E-Portfolio Design: Generic Rules for Creating Centers

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According to Christopher Alexander, each pattern represents a generic rule for making a kind of living center. With this in mind, a pattern language essentially seeks to define generic centers that may be used in designing projects. Hence the principle task of any pattern language writer involves trying his or her best to convey the information contained in the whole system of patterns. The authors of this paper identified and described 38 patterns that formed the basic vocabulary of a constantly evolving pattern language for working with e-portfolios. Consequently, the main purpose of this paper is to show how the recorded language as a system of patterns (or centers) works as a whole, and has the capacity to promote the sustainable development of living e-portfolios.

E-Portfolio Design; Pattern Language; Living Centers; Structure-Preserving Transformations; Wholeness

1. Introduction

What is an e-portfolio? What does it represent for learners and their learning facilitators (teachers, peers, friends, etc.)? At the simplest level, an e-portfolio is both a system in which learners can record electronic evidence of lifelong learning (texts, multimedia, images, blog entries, hyperlinks, etc.), and a social networking system which provides a way for learners to interact with their learning facilitators and create their own online communities (communities of practice, communities of interest, etc.). The selected and reflected e portfolio content (= artifacts) a learner wishes to show to his or her learning facilitators is arranged into meaningful webpages called "e-portfolio views" (cf. Figure 1).

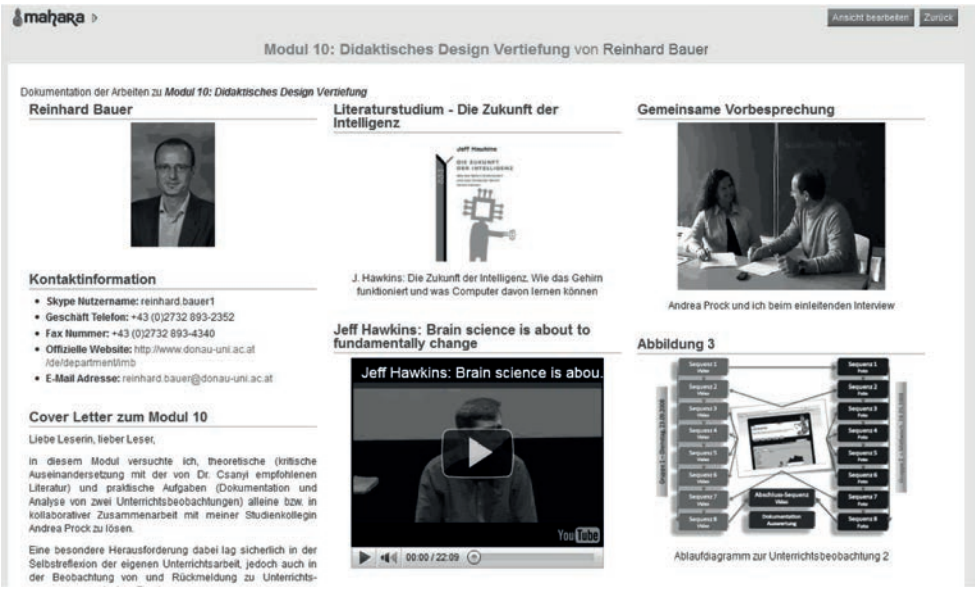


Figure 1: Screenshot of an e-portfolio view[1] created with the open-source e-portfolio software Mahara

The work on a learner's first own e-portfolio views starts by systematically gathering all the information that might be relevant for its design. Similarly to any other design project, this requires, especially for non-experienced and novice users, quite a number of capabilities and skills. Even for e-portfolio experts it is sometimes hard to explain how to best use an e portfolio for learning purposes. There are a few guidelines that help with the basics (cf. Brunner, Häcker & Winter, 2006; Himpsl-Gutermann & Bauer, 2011; Jabornegg, 2004), but what we found what was missing was a common language for describing e-portfolio practice.

1 Retrieved December 30, 2014, from http://www.mahara.at/view/view.php?id=741

Bearing this in mind, we created a pattern language for working with e-portfolios (cf. Bauer & Baumgartner, 2012a, 2012b). Our intention was to represent the basic vocabulary in the form of different patterns (cf. Appendix, Figure 6 & Figure 7) that could help lecturers and students to work on and with e-portfolios. We argue that, compared to conventional didactic guidelines, the identified e-portfolio patterns supported a wider variety of application scenarios. Just as the basic vocabulary of a natural language consists of different parts of speech (nouns, verbs, adjectives, etc.) with specific functions in terms of possible combinations (at the sentence and text level), our language of e-portfolio patterns also describes different functions: e.g. patterns for the implementation of e-portfolios in courses or patterns for the creation and design of e-portfolios. Along the lines of a generative grammar that enables speakers to understand and to generate an infinite number of sentences, even though there are only a finite number of words available, the recorded patterns enable learners to create an infinite number of e-portfolios and e-portfolio views.

Alexander notes that, "[a]t the beginning of every building design process, it is necessary to get an idea of what is going to happen in the building, how it is going to work" (Alexander, 2002, p. 342). Alexander regards design as an activity of defining functions ahead of time. Furthermore he argues that all of these functions, "when they are working well in a building, are associated with living centers", and therefore they "need to be expressed as rules for making *centers*" (ibid., emphasis in original).

What Alexander mentions in the context of architectural design also applies to e portfolio design. In our opinion, at the beginning of every e-portfolio project, it is indispensable for students to think about the purpose of the project. They should be aware that the main purpose of an e-portfolio is to communicate with others. Thus, every e-portfolio should tell a story: "Portfolios are students' own stories of what they know, why they believe they know it, and why others should be of the same opinion" (Paulson & Paulson, 1991, p. 2). An e-portfolio, therefore, is not a mere collection of different data gathered in a non-systematic and incoherent way, but rather "a purposeful and coherent collection that communicates what learnings have taken place" (ibid.). The degree of life of these stories (= e-portfolios) depends upon the intensity of the events (= centers) recorded, and is determined by how they are linked together in a sequence and by the meaning (= function) that is attributed to them.

Against this background, in the following sections, we attempt to outline how our system of patterns works as a whole, i.e. in what sense the different patterns can be regarded as generic rules for creating centers.

2. Creating a System of Patterns for Working with E-Portfolios: Preparatory Work

As a starting point for compiling our catalogue of patterns on e-portfolio work we used the taxonomy for e-portfolios, which was developed during a two-year research project called "The use of e-portfolios at (Austrian) universities" (cf. Baumgartner, 2012). These e-portfolio patterns are linked to one another and in this way already form a kind of limited pattern language. The system of categories and characteristics of e-portfolios, which was developed through processes of analysis and monitoring, formed the theoretical basis for the inductive pattern mining process.

There are, on the one hand, the three main types of e-portfolios (reflection, development, and presentation portfolios), and, on the other hand, the main activities (selecting, assessing, organizing, planning, presenting, networking, and reflecting) with the corresponding secondary activities (deciding, identifying, inspecting, approving, judging, giving feedback, appreciating, linking, and discussing), which are important for the creation of an e-portfolio.

Activities like collecting, documenting, illustrating, and elaborating, which – regardless of the type of portfolio – are absolutely essential for any portfolio work, are considered invariant with regard to the practical work of creating e-portfolios and are recorded in the catalogue of patterns, despite the fact that these activities could not be incorporated into the taxonomy due to their insufficient selectivity. The same applies to the activity of production, even if it generally precedes any portfolio work. It also applies to patterns that fundamentally affect the organization and implementation of e-portfolio work.

Alexander notes that the definition of the pattern itself, as an activity, may also be regarded as structure-preserving (cf. Alexander, 2002, p. 347). In our opinion, this is the context in which our preparatory work for creating a pattern language for working with e-portfolios should be understood.

3. Structure-Preserving Transformation and E-Portfolio Design

In the second volume of The Nature of Order, entitled "The Process of Creating Life" (2002), Alexander talks about "structure-preserving transformations":

> *The process of choosing or defining functional centers, if it is to be part of a living process, must itself derive, then, in some fashion, from the existing wholeness. Like the elaboration*

> *of geometry itself, the pre-operational phase when centers-to-be are being defined must be drawn from the existing wholeness by structure-preserving transformations (Alexander, 2002, p. 343).*

What does this mean in the context of e-portfolio design? Going back to storytelling as a metaphor for illustrating what an e-portfolio is all about, at the beginning of every e-portfolio design process, students have to be aware of what kind of story they want to tell (here: what kind of e-portfolio they want to develop, i.e. a reflection, development, or presentation portfolio). In general, all stories have the same elements (plot, protagonists, setting, etc.) and identifying these elements increases the students' understanding of their stories. It must be taken into account that writing an interesting story (here: the design of an interesting e-portfolio) is an "unfolding" rather than an "assembling" process. That is to say, if an author presents only a detailed set of isolated descriptions of the setting and the characters who are involved in a story (here: a series of e-portfolio artefacts not connected to one another at all, or only loosely connected), the key interests of a reader will not be met. Facts, characters and events of a good story have to be connected in reasonable and interesting ways. In this respect, the most important aspect of wholeness is the recognition that everything is in relationship with everything else. Regarding this matter, Alexander writes:

> *Each pattern is a rule which describes a type of strong center that is likely to be needed, on a recurring basis, throughout a particular environment or class of environments. Further, a pattern not only describes a recurring center, but also describes a relation between* **other** *generic centers. The pattern both describes a generic* **center**, *and describes a generic* **relation** *among other generic centers. But it must be remembered that the pattern describes a* **generic** *center, not a particular center. In this sense the pattern is not so much like an element in an erector set, but more a rule for making a certain kind of center capable of making an infinite number of particular centers of the same type, whenever they are needed (ibid., p. 345, emphasis in original).*

With regard to the pattern language on e-portfolio work, the following example may illustrate the significance of Alexander's idea: Taking a random pattern from the list (cf. Appendix, Group 4: Patterns for Reflective Learning), the pattern MY MIRROR is at first connected to certain larger patterns: COMPULSORY EXERCISE and VOLUNTARY EXERCISE; but also connected to certain smaller patterns: ASSESSING, LINKING, and REFLECTING. The meaning of the patterns COMPULSORY EXERCISE and VOLUNTARY EXERCISE are incomplete unless they contain MY MIRROR; and similiarly, MY MIRROR is itself incomplete, unless it contains the patterns ASSESSING, LINKING, and REFLECTING.

What this means in practical terms is that by reflecting on their personal learning processes or on certain artifacts using the pattern MY MIRROR, students must not only follow the instructions that describe this pattern itself, but must also try to embed their reflections in the patterns COMPULSORY EXERCISE and VOLUNTARY EXERCISE. This succeeds further when they use the patterns ASSESSING, LINKING, and REFLECTING.

There are no isolated patterns or centers: each pattern or center is supported by other patterns that surround it or are embedded in it. Only in this way it will be possible that one center can be strengthened by other centers.

Following this approach, the structure of an e-portfolio unfolds just like the plot of a story, i.e. step by step, all artifacts connected and related to each other, at the same time never losing track of the whole.

Bearing this in mind, the following ten features of living processes, which Alexander relates to the field of architecture, may, in our opinion, also be considered as fundamentally useful for designing living e-portfolios (cf. ibid., pp. 229 et seq.):

» Step-by-step adaptation

» Using each step to enhance the whole

» Creating a center such that that it is shaped by the next step in the differentiation

» Generative sequences as keys to success

» Uniqueness of every part

» Patterns as generic rules for making centers and life enjoyable

» Production of deep feeling

» Creating a coherent geometric order

» Building a form-language from theory

» Simplicity

In the following section we will briefly describe and clarify these structure-preserving transformation principles within the field of e-portfolio design.

4. Comprehending Alexander's Transformation Principles Within the Field of E-Portfolio Design

Alexander's fifteen fundamental properties of living centers (cf. Alexander, 2002a, pp. 239 ss.) are best understood as suggestions for structuring any kind of planning and design process. Therefore, they can also be applied for e-portfolio design. It must be observed, however, that not the individual properties themselves are important, but so are their interactions within the wholeness of a system (cf. Bauer, 2015, p. 4). In this context Alexander notes:

> *The interdependence of the properties seemed to contain a hint of something else, something richer and more complex than the properties themselves – and also more unitary – which somehow lay behind the properties. I began to realize that these fifteen properties were indicators, rough approximations of some deeper structure which looked and felt like "all of them together". [...] this "something" must be some kind of field in which centers create wholeness and wholeness intensifies centers (Alexander, 2002a, p. 238).*

Creating e-portfolios and learning with e-portfolios is complex and demanding and poses many challenges for learners. Decisions taken by the learners organize the design process and cause changes. In this context, Alexander refers to "structure-preserving transformations" (Alexander, 2002b, pp. 51 et seq.), i.e. individual steps that create and affect centers. Similarly we asked ourselves the question: what role do these transformations play in the process of creating living e-portfolios?

4.1. Step-by-step Adaptation

How do learners create a new e-portfolio view? In reference to this, we identified three pattern groups that support the portfolio process that learners have to work on: patterns for individual (cf. Figure 2), reflective (cf. Figure 3) and collaborative learning (cf. Figure 4).

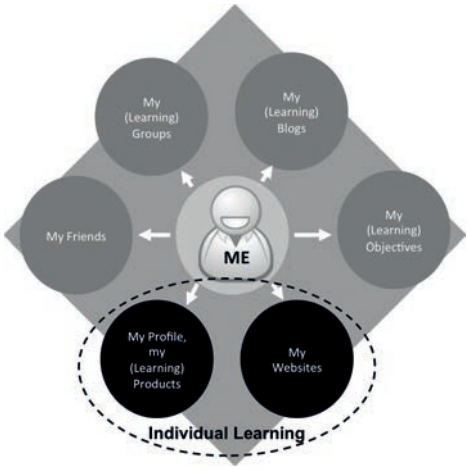


Figure 2: Individual Learning

Patterns for individual learning help students to organize, manage and structure data. The pattern MY PERSONAL LEARNING ARCHIVE is connected to smaller patterns like SELECTING, PLANNING, PRODUCING, ORGANIZING, and PRESENTING. Some of these smaller patterns, in return, are in close interaction with other patterns: PRODUCING is linked to COLLECTING, DOCUMENTING, ELABORATING and ILLUSTRATING which uses FOR THE EYE and FOR THE EAR (cf. Appendix, Figure 6).

Patterns for reflective learning refer to the possibility of documenting personal learning pathways and commenting on the development of various skills. MY MIRROR is supported by the patterns ASSESSING, LINKING and REFLECTING (cf. Appendix, Figure 6).

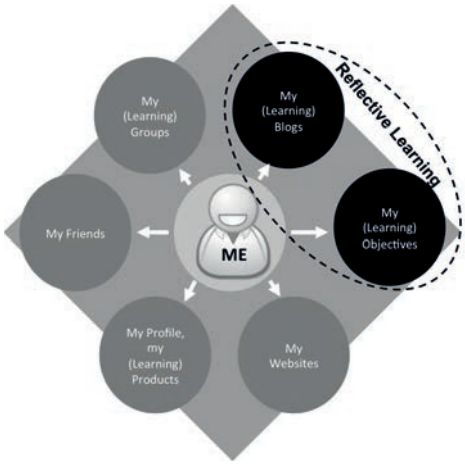


Figure 3: Reflective Learning

Finally there are patterns for collaborative learning. Generally speaking, an e-portfolio is a tool or rather a method to support personal learning processes. If it is intensively used over a period of time, it may become a kind of a personal learning environment that facilitates formal and informal learning activities among friends and peers: for these purposes, e-portfolio software usually offers appropriate tools for making friends, working and learning in groups etc. In this context, collaborative learning (cf. Figure 4) means that I as a learner invite MY FRIENDS to DISCUSS issues with me. I ask them to APPRECIATE, JUDGE, APPROVE of my work and to GIVE FEEDBACK. Thus using the e-portfolio as a personal learning environment enables NETWORKING with other learners (cf. Appendix, Figure 6).

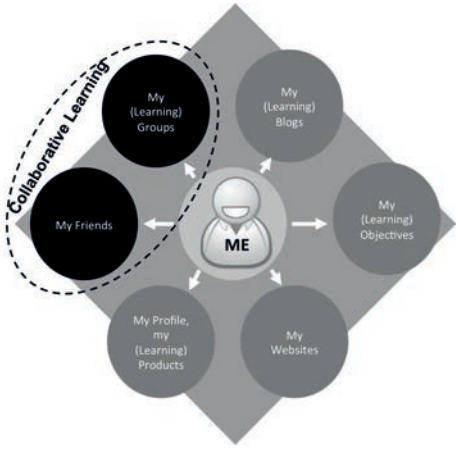


Figure 4: Collaborative Learning

The creation of an e-portfolio is a slow, gradual process. It corresponds to what Alexander describes as the most basic and necessary feature of any living process, as the core of all living processes:

> *The living structure emerges, slowly, step by step, and as the process goes forward step by step there is continuous feedback which allows the process to guide the system towards greater wholeness, and coherence, and adaptation (Alexander, 2002b, p. 230).*

The living structure of an e-portfolio cannot be created by static design and production; it can only be created by the unfolding process itself. As a first step, students collect appropriate data and documents (= individual learning), then they reflect on the selected data (= reflective learning) before they begin networking with their peers and asking them to provide feedback on their work (= collaborative learning). Continuous feedback by others permits the optimization of the learner's own work and helps the learner to deepen and expand his or her own skills, i.e. to improve his or her performance.

4.2. Attempt of each step to enhance the whole

Alexander states "that in a living process everything that happens, goes step by step" (Alexander, 2002b, p. 250). In this process each step contributes to enhance the whole. Thus, in order to produce a living e-portfolio it is essential to form a vision of the emerging e-portfolio in our mind's eye and not in sketches on paper. Words and interior visions "allow the unfolding to go forward more successfully. [...] the centers which evolve, one by one within the living process, are not hampered by arbitrary information and decisions that come too early" (ibid., p. 257). An e-portfolio as a personal learning environment always emerges during the design process. However, as mentioned above, in the early stage learners have to think about the type of e-portfolio (reflection, development or presentation portfolio) they want to create. Selecting appropriate artifacts for an intended audience particularly depends on the type of e-portfolio the learner chooses to create (cf. Figure 5).

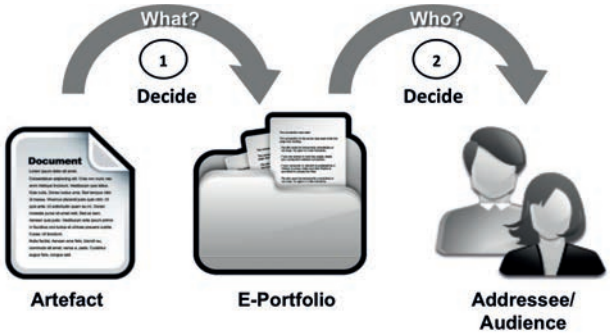


Figure 5: Decision-Making in reference to Artefacts and Audience

4.3. Creating centers in a way that they are shaped by the next step in the differentiation

From the point of view of wholeness, "[c]enters are not atomic, and are not in any normal sense building blocks" (Alexander, 2002b, p. 268). According to Alexander, one has to see that living centers are not only interrelated and support each other but also change the structure of the whole.

In this line of reasoning, creating a living e-portfolio is not a mechanical task of adding one page to the next, each page independent from the ones before. LINKING does not only relate one page to another but also changes each page itself. The content of one page is shaped and changed by the presence and content of the pages linked to it.

Apart from that, in this context, LINKING has a special role: "[t]he main job, of any task of

creating centers is always to melt away the divisions between things" (Alexander, 2002b, p. 294, emphasis in original). But LINKING not only transforms the structure of the whole: Every new piece of content – if it is not added as an isolated building block but rather with the attempt to create "not-separateness" and to create a new center which supports the whole – transforms not only the whole but all the other centers as well.

For e-portfolios it is obvious that all the activities of MY FRIENDS (DISCUSSING, APPRECIATING, JUDGING, APPROVING, GIVING FEEDBACK) change the character of my work tremendously as they frame my work from another perspective and change my monologue to a dialogue. But this is also the case when I PRODUCE another image for ILLUSTRATING and PRESENTING one of my thoughts. The expression of my view is no longer the same; the thought itself perhaps has not changed but it has taken another form, found another expression.

4.4. Generative Sequences are the Key to Success

A living e-portfolio cannot be created in a single blow. This is evident in the case of the REFLECTION PORTFOLIO and the DEVELOPMENT PORTFOLIO but it is also valid for the PRESENTATION PORTFOLIO because the learner has to present his or her material step-by-step in a certain sequence. As one thought or piece of information after another is added, the living character of the e-portfolio slowly unfolds.

Alexander emphasizes that for wholeness to emerge, all the steps have to be taken in a certain order and that it is of vital importance to find the "right" sequence (Alexander, 2002b, p. 300 et seq.). For e-portfolio work, this may seem a bit strange, as software is very flexible and text, pictures, hyperlinks, and so on can be changed easily. Further, our pattern map (cf. Appendix, Figure 6) may give the impression that it consists of an interrelated network of actions without any predefined sequence.

But this assumption is not correct and the fact becomes more clear when one takes into account the fact that there are three distinct different portfolio types immediately following the entry pattern. It is also clear that a learner cannot start PRODUCING or ORGANIZING without COLLECTING material first. In contrast to traditional guidelines, where exactly one event follows the other in a linear and cumulative way, the sequences for creating life are structure-preserving. They unfold the whole by means of differentiation and "[e]ach differentiation acts on the product of the previous differentiations, and as it does so new centers are formed und unfolded, and in turn themselves – later – get differentiated further" (Alexander, 2002b, p. 302).

In order to help newcomers to e-portfolio work to find appropriate generative sequences, we visualized the pattern language from Figure 6 also in a more traditional, hierarchical way (cf. Appendix, Figure 7).

4.5. Uniqueness of every part

The uniqueness of parts arises from the interaction between them and their interaction with the whole. Living structures do not have unconnected, isolated parts but parts that function as centers in a unified whole. A part "becomes unique because each part is adapted to its context and because, in the large, no two contexts are ever the same" (Alexander, 2002b, p. 324).

Even if one uses the same curriculum vitae in two different e-portfolios (say one for presenting learning outcomes of a master's degree, the other one to present one's own experiences during a career of playing chess tournaments) these two résumés form different kind of centers as they relate to a different context.

However, in order to strengthen these centers and to improve their aliveness, it would be beneficial to adapt the CVs to their overall function in a special context. For Alexander, adapting repetitive elements to their context so that they become unique is the formula for all living processes: "If you pay attention to the wholeness, intensify it, intensify it some more – gradually then it becomes unique" (Alexander, 2002b, p. 337).

4.6. Patterns as Generic Rules for making Centers and Life Enjoyable

In collaboration with his colleagues, Alexander developed the overall concept of the pattern language and presented one for architecture (Alexander, Ishikawa, & Silverstein, 1977; Alexander, 1979). In the context he described, pattern languages worked as generative systems to create centers for living human environments:

> *A pattern language is essentially a way of defining generic centers, and then using them, sequentially, in design projects. The entities we called patterns were – albeit in an early formulation – somewhat similar to the entities I now call centers. One might say that every pattern which was defined under that theory was, in effect, a rule for making or partly making some important type of center, necessary to the life of a living human environment (Alexander, 2002b, p. 344).*

As Pattern languages have to fulfill various human needs, we identified the following:

» Each culture has its own pattern language. For instance our e-portfolio pattern language is tailored to the needs of a culture where REFLECTING and COLLABORATING are the

preferential way of learning. For instance, in our pattern language there is no center (or pattern) for rote learning but there are patterns for DISCUSSING, GIVING FEEDBACK, NETWORKING and so on.

» Although pattern languages for working with e-portfolios vary from one learning culture to another, there is an invariant structure for all pattern languages for working with e portfolios because they should address the basic needs of MY PERSONAL ARCHIVE (PLANNING, PRODUCING, ORGANIZING, SELECTING, and PRESENTING).

» Patterns explicitly provide the rules for the creation of centers and for relating then to the whole (context) and therefore should "allow discussion, debate, and gradual improvement of the material" (Alexander, 2002b, p. 345).

» Today, people tend to understand the importance of pattern languages and try to develop suitable patterns. However, some patterns are not suitable for providing the generative rules for creating a living whole system or environment. Pattern languages have to comprise "everything that needs to be said about a given [...] situation, and that the various patterns it contains work together as a whole system which accounts for all morphology that is required [...]" (ibid.).

4.7. Production of Deep Feeling

In science, the notion of "feeling" often arouses skeptical brow-knitting because it is confused with personal emotionality, which is supposed to be excluded from so-called "objective" scientific method. FromAlexander's perspective, however, "feeling" is "the mode of perception and awareness which arises when a person pays attention to the whole" (Alexander, 2002b, p. 371). Thus, whenever we pay attention to the whole, we experience feeling. This gives us the possibility to enhance the liveliness of a certain structure, if we choose steps that intensify the positive feeling for the emerging whole. According to Alexander, it is very difficult to judge this feeling in absolute terms. Rather only by comparing two objects, two different steps (or centers) can one get a sense of how they change the whole. According to Alexander, we can produce a relatively objective judgment about an object because the feelings are reproducible in different people. For Alexander, a feeling produced by focusing the awareness on the wholeness of a configuration is precise, accurate, reliable and stable.

This is a much-disputed claim and all the experiments that Alexander carried out to prove his assertion failed to convince the scientific community at large. When we tried to reproduce some of these experiments ourselves (cf. Baumgartner, 2013) we did not get a clear confirmation of his claim. However, this does not necessarily refute Alexander's claim. Our

experiments may have been influenced by technical difficulties and semantic ambiguities (e.g. presentation mode, the verbal presentation of the questions).

On the one hand, feelings cannot be clearly captured verbally, visually or aurally. This makes it impossible to communicate them objectively. I am able to communicate my toothache, but ultimately the pain remains mine and not yours. There is some inner subjective quality about feeling that makes it difficult to describe them objectively, as philosophers have pointed out many times (e.g. Searle 1983, Nagel 1989).

On the other hand, manifest and evident differences really do exist in the world, such that a comparable judgment can be made in an interpersonal, reproducible and stable manner. In these cases people (from the same culture, and with the same background and needs) may judge the same objects in the same way, e.g. as being ugly or beautiful. In these cases we can at least say that it is possible to issue a reliable "aesthetic" verdict about the quality of life of an object. Even if this does not constitute an anthropological constant in the Alexandrian sense, it does show at least that certain groups of people ("target groups" in public relation parlance) share at least some profound common basis that can be used to improve design.

We think that our argument is not in conflict with Alexander's. If we compare the feelings aroused by focusing on our awareness of the wholeness of two situations, we must concede that seeing the underlying "deep structure"

- is in practice very hard and needs practice,
- has a clearly subjective dimension ("Does it increase my own wholeness?"), and
- depends on the imagined or constructed context of the situation

For example, Alexander tries to demonstrate how to choose from different doors according to the degree of feeling (Alexander, 2002b, p. 376 et seq.). He sketches different doors and asks people to describe the feelings these doors arouse, remarking in a footnote:

> *Of course I am simplifying the situation drastically, since in a real case, my decision will be affected by the extent to which this door in its context, has the most feeling. That would make an enormous difference (Alexander, 2002b, p. 396).*

Therefore it is important that in our pattern language for e-portfolio work choosing the right context as the basis for further judgment is essential (regardless of whether it is a REFLECTION PORTFOLIO, DEVELOPMENT PORTFOLIO or PRESENTATION PORTFOLIO). Even if all artifacts do to some extent affect the whole and – seen in their context – arouse certain

feelings, there are two patterns that are particularly predestined to provoke feelings: FOR THE EYE and FOR THE EAR.

4.8. Creating a Coherent (Geometric) Order

What is a coherent order? Put simply, a coherent order refers to a logical progression in which each part naturally follows the previous one. Alexander describes this process in relation toother living processes when he notes:

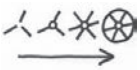
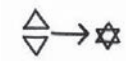
> *All living processes use unfolding to create geometric order. […] the unfolding of coherent order – especially through the use of the fifteen transformations – occurs continuously. […] when we contemplate any living process at all, we always see that the length and breadth of the process will be suffused by steps through which a coherent geometry unfolds. (Alexander, 2002b, p. 402 s.).*

Later in his text, Alexander states that "a similar 'brutal' and purely geometric process always occurs somewhere in other kinds of unfolding that generate living order. […] something similar is going on in poetry, in dance, in the formation of social structure, in planning […]" (Alexander, 2002b, p. 429). Alexander answers pivotal questions as to whether the formal creation of geometry really applies to other living processes - such as the formation of a community or the unfolding of a melody played on a flute, - with a clear yes. In his opinion, it applies "to the emergence of any coherent whole, in almost any medium" (Alexander, 2002b, p. 430).

Working with and on e-portfolios is a process that includes creating a coherent narrative about the past, the present, and the future. This unique unfolding description of a learning experience takes the following center-generating transformations into account (cf. Table 1, based on Salingaros, 2012, pp. 102 et seq.; diagrams drawn by Helmut Leitner):

Table 1: Center-Generating Transformations

	**Stepwise: Perform one step at a time** It is impossible to complete an e-portfolio view all at once. The learners have to start with (a) the context definition (choice between the patterns REFLECTING PORTFOLIO, DEVELOPMENT PORTFOLIO or PRESENTATION PORTFOLIO), and then to continue with (b) the collection (PRODUCING, COLLECTING, DOCUMENTING, ELABORATING, ILLUSTRATING), (c) the reflection (LINKING, DISCUSSING), (d) the selection (IDENTIFYING, INSPECTING, DECIDING), (e) the projection (ASSESSING, APPRECIATING, JUDGING, APPROVING, GIVING FEEDBACK), and, finally (f) the presentation (PRESENTING, DEVELOPMENT PORTFOLIO, PRESENTATION PORTFOLIO).

	**Reversible: Test design decisions using models; "trial and error"; if it doesn't work, undo it** Using the pattern MY FRIENDS, and being supported by the smaller patterns of NETWORKING and DISCUSSING constitutes an opportunity for judging whether or not an individual design step has indeed led closer to a whole and living e-portfolio that is a coherent narrative of the past, the present, and the future. Such an e-portfolio view should make a learner's special skills and knowledge to him-/herself and to others. Undoing a design step is necessary if it fails to do so.
	**Structure-preserving: Each step builds upon what is already there** Mehaffy and Salingaros (2011) see this as "the theoretical and philosophical underpinning of all of Alexander's [...] work. The most complex, yet adaptive and successful designs arise out of a sequence of co-adaptive steps and adjustments that preserve the existing wholeness. On the other hand, designs that arise all at once are for the most part simplistic, non-adaptive, and dysfunctional. A trivial algorithm cannot generate living structure. And even a single step away from wholeness can derail the system." This also applies to the design of an e-portfolio view: the selection of appropriate artifacts starts with the pattern IDENTIFYING followed by INSPECTING, DECIDING, etc.
	**Reversible: Test design decisions using models; "trial and error"; if it doesn't work, undo it** By using the large patterns MY MIRROR and MY FRIENDS combined with related smaller patterns like REFLECTING, DISCUSSING, etc. it becomes possible to create an improved overall coherence.
	**New from existing: Emergent structure combines what is already there into a new form** Mehaffy and Salingaros (ibid.) state that "a functionally complex system evolves through cumulative steps, changing and getting better and more complex and thus acquiring more advanced capabilities. [...] designing from evolving wholeness will introduce features – asymmetries, symmetries, connections, new scales – that are inconceivable within an assembly approach to design." This also applies to the design of an e-portfolio view: e portfolio systems provide a large data repository for user files. Therefore, learners can create different assemblages out of the existing data files, i.e. e-portfolio views targeted towards particular audiences.

4.9. Building a Form-Language from Theory

If a pattern language works well, it follows rules to create living centers. Alexander's pattern language, together with the 15 properties he describes in Volume 1 of "The Nature of Order" (2002a) form the theoretical underpinning for a formal language that can be used on every object or situation in a specified domain.

The goal of a pattern language is to carry out formal transformations and to create a coherent order, a place where people can enjoy their lives. For Alexander it must a geometric order because living centers in space are defined geometrically. Of course, this geometric approach cannot be applied to all other relevant design domains. In these cases, the predominantly geometrically defined 15 properties must be adapted to those domains. We have explored this in different ways with regard to education in other contributions in this volume (cf. Bauer, 2015; Baumgartner & Bergner, 2015).

While working on our pattern language for e-portfolios we did not explicitly refer to the 15 properties as transformational aides. This is because they did not make sense to us in the way Alexander formulated them. However, we believe that a logical next step is to develop a pattern language for e-portfolio work now, having already adapted Alexander's 15 properties to the educational domain.

4.10. Simplicity

Alexander defines simplicity in a procedural way:

> *In my description on the fundamental process, I have stated that what happens next (at any moment in the unfolding of a living process) is the* **simplest** *thing that can be done to intensify existing centers. It is necessary that it must be simple because if there is too much extraneous clutter, the clutter gets in the way, makes less room for new necessary structure that the unfolding process is trying to achieve. Thus, "doing the simplest thing," only the thing which is* **required** *and nothing* **beyond** *what is required, is a practical and efficient necessity (Alexander, 2002b, p. 463, emphasis in original).*

According to Alexander, there is an internal or psychological quality, which he calls "purity of heart" (ibid., p. 464) that is essential to the generative process. During this process we have to critically question every (new) distinction. Any distinction that is unnecessary should be removed and replaced with a symmetrical counterpart. Asymmetrical structures tend to induce unnecessary centers that interfere with already existing wholeness and are prone to destroy the liveliness achieved so far.

Figure 6 (cf. Appendix) envisions our network of 38 related patterns. Even though it appears complex and seems to counteract the maxim of simplicity, its actual task is to show the wholeness of structure that is our e-portfolio language. Figure 7 (cf. Appendix) illustrates the same pattern language in a visually simpler way.

Each transformation caused by one of the 38 patterns is pretty simple. But this does not mean that beginners and experts will produce similar results. Becoming aware of whole-

ness takes time, experience, and practice. To help practitioners of all levels to work efficiently and effectively, we have therefore applied the same structure to every pattern in our pattern language. Each pattern is built with the same sequence, It includes: (a) name of the pattern, (b) photo, (c) environment, (d) problem, (e) forces, (f) solution, (g) details, (h) stumbling blocks, (i) advantages, (j) disadvantages, (k) examples, (l) types of user, (m) tools, (n) related patterns, and (o) references.

5. Conclusion

The main goal of this paper was to provide background information and explanations to demonstrate that our pattern language for working with e-portfolios is in alignment with Christopher Alexander's general thrust and theoretical. Even if we did not appreciate some of the philosophical remarks Alexander made in "The Nature of Order" at the time when we developed our pattern language, we still believe that the 38 patterns we identified for our pattern language are effective in designing living e-portfolios and thus can be said to qualify as real patterns.

In order to understand and facilitate the use of our pattern language for working with e portfolios we plan to design a set of **E-Portfolio Pattern Cards**. By "playing" with these cards, learners will be able to review and deepen their knowledge about about e-portfolio design, e-portfolio patterns, and the art of useful pattern combining.

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7. Appendix

In this appendix we give a brief overview of our pattern language for working with e-portfolios in the form of a list of patterns and two pattern maps (cf. Bauer & Baumgartner, 2012).

As with the basic vocabulary of a natural language, which consists of different parts of speech (noun, verb, adjective, etc.) which have specific functions in terms of possible combinations (sentence and text level), our pattern language describes e-portfolio patterns with different functions such as patterns for the implementation of e-portfolios in courses and patterns for the creation and design of e-portfolios. Just as a generative grammar enables a speaker to understand and to generate an infinite number of sentences even though there are only a finite number of words available, the described e-portfolio patterns enable users to create an infinite number of e-portfolios. Our pattern language for working with e-portfolios represents the basic vocabulary in the form of different patterns that help lecturers and students to work on and with e-portfolios.

The pattern map presented in Figure 6 shows the relationship between the 38 e-portfolio patterns we have identified so far and how they support each other. They can be divided into different groups (visualized by different shades of grey) on different levels (cf. Figure 7): Some patterns are applied to special types of e-portfolios and their organization, while others address the motivation behind e portfolio work while still other patterns are more important for individual, reflective, and collaborative learning. Thus, the recorded pattern language basically comprises three main levels that address the following questions:

- **Level 1: Which fundamental types of e-portfolios are at the learner's disposal?**
- **Level 2: How can e-portfolio work be organized in a motivational way?**
- **Level 3: Which possibilities are offered for e-portfolios design?**

For better orientation within the pattern language and for better locating individual patterns, our catalogue of e-portfolio patterns is divided into five large groups of overall patterns which contain other (sub-) patterns:

Level 1

Group 1: Patterns for E-Portfolios

1. E-PORTFOLIO (= Entry Pattern)
2. REFLECTION PORTFOLIO
3. DEVELOPMENT PORTFOLIO
4. PRESENTATION PORTFOLIO

Level 2

Group 2: Patterns for the Organization and Motivation of E-Portfolio Work

5. ORGANISATION FORM
6. UNITY MODEL
7. CENTRIFUGAL MODEL
8. CENTRIPETAL MODEL
9. PARALLEL MODEL
10. MOTIVATION
11. COMPULSORY EXERCISE
12. VOLUNTARY EXERCISE

Level 3

Group 3: Patterns for Individual Learning

13. MY PERSONAL LEARNING ARCHIVE
14. SELECTING

15. IDENTIFYING

16. INSPECTING

17. DECIDING

18. PLANNING

19. ORGANIZING

20. PRODUCING

21. COLLECTING

22. DOCUMENTING

23. ELABORATING

24. ILLUSTRATING

25. FOR THE EYE

26. FOR THE EAR

27. PRESENTING

Group 4: Patterns for Reflective Learning

28. MY MIRROR

29. ASSESSING

30. LINKING

31. REFLECTING

Group 5: Patterns for Collaborative Learning

32. MY FRIENDS

33. NETWORKING

34. APPRECIATING

35. JUDGING

36. APPROVING

37. GIVING FEEDBACK

38. DISCUSSING

Depending on the particular role users of this pattern language play in the overall structure of e-portfolio work, they can select those patterns which are most relevant to their individual needs, and are relevant to the specific phase of the e portfolio work in which they are involved.

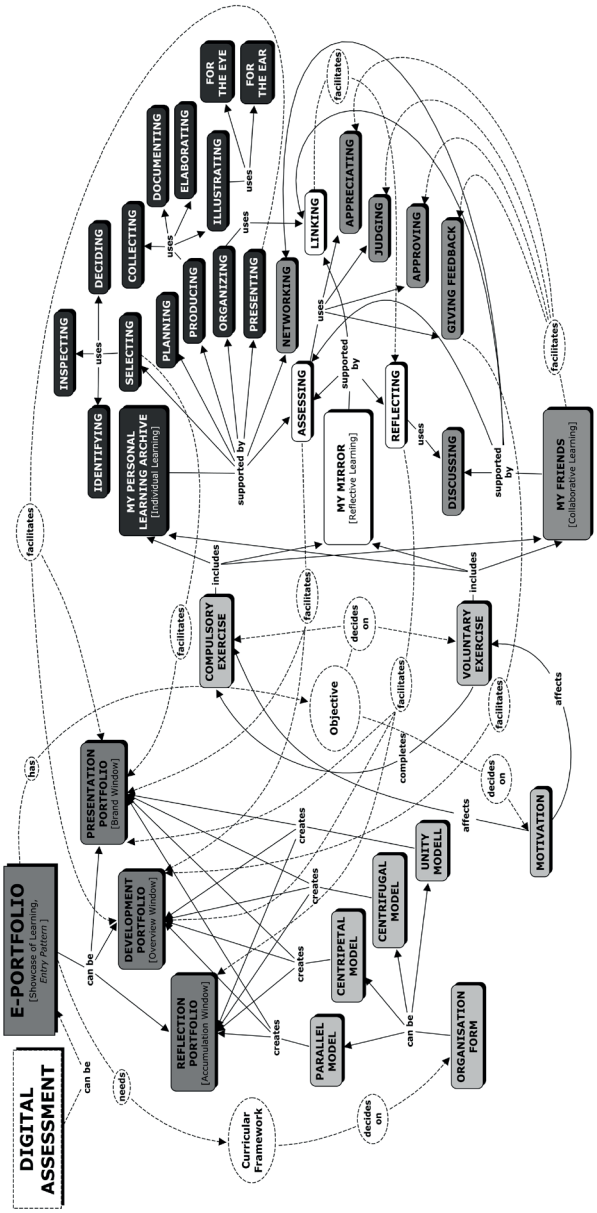

Figure 5: Decision-Making in reference to Artefacts and Audience

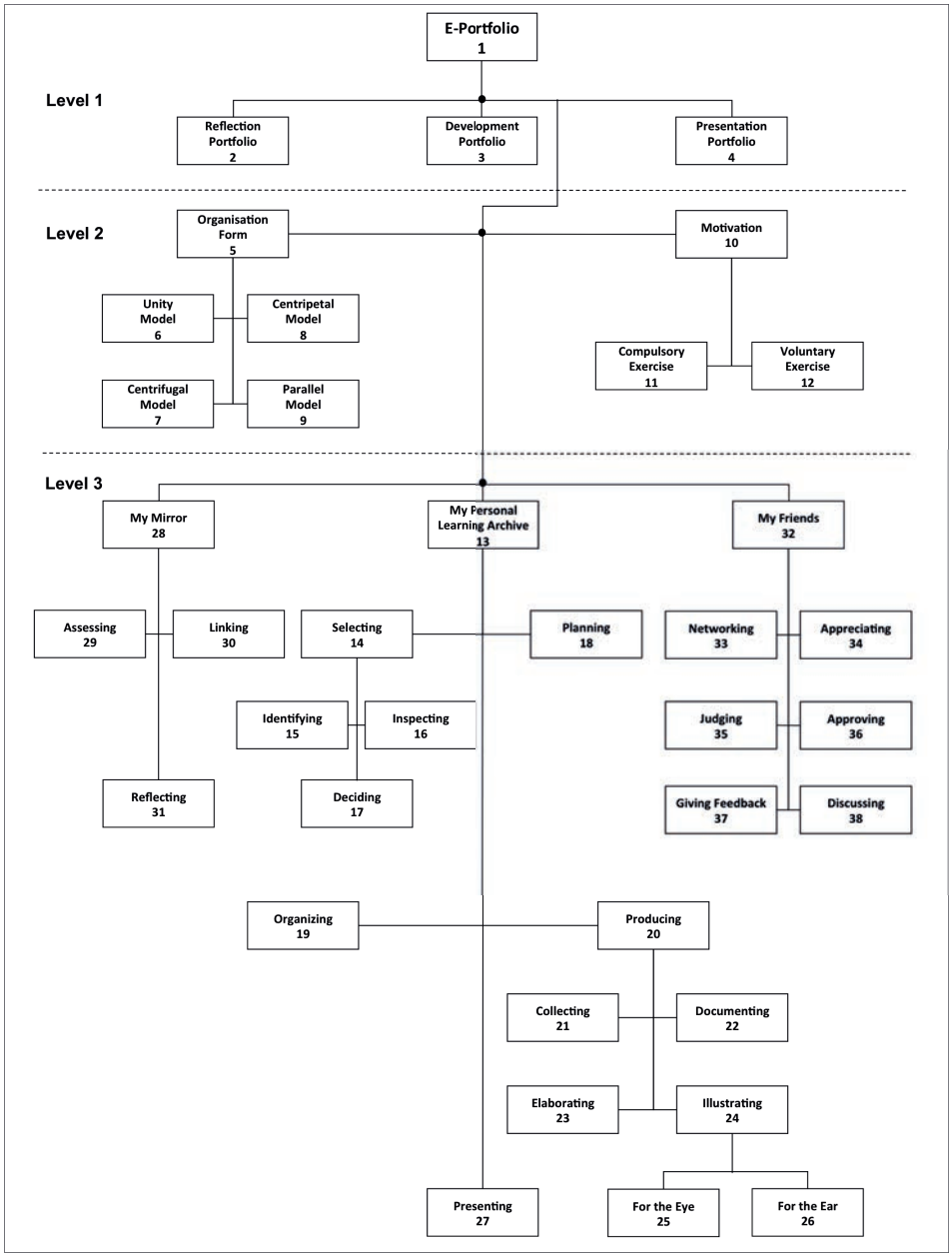

Figure 5: Decision-Making in reference to Artefacts and Audience

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