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A First Glimpse at the Whole

Christopher Alexander's Fifteen Fundamental Properties of Living Centers and Their Implication for Education

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Abstract

We are currently experiencing an interesting discussion raised on how to transfer design patterns from architecture and software engineering to education. Computer scientists and pedagogues try to define patterns and pattern languages suitable for educational needs. The main goal of their work is to enhance quality and to foster best practices of teaching. However, in most cases, within their pattern development these writers only refer to Christopher Alexander's early works [1, 2] which are an intentionally vague attempt to suggest the Quality Without a Name (QWAN), and, doing so, they do not consider the later ones [3, 4, 5, 6], Alexander's more refined attempt to not only name the QWAN but to describe its taxonomy. In our perception, talking about a pedagogical pattern language requires definitely thinking about and describing its taxonomy, in other words, we have to think about a "grammar", a set of logical and structural rules that govern the composition of meta patterns, patterns and subpatterns like sentences, phrases, and words in any given natural language. Analyzing an exemplary educational scenario this contribution will

demonstrate the applicability of Alexander's fifteen properties of living centers in education and intends to open discussion and reflection about the important role of an educational taxonomy for classifying existing pedagogical patterns.

Keywords: Living centers, taxonomy, education, educational scenarios, pedagogical patterns, methodology.

1 Introduction

With this thematic paper we would like to exemplify our first considerations on how might be used Christopher Alexander's fifteen properties of living centers as a foundation and starting point for the analysis and classification of di□erent stocks of educational scenarios, the "phrases" in a system of pedagogical patterns. In our perception, the lack of an agreed educational taxonomy has its root in a misunderstanding of how to define educational scenarios (e.g. di□erent didactical levels are usually confounded) and, with regard to taxonomies, assuming a strict hierarchic structure of taxonomies, forgetting the importance of a holistic approach.

In these premises, the following considerations are a tiny fragment of a complex discussion which we had during a research workshop last year. It dealt with the pattern approach of Christopher Alexander. This year, preparing a didactic lecture on patterns in the context of a Grundtvig Workshop in Vienna, we tried to build on some of the workshop results. We attempted to transfer Alexander's fundamental properties of life discussed in the 5th chapter [cf. 3, pp. 143-242] of his book "The Nature of Order – The Phenomenon of Life" (TNO) to pedagogy. To provide a basis for our considerations, first of all we deduce five premises from Alexander's conceptions.

- The concept of life is far more than our traditional biological understanding. For Alexander, "life" is an emergent property of structures, i.e. the nature of order. Life emerges from the wholeness, the structural coherence and therefore is an emergent property of matter:

  The key idea in this book [TNO] *is that life is structural. It is a quality which comes about be-cause of the existence of a discernible structure in the wholeness – and therefore explains what we perceive as the quality of buildings of artifacts* (TNO, p. 110).

We dare to suppose that the quality named in this quote refers to the former QWAN.

- "Life" is not a yes-no property, but according to its degree of wholeness, degree of harmony, and degree of structural coherence a gradual property of matter:

[. . .] almost all of us perceive this quality, and feel it as it occurs in varaying degrees in different parts of space. [. . .] this quality is not merely the basis for a distinction between beautiful things and ugly things. It is something which is detectable as a subtle distinction in every corner of the world, [. . .]. It is a quality which changes from place to place and from moment to moment, and which marks, in varying degrees, every moment, every event, every point in space (TNO, p. 64).

- By introspection "life" can be perceived as a feeling. This "sense of life" can be sharpened by practice. The determination of the degree of life cannot be reduced to individual opinions and /or values, but can be empirically confirmed. In this context, especially the comparison of objects and /or situations in pairs is helpful:

  What we call "life" is a general condition which exists, to some degree or other, in every part of space: brick, stone, grass, river, painting, building, daffodil, human being, forest, city. And further: The key to this idea is that every part of space – every connected recognition of space, small or large – has some degree of life, and that this degree of live is well defined, ob-jectively existing and measurable (TNO, p. 77).

- How wholeness can be analyzed? Disassembling something into individual elements destroys its configuration, its internal consistency, i.e. that which represents the wholeness. Therefore Alexander uses a recursive concept of centers: centers are induced by the wholeness and refer to their relations with other parts, which contribute as centers themselves, i.e. a center itself consists of centers:

  There are four key ideas, all arising from the structure of centers [. . .]:
  1. Centers themselves have life.
  2. Centers help one another: the existence and life of one center can intensify the life of another.
  3. Centers are made of centers (this is the only way of describing their composition).
  4. A structure gets its life according to the density and intensity of centers which have been formed in it. These four points, simple as they are, give us the secret of living structure, and of the way life comes from wholeness" (ib.).

- The wholeness is a type of field structure and is defined as a pattern of centers in space. Even if it is a social, action, movement and/or cultural center, there is always a spatial dimension, the dynamics are a configuration of forces in space:

  A center is not a primitive element. Centers are already composite. Yet they are the most primitive element available. They are bits of wholeness which appears

> *as structures within the wholeness. [. . .] Centers are always made of centers. A center is not a point, not a perceived center of gravity. It is rather a field of organized force in an object or part of an object which makes that object or part exhibit centrality. This field-like centrality is fundamental to the idea of wholeness* (TNO, p. 118).

Especially in the last premise, the universal importance of space as a structural characteristic – used as a concept of space on a meta level, and not in a physical sense – becomes clear. Based on his professional interests as an architect, Alexander tried to find out over 20 years, why, at certain constellations, emerges the feeling of aliveness of structures and other artifacts. He has met here on fifteen fundamental properties and structural features which, in his opinion, are responsible for life.

In our opinion, that is the crux of the matter: until now, the whole pattern discussion focuses on a mere transfer of Alexander's pattern description language to other fields. Rather than dealing with his substantive conceptions, his taxonomy of patterns or pattern grammar, his description method concerning design patterns (name – context – problem – solution – forces) was copied. Therefore the discussion within the pattern community often revolves around the structure of this description, e.g. if there should be included another subitem which shows and analyzes the interaction of forces.

From our point of view, instead of sometimes hair-splitting discussions about description formalities it would be more important to think about how to implement the fifteen characteristics of life which, according to Alexander, are responsible for good design solutions. Certainly, this raises the question whether the properties may be transferred to other fields – such as pedagogy – at all.

The properties described by Alexander are structural characteristics of matter (here used in a philosophical sense). From our perspective, they are so general that, in the context of education, we can apply them not only to space but also to time, content and social interaction.

The use of teaching methods is not merely the application of certain techniques, but also a methodological, more or less elaborate course of instruction resulting from learning tasks, learning objectives, learning abilities of the students, the school environment etc., i.e. a lot of small parts which together form a whole, an instruction.

In this context, the number of properties does not matter; Alexander himself notes: *"Throughout my efforts to define these properties, it was always clear that there were not five, and not hundred, but about fifteen of these properties"* (TNO, p. 242). So we do not want to describe a certain number of properties applicable to education, our principal aim is to demonstrate

- that the spatial properties of life described by Alexander can be regarded as structural aspects of a holistic approach and should be used on a meta level for design and other fields,

- that in pedagogy, i.e. with regard to educational design, apart from spatial structures content, social and temporal aspects are very important for the learning course and process as well. In this context, Alexander's properties may be useful for the development and description of a taxonomy for educational scenarios.

2 Toward an educational taxonomy

Talking about Alexander's 15 properties and their benefits for developing an educational taxonomy, the first thing we have to do is to clear up three crucial questions:

2.1 What do we mean by taxonomy?

A taxonomy is a classification schema built by a system of consistent generative principles, procedures and rules guided by a functional logic appropriate for reflecting the (assumed) mechanism of action of the classified object [7].

2.2 Why do we need an educational taxonomy?

Pedagogy has not succeeded so far in establishing a consistent taxonomy of educational scenarios. Developing an educational taxonomy is primarily a theoretical enterprise, but it does not mean that the result itself is only important to theoreticians. If, for example, a teacher wants to design a successful lesson, it is vital to reflect in detail all the features that are necessary to achieve the desired result (cf. Figure 1). As a product, a good taxonomy should serve as a convenient and helpful tool for practical purposes to support and facilitate teaching and learning process. The process of developing a systematic classification scheme for educational scenarios itself is an important step in the construction of a new theory on education which pursues a holistic approach. As Kurt Lewin [11, p. 169] said: *"There is nothing as practical as a good theory."*

2.3 Does a taxonomy bolster wholeness, rather than destroy it?

In our opinion, taxonomy and wholeness are not necessarily a contradiction. The analysis of individual aspects will help to see and understand the whole. For instance, if we want to talk about the grammar of a certain (natural) language, i. e. the set of logical and structural rules that govern the composition of sentences, phrases, and words, we have to study and analyze these rules, including morphology and syntax. Then, knowing the di□erent components and rules of the language helps to understand the system of the language as a whole. When we try to explain one kind of entity by showing it to be constructed of other di□erent kinds of entities – e.g. a phrase is build of words – we have to realize that *"[yet] all these things are themselves centers. That is why we notice them"* (TNO, p. 117). With this in mind, it is comprehensible why developing a taxonomy might contribute to be aware of the wholeness.

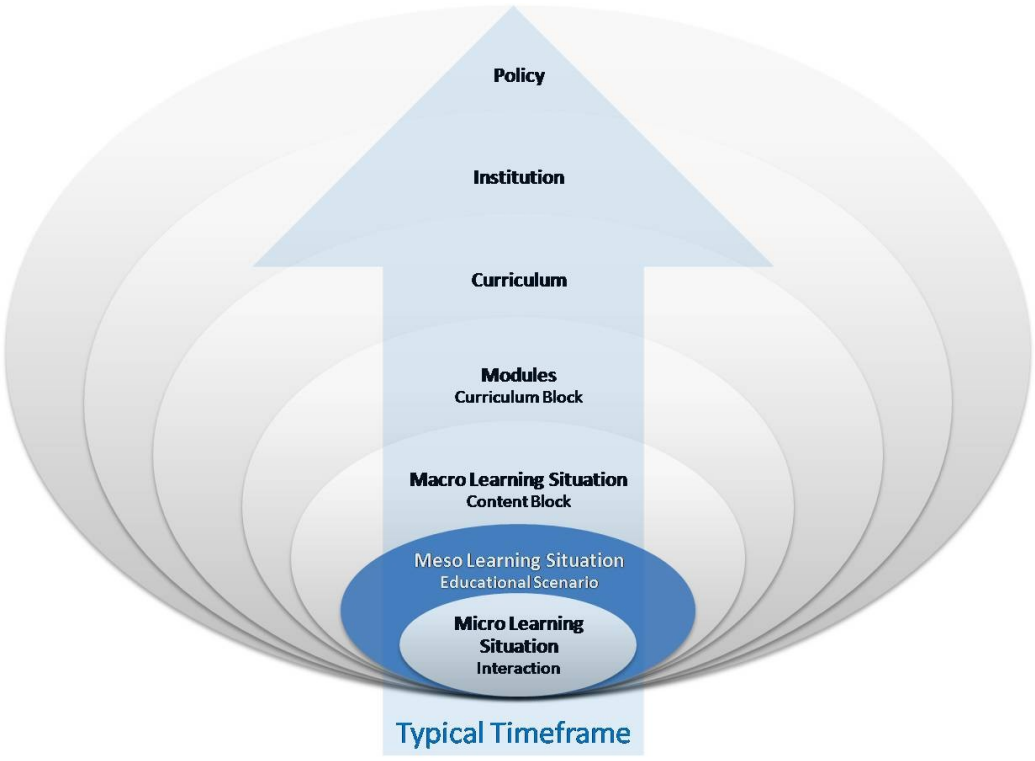


Figure 1: Hierarchical levels of an educational framework (Baumgartner & Heyer, 2007)

2.4 Advantages of taxonomies

A good taxonomy has to meet the following tasks [7, pp. 17-19]:

- **Integration:** isolated phenomena are bundled into groups (Taxa); they are classified;
- **Orientation:** a taxonomy provides a consistent framework;
- **Information:** facilitates communication;
- **Cost reduction:** uniform description facilitates re-usability;
- **Transfer:** similarities become evident, main types are easier to learn, distinctions between types and variants are easier;
- **Innovation:** (so far) unknown methods and systematic frameworks come into view;
- **Heuristics:** Quest for new types (classes) are inspired (e.g. compare periodic table of the elements).

Based on the diversity of these tasks it becomes clear that the development of a taxonomy is a central desire within the continuous development and use of didactically meaningful e-learning o□erings. Accordingly, already the *Best Practice and Implementation Guide* [9] suggests that *"a taxonomy of pedagogies, or some examples of such taxonomies"* would be important and should be introduced as element in the IMS Meta-Data classification.

2.5 Troubles with taxonomies

To summarize: There is no educational taxonomy for e-learning because it is missing as well an agreed classification scheme of general learning processes. There is a reason for that: In the phase of development of a good taxonomy we will be confronted with some troubles:

- **Categories:** How many and what kind of criteria should be constructed out of the infinite pool of characteristics (attributes)?
- **Operationalisation:** How to confine/delimit and how to measure the di□erent characteristics?
- **Structuring:** What kind of attributes are to what extend decisive for a new category (new class vs. variant, version, mutation)?
- **Granularity:** Which hierarchic level has to be chosen to get a taxonomy serving the desired practical purposes?

In our opinion, Alexander's fifteen fundamental properties which are showing the vitality of centers, might be very useful for answering these questions, and, in conclusion, for providing the development of a good educational taxonomy. In the following paragraphs we will try to demonstrate where there could be benefits for educational scenarios from exploring these fifteen properties of living centers.

3 What is an educational scenario?

Talking about educational scenarios requires a short definition of this concept. For our purposes we will draw on former investigations in this realm [8].

3.1 Definition

The concept of a "scenario" is adopted from the theater or movie language. It describes the essential factors of a screenplay. The technical specification IMS Learning Design [10] which provides a language for describing learning activities in a standardized way, has applied exactly this term.

As a first approximation, we can perceive an educational scenario as a representation of an educational setting, which comprises of an arrangement (configuration) of social, spatial,

content-related, and temporal variables (= action patterns). This definition includes both, abstracting unnecessary details of action situation and characterizing necessary conditions and environments for the implementation.

3.2 Why do we need educational scenarios?

We will now go into more detail regarding the second layer of the educational hierarchy (cf. Figure 1). This meso learning level (cf. Figure 2) is orientated to a certain didactical situation like "presentation", "group work" and so on. We think that one of the biggest challenges in educational theory is to overcome these rather abstract didactical concepts. The descriptions of these scenarios are too general since these situations can be implemented in a range of di□erent ways. There are many di□erent kinds of "presentation" and "group work". These abstract educational settings only indicate the predominant teaching/learning mode: The educational scenario "presentation" refers to a speaker/audience setting. Detecting the predominant mode with regard to "group work" is more di□cult: It could be a group exercise (e.g. group discussion within a lesson) or a collaborative creative act (e.g. editing a wiki page). On the other hand, detecting the predominant teaching/learning mode is not enough for the practice of educational design. That is why we need a much more defined description/notation system for the educational setting.

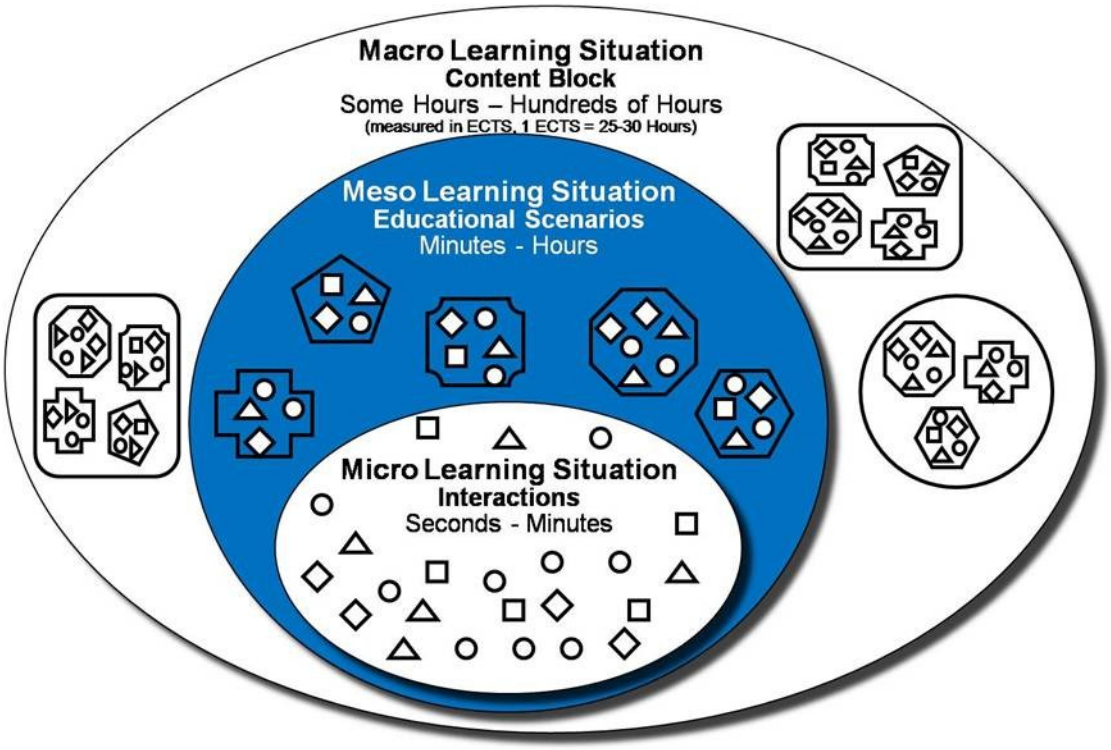


Figure 2: The educational stratification model

3.3 The four dimensions of an educational scenario

We can sum up our line of argument emphasizing the main dimensions of educational scenarios (cf. Figure 3):

- It is essential and typical that an educational scenario includes the detailed description of social interaction (How many people interact? What are their roles of interaction?), space (Within what kind of spatial surrounding do they interact?), content (What is its form of presentation?) and time (How long does each activity last?).
- It is important to understand that at this level the description of the educational setting is not determined by specific content or specific subject areas. A presentation, whether implemented in form of a talk or as a "Ball Bearing scenario" (see the following example), can be designed for any kind of subject.

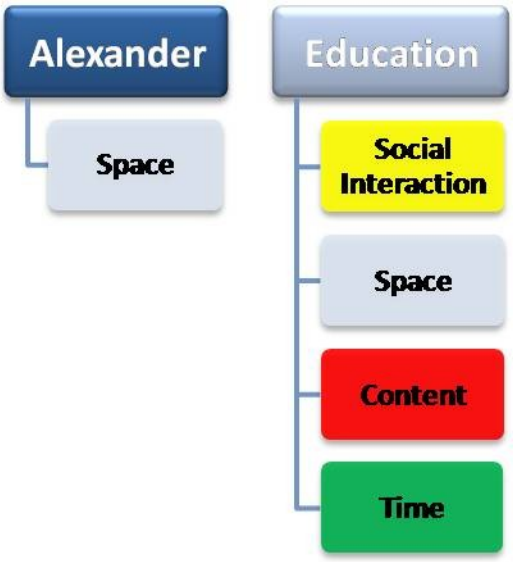


Figure 3: Four dimensions of educational scenarios

3.4 "Ball bearing method"

The "Ball Bearing method" (German: "Kugellager") is very useful for structuring new content, exchanging information, views etc. It can be used to prevent an endless sequence of "presentations in front of an audience". For instance, different students or groups one by one present different topics to the audience. These series of presentations tend to get boring for the audience. The activation of the students is low; many times they are just waiting for their turn to present.

To understand the specifics of the "Ball Bearing method", this educational scenario can be explained by the following example: Students of a block inside the Educational Technology II course[1] had to prepare and inform themselves about e-learning standards. For the implementation of the "Ball Bearing method", at first they got informational material on ten different e-learning standards. Then, in small groups, the students investigated one of the e-learning standards. After their investigations, half the course participants formed an inner circle, while the other half formed an opposing outer circle (cf. Figure 4). The inner circle of students – and this is the reason for calling this educational scenario "Ball Bearing" – rotates one station clockwise each time a central signal is given. During a fixed time frame (e.g. five minutes), the members of the groups in the outer circle present their findings using posters, notes or even computer presentations. The outer circle remains fixed as the inner circle wanders by a central signal (e.g. a bell) to the next station. When the

[1] "Educational Technology" was a former master's programme at Danube University Krems. Since 2007 it is called "eEducation".

circle is thus completed, the participants change roles – the inner circle people switch with the outer circle people and the second half of the "Ball Bearing" process begins by repetition of the procedure just described.

Figure 4: Students at Danube University Krems performing the educational scenario "Ball Bearing"

4 Alexander's fifteen fundamental properties and their implication for education

According to the four dimensions of educational scenarios (cf. Figure 3), in the following table we present our analysis results concerning the "Ball Bearing method". Apart from their spatial analogy to Alexander's 15 properties we attempted to name their social, content-related and temporal dimensions as well.

Table 1: 15 fundamental properties of living centers and their implication for education exemplified by the "Ball bearing method" (Part 1)

Alexander's 15 Fundamental Properties of Living Centers (TNO)		4 Dimensions of Educational Scenarios			
Name	Definition	Social Interaction	Space	Content	Time
1. LEVELS OF SCALE 	is the way that a strong center is made stronger partly by smaller strong centers contained in it, and partly by its larger strong centers which contain it.	Large group, small groups	Large room, small rooms	Posters	5' per group, total time e.g. 60' with 6 groups
2. STRONG CENTERS 	defines the way that a strong center requires a special field-like e□ect, created by other centers, as the primary source of its strength.	Peer-to-peer	Outer circle = stations	Poster	5'
3. BOUNDARIES 	is the way in which the field-like e□ect of a center is strengthened by the creation of a ring-like center, made of smaller centers which surround and intensify the first. The boundary also unites the center with the centers beyond it, thus strengthening it further.	Inner/Outer Student group	Inner/Outer circle	Headline, frame of graphs, (web-) pages	Bell = Signal for rotation

Table 3: 15 fundamental properties of living centers and their implication for education exemplified by the "Ball bearing method" (Part 2)

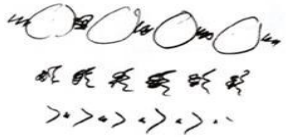
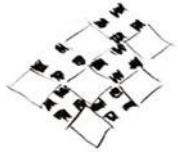
Alexander's 15 Fundamental Properties of Living Centers (TNO)		4 Dimensions of Educational Scenarios			
Name	Definition	Social Interaction	Space	Content	Time
4. ALTERNATING REPETITION 	is the way in which centers are strengthened when they repeat, by the insertion of other centers between the repeating ones.	Presentation to all the other groups	Everybody part of outer/inner circle	Talking / Listening	5'/5'... 30'/60'
5. POSITIVE SPACE 	is the way that a given center must draw its strength, in part, from the strength of other centers immediately adjacent to it in space.	Peer-to-peer learning without teacher	Enough room for rotation	Intonation, white space around a graph	Co□ee break
6. GOOD SHAPE 	is the way that the strength of a given center depends on its actual shape, and the way this e□ect requires that even the shape, its boundary, and the space around it are made up of strong centers.	Same group size	Su□cient room for necessary activities	Same level of di□culties and details	Adequate time frame for each round

Table 5: 15 fundamental properties of living centers and their implication for education exemplified by the "Ball bearing method" (Part 3)

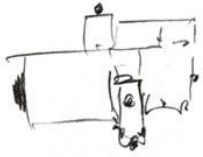
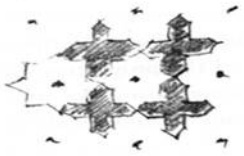
Alexander's 15 Fundamental Properties of Living Centers (TNO)		4 Dimensions of Educational Scenarios			
Name	Definition	Social Interaction	Space	Content	Time
7. LOCAL SYMMETRIES 	is the way that the intensity of a given center is increased by the extent to which other smaller centers which it contains are arranged in locally symmetrical groups.	Peer-to-peerwork, twinning	Inner/Outer circle	1 Poster for every group	Every presenta-tionsame time frame
8. DEEP INTERLOCK & AMBIGUITY 	is the way in which the intensity of a given center can be increased when it is attached to nearby strong centers, through a third set of strong centers that ambiguously belong to both.	Di□erent roles: learner = teacher & vice versa	Circle rotation, part of inner/outer circle	Question focused on a problem (feedback/ evaluation)	Fixed time schedules & personal presenta-tionstyle
9. CONTRAST 	is the way that a center is strengthened by the sharpness of the distinction between its character and the character of surrounding centers.	Teacher vs. student groups	Inner/Outer circle	Group product vs. individual presentatio, text vs. graph	60‘ vs. 5‘

Table 7: 15 fundamental properties of living centers and their implication for education exemplified by the “Ball bearing method” (Part 4)

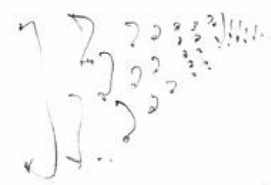
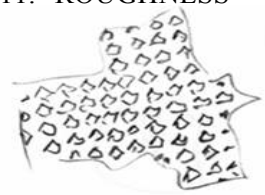
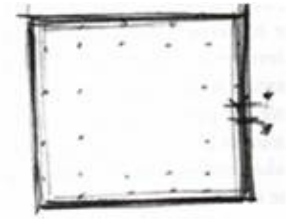
Alexander’s 15 Fundamental Properties of Living Centers (TNO)		4 Dimensions of Educational Scenarios			
Name	Definition	Social Interaction	Space	Content	Time
10. GRADIENTS 	is the way in which a center is strengthened by a graded series of di□erent sized centers which then “point” to the new center and intensify its field e□ect.	Increasing confidence, responsibility	Di□erent locations provide di□erent perspectivesfor a general subject	Small variation of every presentationleads to growing knowledge	Sequenced repetition of learned material (e.g. forgetting curve of Ebbinghaus)
11. ROUGHNESS 	is the way that the field-e□ect of a given center draws its strength, necessarily, from irregularities in the sizes, shapes and arrangements of other nearby centers.	Individual characters of teachers, students	Every station has its individual properties	Short presentation-provides rough summary	Within every time frame individual time management
12. ECHOES 	is the way that the strength of a given center depends on similarities of angle and orientation and systems of centers forming larger centers, among the centers it contains.	Socialization, incorporation of rules	Prototypes of a classroom adapted for specific method	Prior knowledge intensified and/or enhanced, redundance	Repetition

Table 9: 15 fundamental properties of living centers and their implication for education exemplified by the "Ball bearing method" (Part 5)

Alexander's 15 Fundamental Properties of Living Centers (TNO)		4 Dimensions of Educational Scenarios			
Name	Definition	Social Interaction	Space	Content	Time
13. THE VOID 	is the way that the intensity of every center depends on the existence of a still place - an empty center - somewhere in its field.	To concentrate/ to gather oneself	Way from one station to another	Starting the presentationwith an empty poster	Recreational periods
14. SIMPLICITY & INNER CALM 	is the way the strength of a center depends on its simplicity - on the process of reducing the number of different centers which exist in it, while increasing the strength of these centers to make them weigh more.	No social distractions	Removing furniture	Simple & clear examples, to get directly to the point	Clear time structure
15. NOT-SEPARATENESS 	is the way the life and strength of a center depends on the extent to which that center is merged smoothly - sometimes even indistinguishably - with the centers that form its surroundings.	Awareness of being part of a group/a larger social system	Classroom as a part of larger spatial structure (e.g. school)	Embedded in a learning objective	Scenario as a part of curriculaS-cenario as a part of curricula

5 Conclusion

Despite the fact that our "thought experiment" has to be challenged, the example described above shows that Alexander's structural elements can be transferred to pedagogy. The novelty and the art of educational design, which we can learn from Alexander, are precisely to combine the different structural features in such a way that they form mutually supporting centers which allow emerging wholeness. From this we can infer that

1. – if we want to transfer Alexander's approach to another subject –, we have to consider unquestioningly his 15 structural properties of living centers; a mere transfer of "formal" characteristics like *name – context – problem – solution – forces* is insufficient;

2. a one-to-one transfer of these structural properties is not possible, because talking about space or time, for instance, we do not refer to physical space or physical time. We have to use these concepts on a meta level. In higher education we use the European Credit Transfer and Accumulation System (ECTS), a standard for comparing the study attainment and performance of students across the European Union. One credit stands for around 25 to 30 working hours;

3. Alexander's 15 structural properties always comprise four universal dimensions: *space*, *time*, *social interaction* and *content*. Within this assumption, the expression *content* seems to fall out of alignment. What is meant by applying this concept? We guess that content refers to the corresponding subject. In architecture, for instance, content might refer to the special *function* of a building.

To sum up, we would like to point out that our first attempt to transfer Alexander's fifteen properties of living centers to educational/pedagogical theory needs to be validated, i.e. further educational scenarios must be analyzed in terms of their compatibility with the fifteen properties. The analysis of a typical educational scenario like the "Ball Bearing method" could be considered as starting point for further considerations and discussions.

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