work in Loops with <i>What do you know about space?</i> The teacher divides students in groups of 2-3 and instructs: 1. open you tablet computer, 2. open Loops in the web-browser, 3. log in. Students open the Loop on their tablets. Teacher helps students to log-in. Students work watching movies, reading facts and writing answers to questions. 10.30: "Finish the sentence you write", "Have you handed it in?", the teacher encourages. Students remind each other to save the work.</p>
<p>After working through the first hub, we move on to the hub called The Planets. We will start by watching a short film about the different planets. After that, students will practice reading comprehension by reading individually a shorter factual text and answering questions that belong to the text.</p>	<p>10.34: Work in Loops with <i>The Planets</i> The teacher starts the Film about our solar system on the big screen and gives instructions after watching the film: 1. watch the movie about The Planets, 2. select a planet, 3. read through the fact sheets, 4. answer questions about the planet, 5. watch other movies when done. Students fetch headphones and start to watch movies and reading facts on their tablets. They work in their own pace. Teacher helps students to log-in when Loops freezes and repeats what to do. "I know what solid form is", a student exclaims. Students write answers to questions about the selected planet.</p>
<p>The next part is a group assignment where the students will work in small groups and make a form of presentation about which planets are in our solar system. Students may choose between presenting their work digitally or analogously with, for example, a larger piece of paper. Materials they can choose from will be available in classroom: large colored paper, felt-tip pens, glue, scissors and white A4-paper.</p>	<p>11.20: Work with <i>The order of the planets</i> The teacher gives instructions: 1. search for image over the order of planets, 2. choose tools (tablet or draw by hand), 3. take photograph, 4. send to the teacher. The teacher starts to search online for “good” images, chooses one of the images and changes instructions proposing that everyone draws on paper with felt-tip pens. Students fetch paper and color pens and start to individually draw the order of planets.</p>
<p>While we wait for everyone to be ready, there are nodes with movies that they can watch in the meantime.</p>	<p>11.40: Finalizing the work One by one the students hand over their finished drawing to the teacher and leave the room.</p>

Towards the end of the initiation genre, the teacher begins an introduction to the overarching contents of the lesson “About Space” (ID). She reads the text from *Loops* out loud to the group, shows a short film of Sweden’s first astronaut, Christer Fuglesang, eating sweets in space, and asks the students about the astronaut.

The collaboration genre commences with the students working individually with reading comprehension training through films and texts and filling a question-answer form in *Loops* on what they know about space. Again, ID is prevalent, and the teacher checks up on individual student progress throughout. Only little interaction occurs between the teacher and the whole group. Next, the teacher introduces the main content of the lesson “The Planets,” which begins with a film about the solar system followed by a presentation of what to do in *Loops*. Again, students work individually; they watch a film about the planets, choose one planet to work with, and then read a fact sheet and answer questions about the chosen planet. After a while, they assemble as a whole group for new instructions on how to work with the order of the planets in the solar system. This is a digital task initially, but during the lesson, the teacher changes direction and makes it a paper and pen activity.

Regarding closing genre, the lesson has no formal ending, such as the teacher gathering all students to have a joint send off, as is tradition in primary school. Instead, students would leave the classroom after completing their task. The implicitness of the RD in this closing genre is probably different from most other closing genres for other lessons, suggesting that thematic work is something different from ordinary lessons.

4.2 Flexibility of the space: Framing, relations, and accessibility

The school provides furniture of different types of seating arrangements and tables of various heights, forms, and materials in order to provide the best seating arrangements for each teaching and learning situation for both students and teachers. The classrooms’ ideational meanings are weakly framed, representing ordinary classrooms without specific equipment or purposes such as woodwork or science classrooms. However, the built-in flexibility in furniture indicates that changes of arrangements can be made, thus enhancing the weak framing in the sense that “anything goes” in these classrooms.

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When teaching and learning activities take place, the flexibility in furniture is used differently by the teachers and students (see Figure 4). This gives rise to different interpersonal meanings in relation to both the dynamics in the activities and in the creation of relations between actors—between the teacher and students and between peers. During observations, the classroom to the left in Figure 4 represents more flexible and dynamic seating arrangements, which also gives rise to enhanced flow in the classroom and varied relation-building between both students and teachers during the observed lessons. The static furnishing, represented by the classroom to the right in Figure 4, instead enhances whole-class interaction and has limited relation-building between students. Furthermore, it creates more distance between teacher and students.



Figure 4. Examples of furnishings in two classrooms.

Hence, with these placements of furniture (Figure 4), different interpersonal meaning is constructed regarding involvement and distance. During whole-class activities, the distance between students and teachers becomes greater as the teacher is literally further away, but the teacher also approaches the groups of students as a whole. Furthermore, involvement with content and interaction becomes dependent on how and when the teacher invites student input during whole-class sessions. In contrast, distance and involvement in building-relations with both other students and the teacher are afforded during individual and group work as actual distances are minimized (there were examples of students sharing beanbags!) and all students are committed to the tasks. The aspects of involvement, distance, and framing all combine with the textual meaning through the changes afforded in the classrooms. The built-in flexibility allows students to make their way between beanbags and benches to the work spaces they prefer according to the activity.

Teachers create more or less open/closed sections in the room depending on their educational design and on whether they plan for access to all students at the same time or individually.

4.3 Flexibility of the digital: Meaning-making practices and learning resources

During the thematic work, the students are offered to engage and learn about space and the solar system in a synergy between science, language, and art. With this interdisciplinary goal, the teachers combine the aims and central content of the separate subject syllabuses, summarized in Table 2.

Table 2. Subjects and central content of the thematic work.

Subject:	Science - physics	Swedish	Art
Central content:	<ul style="list-style-type: none"> • Motion of the Earth, Sun and the Moon in relation to each other. Different phases of the Moon. • Constellations and the appearance of the sky during different seasons of the year. • Seasonal changes in nature and how to recognize the seasons. • Simple scientific studies. 	<ul style="list-style-type: none"> • Writing with digital tools. • Simple forms of processing texts, such as subsequently going through their own and collaborative texts and making clarifications. • Listening and recounting in different conversation situations. • Oral presentations with various aids such as digital tools and other aids that can support presentation. 	<ul style="list-style-type: none"> • Materials that can be shaped, such as paper, clay, plaster and natural materials and how these can be used in art work.

The curricular goals particularly highlight how to comprehend and make meaning in speech and writing, process digital texts, and search for and evaluate information from different sources (Skolverket, 2018). This is an ambition revealed in the planning document of the thematic work:

We will work both theoretically and practically. By reading factual texts, watching factual films, working with digital tools through *Loops*, and creating their [the students'] own films and creative productions in the studio. (Excerpt from the teacher team's planning document)

During the individual lessons, the students are offered to engage in learning activities and materials of various modes to make meaning and build knowledge about space and the solar system.

Table 3. Analysis of resources and practices offered in the thematic work “About Space” to stimulate students’ meaning-making.

Meaning-making activity	Lesson activity	Mode(s) of learning
Listening and viewing	Teacher reading facts aloud on screen	auditory
	Watching film on screen	visual
Recounting orally	Discussion about content and concepts	oral
Reading	Reading fact sheets on screen	written
	Listening to audio-synthesis reading facts	auditory
Writing	Answering questions on screen	written
	Doing quiz on screen	written
Searching for information and evaluate	Search for images on screen	written, visual
	Discussion what is a good image	visual, oral
Drawing	Drawing on paper with pens	visual, oral
Crafting	Creating with paper and color	visual, oral
Using digital tools	Logging in the platform (Loops)	written
	Navigating the platform (Loops)	visual

The analysis of resources and practices (Table 3) reveals that the students engage with verbal (written and oral), visual, and audiovisual resources when they read on screen, when they listen to the teacher reading texts displayed on the big screen in front of the whole class, or when they watch short films. All activities and resources are digital, except when the students are drawing on paper and crafting.

Our observations of the activities indicate that the students are intrigued by the visual resources of the films’ contents. They are concentrated and pose questions about the film they just watched, which reflects their curiosity towards the contents. In whole-class discussions, the students recount what they learned and formulate exhaustive and concept rich answers. Reading activities are carried out individually and in silence. During these activities, the students engage with digital multimodal factual texts on screen. A couple of students experiment by listening to the text they read using speech synthesis; however, they have trouble comprehending the synthetic voice reading and choose to read themselves instead. The written assignments consist of reading comprehensions to the texts they read previously. For these assignments, the teacher requires only “a few words” for each question.

What emerges in the analysis is that the students are mainly involved in writing activities related to their reading comprehension, of both written texts and films, and not in, for example, creative writing. This is most likely a result of the students being new to this type of thematic work and because many of them are learning to read and write. The students engage in visual and oral modes

when collectively having discussions and drawing, for instance, the order of planets with colorful pens on paper. Similarly, other crafting activities of their joint productions include making the solar system using papier maché, thereby also making meaning through visual and oral modes.



Figure 5. The solar system in papier maché.

The digital encounters during the lessons allow the students to engage in both technology-specific activities, such as learning to master the software (login, navigate, save, and send one’s work), and critical literacy activities, such as searching for relevant images on the Internet. The technology-specific activities are part of the curriculum initiation—with the teachers making sure that all students are logged in on the platform, solving impending technical disturbances, and guiding and supporting students as they navigate the platform or use other functionalities. Critical literacy activities take place during the collaboration stages, often on the students’ own initiative, for instance when searching for additional information to a film. There are also instances of teacher-controlled activities for example when searching for and selecting a relevant image of the planets’ order (see the transcript from observations in Table 1).

Overall, the teachers apply diverse teaching strategies to introduce students to the theme’s content. One teaching strategy consists of a sequence of practices initiated by presenting a word list of central concepts before reading or watching the facts about space followed by written question-answer assignments or oral whole-class discussions. Here, the digital texts and films “speak for themselves” as the teacher lets the students read the texts and watch the films on screen, leaving

them running until the end and then having a brief follow-up. Another teaching strategy is more interactive and directly connected to the reading of fact sheets or watching of films. Here the teacher actively interferes and interrupts the students' reading or stops the film they are watching, facing the students' immediate curiosity and questions in a discussion that explains the addressed concepts or visualizations.

There were some distractions during the lessons, taking focus away from the schoolwork, in either digital or analogue form. For instance, some students take mini pauses where they engage in game apps of different kinds (e.g., pixel art and Block Craft), start coloring, or search online on their own. Similar mini pauses also occur with analogue resources, such as when the students look in an atlas.

5. Discussion

This research has explored the opportunities and limitations of emerging teaching and learning in flexible spatial and digital conditions in a newly built school, focusing on how teaching is organized, how furniture and classroom space creates different meaning-making opportunities, and what resources and practices are offered to stimulate students' meaning-making.

To summarize, the thematic work we followed had a linear character of lesson sequences moving mainly within the instructional discourse. Namely, the teaching and learning activities focused on the different aspects of the contents within the thematic work project "About Space." Regulative discourse was mainly prominent at the beginning of lessons, with evident patience and time spent on contingent technological issues, that is, technology may take place. In line with the school's vision and ambition, the majority of the observed and planned activities took place within the digital space provided through the digital platform, *Loops*. Students read, watched, and wrote through a multimodal experience of the content on their tablet computers. Only artwork was experienced and produced in analogous form. These art products could be seen as either part of the science subject, since the papier maché planets were made to display the character of the planets, or part of the arts subject, since the students made crafted shapes of suns following the same template.

Applying Wood's (2018) concepts of space, actors, and resources, this research sheds additional light on the complexity of teaching and learning contexts. In this research, the focus is arguably on *space* and how both physical and digital space afford different discourses (regulative and instructional) and different meaning-making opportunities for students (reading, writing, and watching). Our study has highlighted the dynamics afforded in such a learning environment as this school, demonstrated in how teachers and students negotiate space in relation to activities and content. This is represented in the opportunities for individualization and collaboration that are aligned with both curriculum and school visions concerning student-centered learning and a content-based, integrated curriculum (cf. Cleveland, 2018). Nevertheless, the afforded dynamics still put a strain on teachers to identify educational gains in "where to do what" (cf. Wood, 2018; Cleveland, 2018).

On the other hand, this research also focuses on *actors*, namely, what teachers and students do in relation to the physical and digital space they access. We have found that teachers use the classroom space differently, constructing possibilities for different types of relation-building; in addition, students make use of the space according to the activities they take part in, such as working at a desk for writing and lying on a beanbag for reading. Hence, there is an aspect of actor agency at play related to the availability of diverse furniture, which also highlights the need to include aspects of how to meaningfully use and arrange furniture when designing activities and lessons.

Teachers not only have to decide upon "where to do what" (cf. Wood, 2018 and Cleveland, 2018) but also be open and sensitive, as well as be prepared to deliberately re-evaluate and alter activities, teaching designs, and contents (Fullan, 2007; Nieveen & Plomp, 2018) in order to match learning activities with individuals in this continually reconstructed flexible learning environment (cf. Cleveland, 2018). In this process, teachers must observe and make use of the different ways students use and organize their ideas in class. These actions on the students' part indicate the level of both understanding and knowledge; they also show how students prioritize among modalities in order to communicate (c.f. Bearne, 2017; Bezemer & Kress, 2016)

Finally, this research also emphasizes *resources*. On this matter, the study shows how the digital space, provided through the tablet computer and *Loops*, affords different multimodal encounters with the content of “About Space” through films, fact sheets, and exercises. The selection of resources (cf. Fullan, 2007; Nieveen & Plomp, 2018)—such as the learning platform—the design of teaching and learning activities, and the choice of digital and analogous activities to include all affect the possible outcomes of any work. Furthermore, once students start doing schoolwork, the teachers’ choices require students to be able to interpret different types of modalities for their learning and to be able to make their own selection of resources to use to convey their abilities or knowledge (cf. Freebody & Luke, 2003; Jewitt & Kress, 2003; Jewitt, 2006; Kress, 2010; Serafini, 2012).

6. Conclusions

Following a newly built, modern school during startup is a unique opportunity. Investigating emerging teaching and learning in schools with flexible spatial and digital conditions provides significant knowledge for future schools. This modern and permissive approach enables more contemporary spatial, multimodal, and digital encounters in line with the emerging societal developments and ways of living. The challenges of such pedagogical innovation concerns transforming complex learning environments into productive teaching environments while maintaining a balance between offering students a structure and encouraging their free exploration. Looking at the aspects of space, actors, and resources separately provides input on teaching and learning; however, combining them provides an even more powerful tool to identify the complexity at play.

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