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Teacher Trainees' Beliefs Concerning Efficient Teaching and Learning – Pedagogical Spaces in Focus

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Abstract

The paper focuses on discovering the relationships between pedagogical architecture and classroom didactics. It is looking for an answer to the question what beliefs teacher trainees have about pedagogical spaces, what connections they see between efficient learning and the organisation of pedagogical spaces, and how they would organise space during their own teaching practice. During the study, two methods were used: unstructured reflective diaries (N=29) and fuzzy-set Qualitative Comparative Analysis (fsQCA). The key point of fsQCA data analysis was the conversion of qualitative data into fuzzy sets. This process was done in several steps. Results shed light on the functional space model of the school, and highlighted the significance of individual, social, learning, and private spaces. The complex space representation of the students showed the school architecture, the inner world of the institution, forms, colours, and the unity of objects and internal space. All this has an effect on methodological culture as non-classical space organisation facilitates the use of new generation methods.

Keywords: *beliefs, pedagogical spaces, Qualitative Comparative Analysis, teacher training*

Introduction

When studying the professionalisation process of teachers' work, special attention should be given to beliefs, as they affect the teaching and learning processes.

Beliefs are ideas about the world that the teacher considers as true (although they might not be true in certain cases), which influence their decisions. Beliefs are used when making decisions, they are cognitive, deeply rooted in the teacher's personality, and strongly affect their actions. Teachers' beliefs come from three main sources. These sources include personal life experience, memories from earlier life as learners at school, experiences from formal education, as well as their own teaching experience and practice (Richardson, 1996). During the years of becoming a teacher, acquiring an approach that necessitates reflection during and after pedagogical activities (i.e., teaching) can be seen as a key competence for students who want to become teachers (Baumgartner & Welte, 2009). In this process, beliefs play an important role. Reflection requires explication and, consequently, leads to a growing awareness of unconscious, subjective theories.

Research Problem

The question arises how the beliefs and reflective competences of teacher trainees can be grabbed. In this study, Tynjälä's (1998) statement is considered of high importance, which states that the written work of teachers and teacher trainees (e.g., reflective diary, lesson commentary, portfolio) helps and necessitates the integration and reorganisation of information, and thus, analytical thinking. Analytical thinking is also represented in the teacher's portfolio, which shows that the teacher trainee is capable of collecting information about the teaching and learning process, and make it relevant to his/her own activity (Levin & Meyer-Siever, 2018).

Research Focus

The presented paper is looking for an answer to the question what beliefs teacher trainees have about pedagogical spaces, what connections they see between efficient learning and the organisation of pedagogical spaces, how they would organise space during their own teaching practice.

The aim of this paper is to discover the beliefs of teacher trainees about the process of teaching and learning using an unstructured reflective diary and Qualitative Comparative Analysis. During a qualitative study, reflective diaries visualise the ways of thinking and individual sets of beliefs behind the textual representation of processes.

Theoretical background

In the last decades, space came to the foreground of interest, and this "spatial turn" generated fundamental changes in social sciences, both theoretically and methodologically. The spatial turn meant a change of perspective. It called attention to the fact that the problem of spatial oblivion, i.e., a priority of time over space, must be dealt with in social sciences. Space provides the frame for social processes and phenomena (Verd & Porcel, 2012). Spatial information helped the notion of Spatially Integrated Social Science get into the focus of qualitative social studies (Goodchild, Anselin, Appelbaum & Harthorn, 2000), where the visualisation and analysis of spatial data appeared as central elements, what is more, a spatial and temporal simulation of social systems also became possible (Cisneros Puebla & Davidson, 2012).

Due to the interdisciplinary nature of thinking about space, a number of spatial typologies are known, listed here without claiming to be exhaustive: physical (topological, projective, linear, and circular), metaphysical (mythical and sacral), social (sociological, national-historic, local, global), communicative (linguistic, textual, contextual, narrative, hermeneutic), Euclidean, non-Euclidean, metric, and topological. The trialectic concept of Lefebvre is partly related to these, but it also enables us to see things in different contexts. Perceived space enables us to see space as a physical entity. Conceived space helps the analysis of mental and cognitive spaces, while lived space facilitates a multifaceted approach to social spaces (Lefebvre, 2006).

In the early 2000s, new ideas appeared that focussed on the notion of "network society" (Castells, 2003). Castells called attention to the fact that it is worth studying networks instead of spaces, as the operation of society and economy and the relationships present in them can only be understood in this way.

The notion of space has several definitions, e.g., the definitions of social space or hyperbolic space are based on different backgrounds, and so go with different research methods. There is no unified way to study space. In our days, the latest computer-assisted qualitative data analysis software (e.g., Atlas.ti, MAXQDA) can be successfully used to handle geo-information in geographic, sociological, or pedagogical projects focussing on space. Computer-assisted qualitative data analysis helps us understand the physical aspects of space, and with its help, insights can be gained into interpretations of space at the level of society (Cisneros Puebla & Davidson, 2012).

The analysis of spatial structures on humans, and the interpretation of pedagogical spaces can clarify the different approaches relevant for education sciences. In

the multitude of spatial approaches, it is hard to define one specific way for education sciences, where an efficient teaching and learning process can be generated. Education science follows the ideas concerning spatial organisation at schools and the effects of pedagogical architecture on the different actors of school life (Hercz & Sántha, 2010; Jelich & Kemnitz, 2003). When analysing pedagogical spaces, it is worth remembering what effects space has on the behaviour of teachers and learners, and how the institution provides individual and social spaces, as these are important parameters of educational spaces.

Research Methodology

Research General Background

The discovery of students' beliefs about efficient teaching and learning was done with a qualitative research project. Instead of a hypothesis, the study was constructed on a set of open questions and problems, and was looking for an answer to the questions how teacher trainees see the process of efficient teaching and learning, and how they view the relationship between pedagogical spatial organisation and classroom didactics.

Research Sample

The study involved teacher trainees (N=29), who were the participants in a pedagogical seminar led by the author of this paper. The sample was selected on the basis of availability. When choosing the sample number, the methodology of Qualitative Comparative Analysis is considered, which prefers studies with multi-variables and a low number of cases. Literature lists studies with a different number of cases, so $15 < N < 50$ (Legewie, 2013), or $10 \leq N \leq 30$ (Thiem & Duşa, 2013) are also considered as appropriate. QCA is well suited to all samples, even for intermediate or large ones (Cooper & Glaesser, 2016; Greckhamer, Misangyi & Fiss, 2013). FsQCA is also a useful tool for analysing small samples (Rihoux, Ragin, Yamasaki & Bol, 2009). The sample used in the presented study is adequate for the methodology to be used.

Instrument and Procedures

The students had to word their ideas about spatial structures in the classroom by means of an unstructured reflective diary. In their homework, they had an opportunity to form the spaces as they wanted, so that it provided the best teaching and learning efficiency. The students made their diaries in two weeks, without any length limitations. Unstructured reflective diaries are a good way to study this

topic as apart from setting the topic it does not impose limitations, so individual subjective beliefs can be discovered effectively.

Data Analysis

Data analysis was made using fuzzy-set Qualitative Comparative Analysis (fsQCA). This method is based on mathematical processes, its basic idea is a study of different cases. Cases are seen as sets, variables as conditions, results as outputs. The first version of QCA works with crisp-set QCA (csQCA) dichotomised conditions, its values are 1 if the statement is true, and 0 if the statement is false (Schneider & Wagemann, 2007).

The method has been criticised for dichotomising, as it reduces the complexity of reality because of loss of information. To eliminate this problem, a fuzzy-set QCA (fsQCA) has been created (Ragin, 2000). Fuzzy logic interprets all relationships and outcomes for each value of the interval [0,1], thus eliminating a dichotomy. Using fsQCA necessitates the knowledge of csQCA as the end of the fsQCA analysis process returns to using csQCA.

The key point of fsQCA data analysis is the conversion of qualitative data into fuzzy sets. During the transformation, Basurto & Speer's (2012) method of calibration for structured interviews was adopted, thus offering a way to use unstructured reflective diaries in this research. Using fsQCA was done in the following steps: setting the conditions and the outcomes (1), and setting thresholds (2), qualitative content analysis of unstructured reflective diaries (3), reviewing coded outcomes (4), defining fuzzy values (5), assigning and reviewing fuzzy values (6), hypothetical truth table (7), logical minimisation (8), prime-implicant table (9), interpretation (10).

Research Results

The results are illustrated with the main content nodes found during fsQCA.

Step 1: Defining the conditions and the output

The inductive content analysis of unstructured reflective diaries (Mayring, 2003) defined three conditions: spatial structure (T), methodological culture (M), and educational tools (E), whereas the outcome was defined as efficient teaching and learning (Y).

Step 2: Setting thresholds

The key point of analysis is the fuzzy-set transformation of data. For unstructured reflective diaries, first the thresholds must be defined for each fuzzy set

(1 – fully part of set, 0.5 – threshold, 0 – not part of set). The thresholds help us decide if a particular case belongs to a set or not. Due to the unstructured nature of the diaries, there are no pre-defined categories, so in the first step the threshold was defined for the three categories based on the content of the text (Table 1).

Table 1. Thresholds and conditions.

Conditions	Threshold levels
Spatial structure	0 – no spatial structure 0.5 – only classroom 1 – spatial structure (more complex than classroom)
Methodological culture	0 – no methodology 0.5 – there is a methodology, but methods and work processes are not clearly defined 1 – methods and work processes are clearly defined
Educational tools	0 – no tools required 0.5 – there are tools but types and demands are not clearly defined 1 – types and demands are clearly defined

Step 3: Qualitative content analysis of unstructured reflective diaries

In this step, the coding of text corpora was done. In the case of unstructured text corpora, analysis was made using inductive logic, main and sub-codes were defined based on the meaning of the text segments. The sub-codes (Table 2) were assigned to the main codes defined in step 1.

Table 2. Main codes and sub-codes.

Conditions / Main codes	Sub-codes
Spatial structure	furniture, "corners", shelves, shapes of equipment, colour of walls, light, acoustics, plants
Methodological culture	work forms, methods: classical, interactive, new generation
Educational tools	teacher's and student's demands

Step 4: An overview of code-output

In this step, the coded data were analysed, all text segments marked with the same code were analysed as a group. It is worth comparing the text segments marked with the same code as it facilitates the assignment of fuzzy values. When reviewing the diaries, it was possible to follow which main codes and sub-codes were present (or not present), and the justification for each value was also seen (e.g., a difference between classical methods in one diary, and a range of methods and work forms in another).

Step 5: Defining fuzzy values

Defining fuzzy values, based on the researcher's decision, can be done on the basis of theoretical background, information about the cases, or sociocultural context. Table 3 shows the fuzzy sets and values.

Table 3. Fuzzy sets and values

Conditions	Fuzzy values
Spatial structure	0 – no spatial structure 0.2 – outer environment, built environment, decoration 0.4 – only classroom 0.6 – classrooms, colours, light, plants 1 – spatial structure, everything is included
Methodological culture	0 – no methodology 0.33 – methods appear 0.67 – work forms appear 1 – methods and work processes are clearly defined
Educational tools	0 – no tools required 0.33 – teacher's demands appear 0.67 – student's demands appear 1 – teacher's and student's demands appear

Starting from Table 3, the question why the values change under different conditions (i.e., why there are five values in the case of spatial structure, and why there are four values in the case of methodological culture and educational tools) should be answered. When coding the texts it was easy to see that the different conditions would have to be treated in different ways. In the case of a similar code system, data loss would have occurred. In the case of methodological culture, work forms have a higher fuzzy value (0.67) than method (0.33), as the students who can differentiate between methods and work forms can also think in complex ways about the efficiency of teaching and learning. In the case of educational tools, the use of values is unambiguous.

Step 6: Assigning and reviewing fuzzy values

Assigning fuzzy values to conditions and outcomes creates a link between theory and practice, and shows how data are described by fuzzy values. If there are problems at this point, then steps 4 and/or 5 must be thought of.

While analysing fuzzy values, the problem of structuring educational tools based on the demands of teachers and students arose. After reading the texts, there was a clear distinction between the demands of the teachers and students,

so the fuzzy values set beforehand stayed unchanged. The students' demands for educational tools have a higher value, as it includes the use of more complex tools (e.g., smart phones in the classroom).

After this review, a fuzzy set table was created (Table 4).

Table 4. Fuzzy values

Case	Spatial structure	Methodological culture	Educational tools	Outcome (Y)	N=29
1	0.6	0	0	1	1
2	0.6	1	0	1	1
3	0.2	0.67	0	1	1
4	1	1	0	1	1
5	0.6	0	0.33	1	1
6	1	0	0	1	3
7	0.4	0	1	1	2
8	0	0	0	0	3
9	0.6	0.67	1	1	1
10	0.6	0.3	0	1	1
11	0.6	0	0	1	5
12	0.6	0	1	1	1
13	0.6	1	1	1	1
14	1	0.67	0	1	2
15	1	0.67	0.33	1	1
16	1	0	0.33	1	1
17	1	1	1	1	1
18	0.6	0.33	0	1	1
19	1	0	1	1	1

Step 7: Hypothetical truth table

After setting the fuzzy values, a dichotomising process for crisp-setQCA (csQCA) was necessary, i.e., the creation of a hypothetical truth table. From this point on, fsQCA follows the steps of csQCA.

Concerning spatial structure in the fuzzy values table clarification is necessary since the value "0.4 – only classroom" is to be seen as true (1) because a reference to the classroom and its furniture is also a reflection to spatial structure. In other cases, values below 0.5 were regarded as 0, whereas above 0.5 values were regarded as 1.

As in csQCA, all the conditions have two outcomes (either 0 or 1) the independent condition n will have 2^n different configurations. Thus, if there are three conditions, there will be 8 cases, the first 6 of which are real (present in real life), while cases 7 and 8 are only logical, as they do not occur in real life (cf., Table 5).

Table 5. Hypothetical truth table

Case	Spatial structure	Methodological culture	Educational tools	Outcome (Y)	N=29
1	1	0	0	1	13
2	1	1	0	1	5
3	0	1	0	1	1
4	1	0	1	1	4
5	0	0	0	0	3
6	1	1	1	1	3
7	0	0	1	?	0
8	0	1	1	?	0

Step 8: Logical minimisation

In the next steps, cases were analysed which yielded the result Y=1. Addition and multiplication are interpreted as follows: a Boolean sum means logical "or", while multiplication means logical "and". All the cases can be described as Boolean multiplications, where capital letters mean fulfilled conditions (1), and small letters mean unfulfilled conditions (0).

Y=1 is fulfilled by cases 1, 2, 3, 4, and 6, that is Y(1)= Tme + TMe + tMe + TmE + TME. This expression is the primitive expression for Y=1.

Real cases can be minimised, in this process the Quine-McCluskey algorithm is used. The primitive expression for Y=1 can be minimised in pairs (e.g., (1,2): Tme + TMe = Te (m+ M) = Te; (1,4): Tme + TmE = Tm (e + E) = Tm, etc.), and so the minimised expression T+Me will result.

Step 9: Prime-implicant table

The prime-implicant table (Table 6) helps find the last configuration linked to outcome Y=1, it represents the minimised and original primitive expressions. The column of TMe can be omitted without changing the value of the expressions, so the minimised expression is Y(1) = T+Me, which can be interpreted as follows: efficient teaching and learning will occur (Y=1) if there is adequate spatial struc-

ture (T), or adequate methodological culture (M) and a non-adequate tool (e) in the classroom.

Table 6. Prime-implicant table

Prime implicant	Primitive expression				
	TmE	**TMe**	**tMe**	**TmE**	**TME**
T	x	x		x	x
Me		x	x		

Discussion

Interpreting the data is the 10th step of the process. In this step, it is worth reverting to the minimised formula T + Me. The expression resulting from a logical deduction is not an ordinary statement, but a combination of adequate spatial structure, or adequate methodological culture with non-adequate tools can have effects on the teaching and learning process.

The remaining part of the presented paper analyses the part of the minimised formula referring to spatial structure (T) according to the diaries. According to the hypothetical truth table, the appearance of spatial structure is represented by cases 1, 2, 4, and 6, altogether N=26 in the diaries. To the spatial structure condition set before the study, sub-codes assigned to the text were defined according to text meaning.

The content elements behind the codes showed considerable similarity, as there were no significant differences among the students' beliefs concerning spatial structures. There were some futuristic ideas about the school building and its surroundings: "Pyramid-shaped school, castle, boot-shape, lying dog, anything that children will like to frequent." The building should have a "Gaudi-ish wavy wall structure suggesting continuity", where there is a special emphasis on colour and light as all this influences our perception of space. Concerning colours, the diaries are diverse, ranging from white (so that is does not distract children from learning) to colourful walls and other neutral colours. In many cases, the students thought that children should colour the walls so that they can develop an emotional link to their own classroom. A key element of the diaries is a need for different "corners". Besides reading, playing, and tale corners there was a need for an internet corner, and also other corners representing a need for private space and for furnishing

the corner according to one's own ideas. This is important as corners help children relax and get ready for classes. Corners represent pleasant and safe private spaces, which is very important for efficient school work. In the case of methods and work forms, the students mentioned classical methods (e.g., visualisation) and new generation methods (e.g., cooperative techniques) as well, and considered all four work forms (frontal, individual, pair work, group work) as equally important. In accordance with methodological culture, an aesthetically decorated classroom will change its space organisation, as well. This is made possible by the use of movable pieces and individual desks arranged in a circle or in a U-shape, complemented with individual lockers.

The idea of one student is food for thought, comprising a tale-like idea and a question about pedagogical space organisation: "In Harry Potter's Hogwarts school there is a room called »Room of Requirement«, which can change into anything you need it to. Of course, everything is possible in a wizarding world. It could be an interesting experiment if an empty room was given to a class and they could use it freely, according to their own needs. I wonder what they would conjure into the room?"

Conclusions

The complex space representation of the students showed the school architecture, the inner world of the institution, forms, colours, and the unity of objects and internal space. It is always worth remembering that spatial structure has an effect on human behaviour, activity, learning and teaching. Spaces trigger or inhibit thoughts, generate chaos or harmony, make you active or passive in the school.

Students' beliefs about spatial structure reinforce the idea that architecture and built spaces in educational institutions have a very special pedagogy. This helps schools to fulfil their missions, to achieve their latent and manifest objectives. Efforts to build schools can only fulfil their ultimate aims if all the philosophical, pedagogical, psychological, and economic factors are taken into account. Future perspectives depict complex schools that prepare children for future challenges relying on their multifunctional operation.

Further studies could include methodological triangulation to involve other qualitative techniques besides reflective diaries in analysing pedagogical spaces, e.g., photo interviews. This involves analysis of photographs of different pedagogical spaces. This would allow for the elicitation of even more subjective ideas.

The methodology of this study can be used to discover complex issues in education sciences, as it offers a nuanced representation of school reality, taking several factors into account. Thus, it contributes to the understanding of school life-worlds.

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