A Holistic Way of Pattern Language Crafting: Process, Forms of Reasoning, and the Grounded Essence Approach (GEA)

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This plenary talk report presents a holistic way of pattern language crafting that I have developed and refined over two decades in collaboration with colleagues. The report discusses three essential aspects: the operational aspect for language construction, the reasoning aspect for scientific inquiry, and the academic aspect for qualitative research. First, the operational aspect for language construction divides the crafting process into three major phases: Pattern Mining, Pattern Writing, and Pattern Symbolizing. Second, the reasoning aspect for scientific inquiry introduces two forms of reasoning employed in pattern language crafting: abduction and essence intuition. Abduction, proposed by Charles S. Peirce as retroductive reasoning for hypothesis formation, is extensively utilized in pattern language crafting through Cause-Seeking Abduction, Goal-Oriented Abduction, and Matching Abduction. Essence intuition (eidetic intuition), proposed by Edmund Husserl as the phenomenological method for grasping and describing the essence of phenomena, is also frequently employed in pattern language crafting. Third, the academic aspect for qualitative research introduces the Grounded Essence Approach (GEA), which consists of Constructing Internal Validity during Crafting and Confirming External Validity after Crafting. This report serves as both a comprehensive follow-up resource for session participants and a reference for those unable to attend the presentation.

Categories and Subject Descriptors: **[Human-centered computing]**: Collaborative and social computing—*Collaborative and social computing theory, concepts and paradigms*—*Collaborative content creation*; **[Human-centered computing]**: Interaction design—*Interaction design process and methods*—Contextual design

General Terms: Human Factors

Additional Key Words and Phrases: pattern language, abduction, phenomenology, qualitative research

ACM Reference Format:

Iba, T., 2024. A Holistic Way of Pattern Language Crafting: Process, Forms of Reasoning, and the Grounded Essence Approach (GEA). HILLSIDE Proceedings of the 31st Conference on Pattern Languages of Programs, People, and Practices (October 2024), 31 pages.

1. INTRODUCTION

The year 2024 marked a new chapter for the PLoP conference, which reached its 30th anniversary. This milestone year brought significant changes, including the official renaming of the conference from 'Conference on Pattern Languages of Programs' to 'Conference on Pattern Languages of Programs, People, and Practices.' Along with this new identity, the conference relocated to Skamania Lodge, Washington, and introduced a new session format called 'Imagination Run Wild.'

At the conference, I had the honor of delivering a plenary talk. My talk described the processes and methods for crafting pattern languages that I have developed and refined over the past 20 years in collaboration with colleagues. I distributed a booklet compiling our previous papers on the methodology, and the attendees appeared to gain valuable insights from both the presentation and the supplementary materials. A photo from that moment is shown in Figure 1.

This report provides the content of my plenary talk. It presents a holistic approach to pattern language crafting from three perspectives: the operational aspect for language construction, the reasoning aspect for scientific inquiry, and the academic aspect for qualitative research. The operational aspect for language construction demonstrates the process of pattern language crafting through systematic construction activities, detailing what is created from the intermediate products of previous stages. The reasoning aspect for scientific inquiry argues that merely following operational procedures is insufficient; rather, substantive thinking grounded in scientific inquiry is essential, and introduces two forms of reasoning: abduction and essence intuition. The academic aspect for qualitative research presents the Grounded Essence Approach (GEA) for qualitative research, specifying patterns as essences that are grounded in experience.

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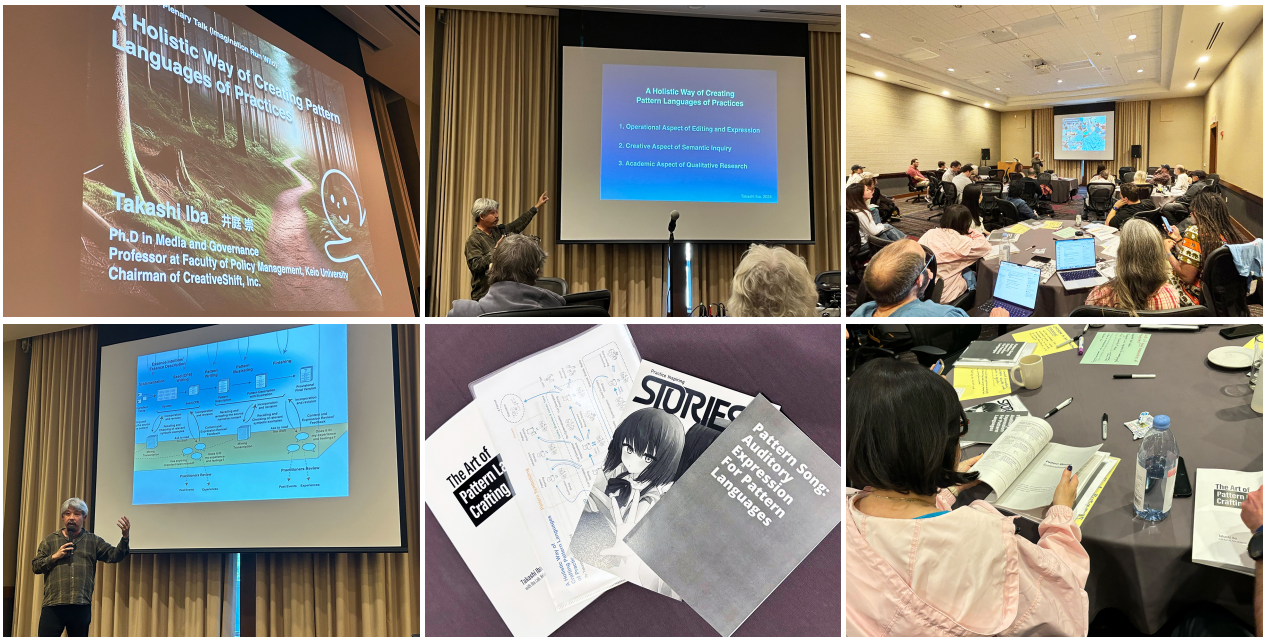

Fig. 1. Scenes from my plenary talk and handouts at the PLoP 2024 conference.

2. PROCESS AND METHODS FOR PATTERN LANGUAGE CRAFTING

In 2002, I crafted my first pattern language on modeling for social simulation, the *Model Patterns* (Okabe and Iba 2003, Iba et al. 2005). Since then, we have crafted the *Learning Patterns* (Iba et al. 2009, Iba and Miyake 2010, Iba and Sakamoto 2011, Iba and Iba Lab. 2014a), a pattern language for creative learning, as well as the *Presentation Patterns* (Iba et al. 2012, Iba and Iba Lab. 2014b) and the *Collaboration Patterns* (Iba and Isaku 2013, Iba and Iba Lab. 2014c). Around that time, I recognized that these works represented examples of what could be considered a new genre called 'Pattern Language of Practices' (initially, to emphasize the distinction from architecture and software, I termed it 'Pattern Language of Human Actions' and 'Pattern Language 3.0'), and I began proposing this concept at various conferences (Iba 2011, 2012).

When I first began crafting pattern languages with my students in 2004, we could find little discussion about the methodology for crafting pattern languages. Consequently, when we crafted our pattern language, I faced the necessity of developing both a crafting process and supporting methods. Thus, I developed our crafting process and methods while simultaneously implementing them. Over the subsequent 20 years, I refined this methodology through the practice of crafting pattern languages with my colleagues in the Iba Lab at Keio University and CreativeShift, Inc. (Iba and Kobayashi 2008, Iba et al. 2011, Iba and Isaku 2012, 2016).

Based on insights gained through this experience, I have delivered keynote and invited talks on the concept of pattern languages of practices and our methodology (Iba, 2012, 2014a, 2015, 2017a, 2022), and have conducted workshops at conferences worldwide, enabling participants to experientially learn our methodology (Iba 2013, Iba et al. 2018, Kubota et al. 2014, Munakata et al. 2017, 2019, Yoder and Iba 2017a, 2017b, Yoshikawa et al. 2017). For more detailed historical information on our creative journey from that time to the present, please refer to Iba (2023a).

Partly due to this influence, our methodology has been adopted by several researchers and authors, with their results beginning to appear in books and academic papers. For instance, in the O'Reilly book *Cloud Native Transformation: Practical Patterns for Innovation* (Reznik et al. 2019), the authors acknowledge that their patterns were developed based on our methodology, citing our papers. The authors state the following in their book:

> "The Hillside Group functions as the de facto hub of the global patterns community, which gathers at annual Pattern Languages of Programs (PLoP) conferences that Hillside sponsors. The conferences focus on pattern writing workshops and invited talks related to pattern development. One frequent PLoP conference presenter is Takashi Iba, a prominent patterns researcher at Keio

University in Japan. Iba is also a prolific patterns author who, working with his students over the past decade, has created more than 20 pattern languages containing more than 600 patterns covering many different topics. As a part of this process Iba has developed his own process for creating patterns and a protocol for presenting them." (Reznik et al. 2019, p.38)

"**Our Approach**

The authors of this book followed largely in Iba's footsteps. Some patterns were mined during whiteboard sessions with Container Solutions engineers, others during collaborative brainstorming and epic patterns-writing sessions in London, Amsterdam, and Baltimore. Early versions of six patterns were produced as part of a paper presented at the 2018 PLoP conference. That paper, titled 'A Cloud Native Transformation Pattern Language,' inspired the creation of many more patterns and eventually grew into this book." (Reznik et al. 2019, p.40)

Furthermore, at EduPLoP, a workshop on educational pattern languages held in the Netherlands, pattern languages were reportedly created following our methodology (Bergin et al. 2015a, 2015b, Warburton et al. 2016a, 2016b). Additionally, in Japan, research conducted using our methodology has started to be published as academic papers. Examples include pattern languages for Living Labs (Akasaka and Nakatani 2021, Akasaka et al. 2020) and a pattern language describing experiences in industry-academia collaborative Project-Based Learning (Osada 2021).

As demonstrated above, several individuals have read and applied our previously published papers. However, these papers were published at different conferences at different times, making them difficult to find. Moreover, since our methodology continues to evolve, some early publications have been updated through subsequent research.

Therefore, in this report, I would like to present our latest processes and methods, while also discussing the forms of reasoning involved and the approaches that make it more robust as a research methodology. Additionally, I would like to include references to our papers that remain valuable resources even from today's perspective. In what follows, I will explain our approach in the following order: the operational aspect for language construction, the reasoning aspect for scientific inquiry, and the academic aspect for qualitative research.

3. OPERATIONAL ASPECT FOR LANGUAGE CONSTRUCTION

The overall picture of the pattern language crafting process I have developed and refined is shown in Figure 2 (Iba 2023b). It consists of three major phases: Pattern Mining, Pattern Writing, and Pattern Symbolizing.

3.1 Pattern Mining

The first phase is Pattern Mining, where we obtain information that will become the elements of the patterns and compile it. 'Mining' means 'digging up,' and what we are digging up here is, of course, not physical ore or crude oil, but pattern material for creating patterns. Pattern material is extracted through interviews with practitioners, delving into their narratives. We call these interviews for extraction 'Mining Interviews' (Figure 3). We ask practitioners to clarify "What is important to do" (*what*) in order to produce good results in their practice, and also ask "How to do it well" (*how*) and "Why it is important" (*why*) (Iba 2021a). The methodology for Mining Interviews and their analysis is detailed in Iba and Yoder (2014) and Iba and Isaku (2016). Usually, we collaborate with around 15 to 20 practitioners to mine rules of thumb from their experience.

In addition to the Mining Interview method, there are other mining approaches. When we are the practitioners ourselves, there is 'Mining Dialogue,' where we explore what is important to do based on our own experiences through dialogue (Iba and Isaku 2012), as shown in Figure 4. There is also 'Mining Research,' which involves extracting important aspects of practice from the literature.

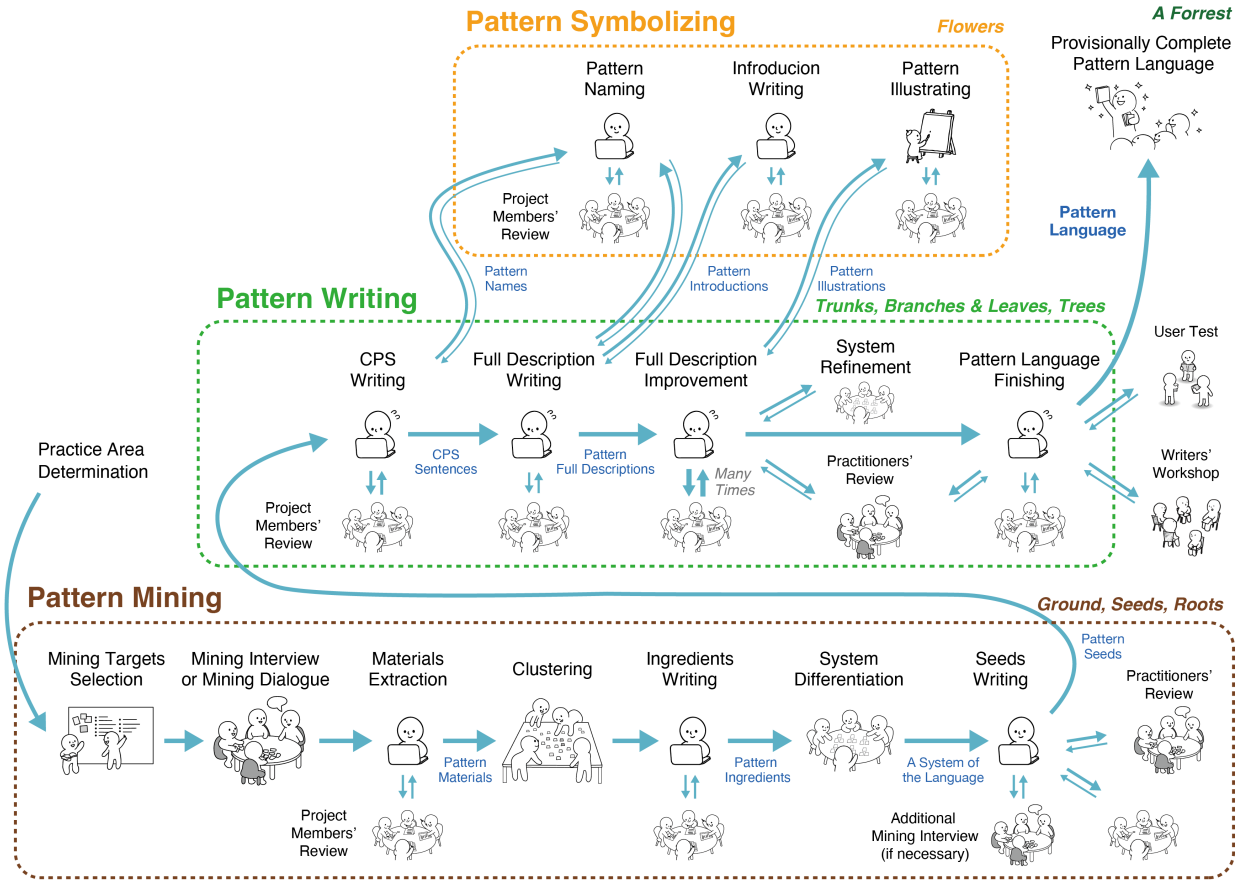

Fig. 2. The pattern language crafting process developed by Takashi Iba and refined through practices in Iba Lab and CreativeShift, Inc.

Fig. 3. Scenes from Mining Interviews, where practitioners engage in Pattern Mining through interviews in in-person settings (left) and online settings (right).

Narratives from Mining Interviews and Mining Dialogues are recorded and transcribed. Subsequently, the transcribed text is reviewed to identify parts that provide significant information for crafting the pattern language, such as "What is important to do" (*what*) and "How to do it well" (*how*). For a more robust approach, each project member independently identifies significant pieces, which are then cross-verified by multiple individuals (Figure 5, left). The essence of these important pieces is then summarized in a single sentence and transferred to cards as shown in Figure 5 (right). These cards, which consist of pattern materials, are called 'material cards.'

Fig. 4. Scenes from Mining Dialogue, where participants mine patterns from their own experiences.

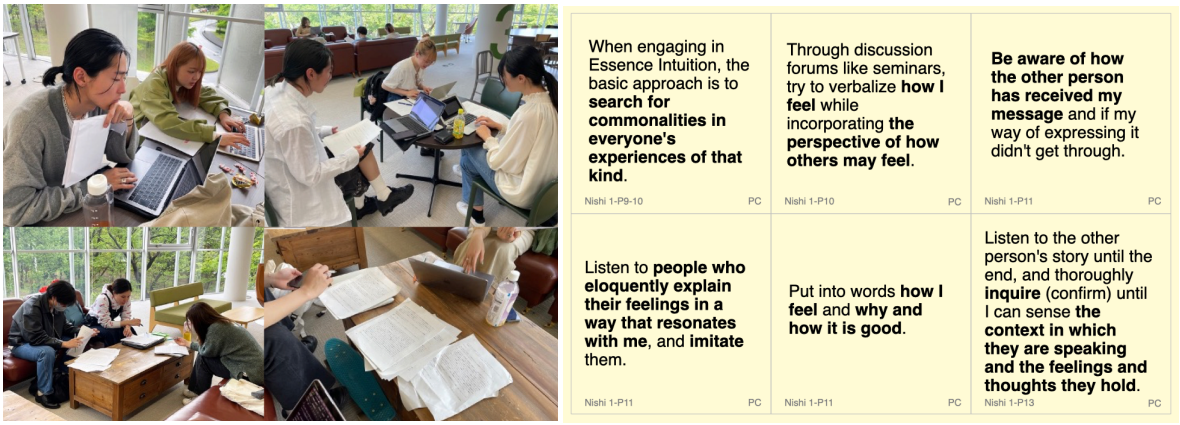

Fig. 5. Scenes from identifying key insights in mining transcripts and validating them with team members (left), alongside the design of material cards that capture these important elements (right).

After creating material cards based on the mining process, the next step is Clustering, where cards that share the same or similar meanings are grouped together. In multiple Mining Interviews, similar stories or rules of thumb are often shared, which are then bundled together. At this stage, these materials represent a collection of various types and sizes. Therefore, we perform Clustering to group material cards with similar semantic content.

When printing material cards, use different colors for each interview to facilitate the clustering process (Figure 6, left). This color-coding serves as a reference when searching for cards during the Clustering process. Additionally, when examining the Clustering results, the presence of multiple colors in the same cluster visually indicates that multiple individuals shared the same or similar concepts (Figure 6, right). For more detailed information on the Clustering method and patterns, please refer to Iba et al. (2017), Iba and Isaku (2016), and Sasabe et al. (2016).

As a result of this Clustering, we obtain groups of material cards. Based on these groups, we express the essence of each group as a single sentence, which we call a pattern ingredient, and create 'ingredient cards' (Figure 7, left). When doing this, we do not simply compile and summarize all the content of the gathered material cards evenly. Instead, we selectively emphasize the most essential cards within each group and express them in a single sentence (Figure 7, right). After creating ingredient cards for all the groups obtained through clustering, we proceed to the next step: System Differentiation. Note that this is what we initially called 'Structure Building,' later renamed 'Systematization' (Iba 2021b), and now call 'System Differentiation' to emphasize *differentiation from the whole*.

Fig. 6. Material cards printed on colored papers (left), and scenes from clustering, where material cards are first randomly arranged and then systematically organized through iterative review to create meaningful groupings based on similarities in meaning (right).

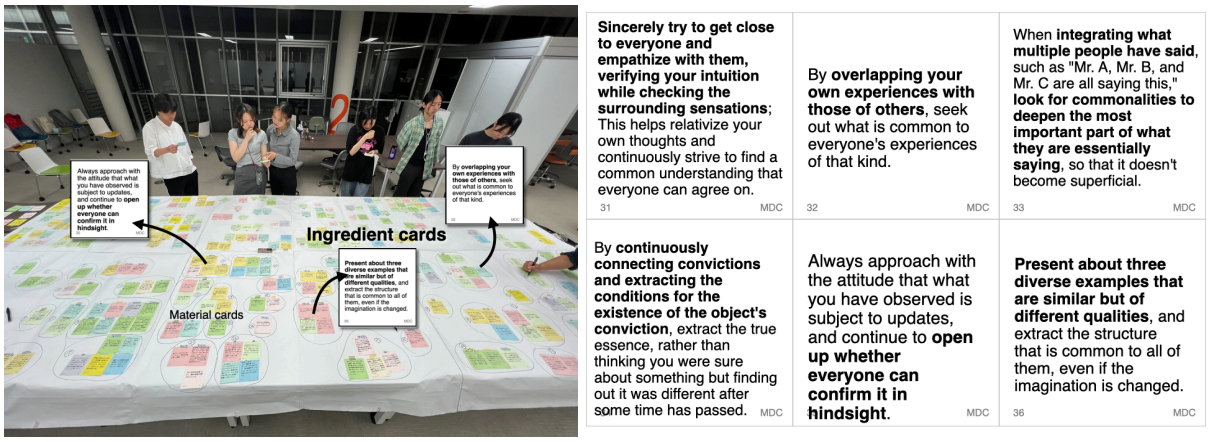

Fig. 7. Creating ingredient cards to articulate the meaning of each cluster formed through Clustering (left), alongside the design of ingredient cards (right).

The system in this context refers to the structure of the pattern language, as well as the framework of positions and meanings that each pattern should fulfill. Figure 8 shows examples of pattern language systems of the *Words for a Dialogue* (Iba et al. 2017, Iba and Nagai 2018) and the *Online Education Patterns* (Hayashi et al. 2021, Adachi et al. 2021, Inoue et al. 2023). As Saussure stated, language is a system of differences, and as Alexander noted, wholeness is not created by combining parts but rather through differentiation from the whole (Alexander 2002). Based on these principles, in System Differentiation, we develop the systematic structure of the pattern language through differentiation from the whole, thereby determining the position and intended meaning of each pattern (Figure 9).

In System Differentiation, we first broadly examine the ingredient cards produced in the Clustering step to gain a general understanding of what is available. Then, we identify three essential parts that are crucial for the entire practice (Figure 10). Here again, each member considers this individually before sharing their thoughts, discussing them, and refining them collectively (Figure 11, left).

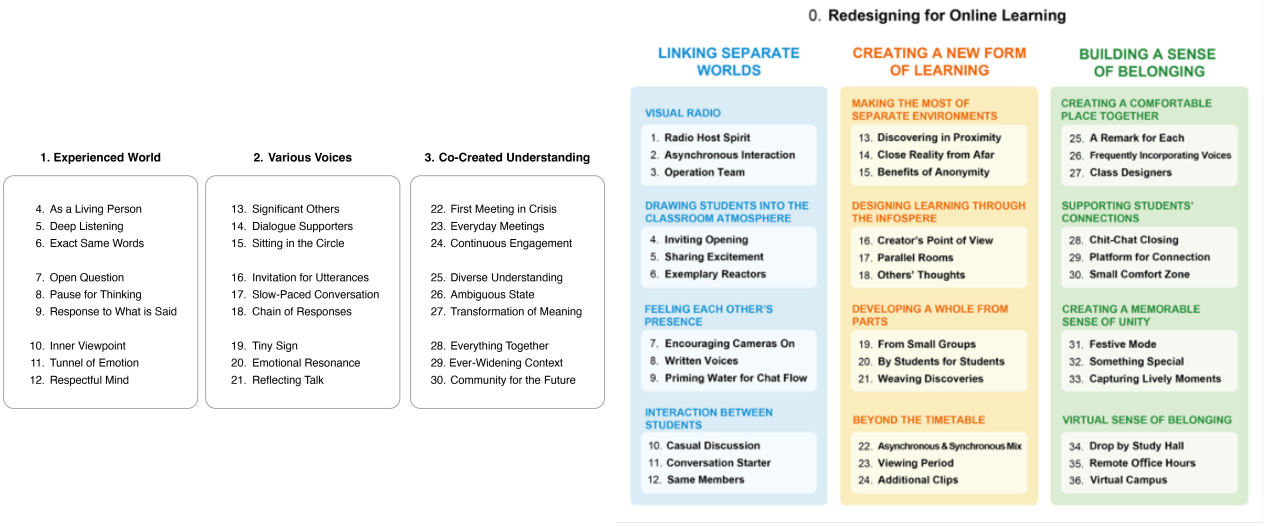

Fig. 8. Examples of pattern language system: the *Words for a Dialogue* (left) and the *Online Education Patterns* (right).

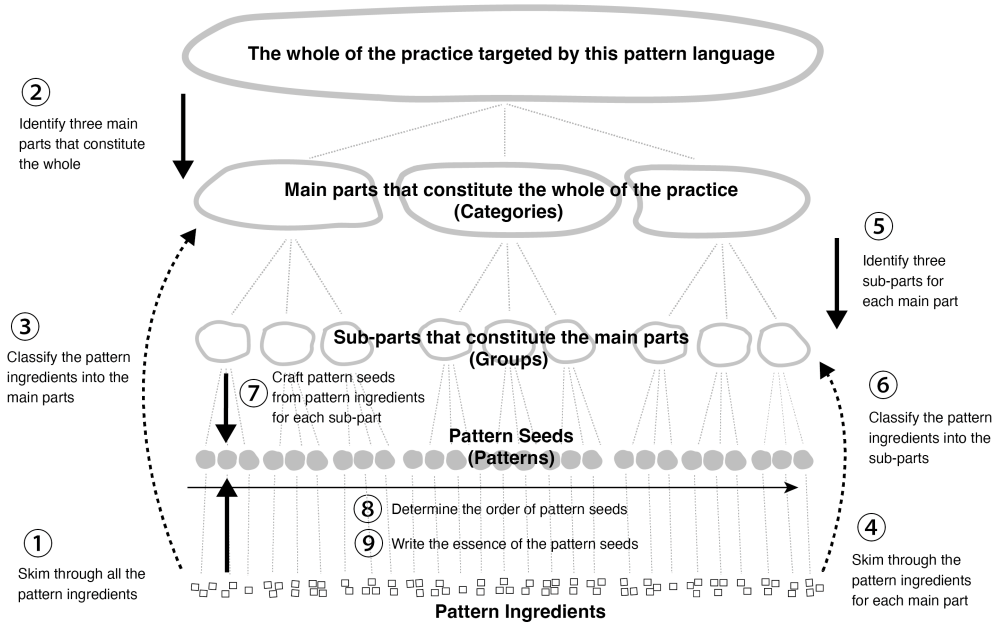

Fig. 9. The System Differentiation process for organizing a pattern language system (Iba 2021b).

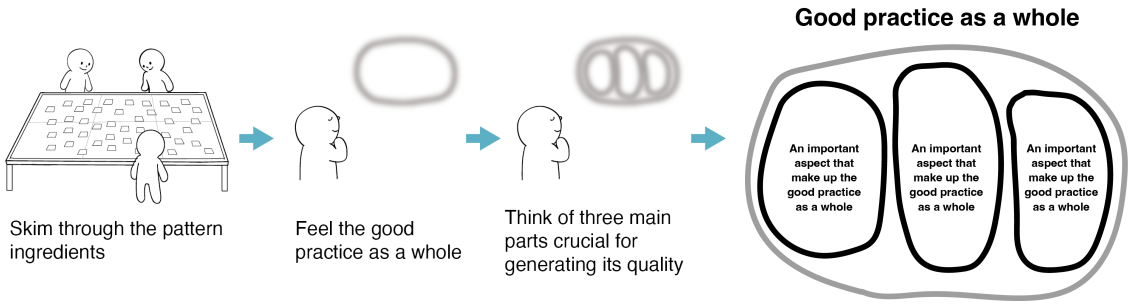

Fig. 10. Differentiation from the whole: After briefly reviewing the ingredient cards to gain a general understanding of what is available, envision the three most important components necessary to ensure the high quality of the practice as a whole, and describe each in a single sentence (Iba 2021b).

Fig. 11. Scenes from conducting System Differentiation: differentiation from the whole and a deliberation among project members (left) and assigning ingredient cards to categories and groups formed through differentiation (right).

Subsequently, we consider three essential subparts that constitute each part. Once these subparts are identified, we attempt to match the ingredients to these subparts and verify whether this arrangement is viable (Figure 11, right). If, as a result of this differentiation from the whole, we find that some subparts have no ingredients, or that there is a significant imbalance with few ingredients in one part while many are concentrated in other parts or subparts, we reconsider our approach. Through this reciprocal process of moving from the whole to the parts and from the parts back to the whole, we weave together the system. This is what we accomplish in System Differentiation, and for more details, please refer to Iba (2021b). As a result of the System Differentiation step, we identify approximately 30 to 40 elements. We call the elements of the system obtained in this way 'pattern seeds.'

3.2 Pattern Writing

From there, we develop the pattern seeds, but the first step is to grasp and describe the essence of each pattern seed in the form of "in what Context, what Problem frequently occurs, and what can be done to resolve it as a Solution." We call this sentence the CPS, taking the initials of Context, Problem, and Solution. The CPS sentence is the pattern trunk. We engage in dialogues with project members repeatedly to confirm the CPS sentences, ensure everyone agrees, and make necessary revisions until we have a satisfactory description.

After that, we enter the stage of adding explanatory branches and leaves to the trunk of the CPS sentence. We clarify and describe which underlying Forces are at work causing the Problem to occur, what concrete actions can be taken to implement the Solution, and what Consequences will be achieved by doing so. In this way, the full text of the pattern description is compiled.

There are various styles for pattern descriptions, but what we have developed and use is what I call the "concise deep style" (referred to as 'Iba style' or 'Pattern 3.0 style' in past PLoP Bootcamps). The detailed content of this descriptive style is thoroughly documented in Iba (2021a). Additionally, when writing pattern descriptions, it is important to be conscious of the contrast between the states described in the pattern's solution and consequences versus the state described in the problem section (Iba 2021c).

These descriptions are also refined through repeated dialogues among project members to ensure that the essence is adequately captured and conveyed, and that the expressions are easy to understand and unlikely to cause misunderstanding (Figure 12, left). Additionally, we have practitioners review the content and descriptions of the patterns, making revisions when necessary (Figure 12, right). These approaches ensure that the content and expressions do not become self-indulgent or disconnected from practical reality. They will be revisited in the section on academic aspect for qualitative research in this report, where I discuss them as part of the methodology for constructing internal validity during pattern language crafting in the Grounded Essence Approach. Furthermore, the critical refinement practices we implement in the final stages of pattern description are detailed in Shimokawa et al. (2020).

Fig. 12. Scenes from Project Members' Reviews, where project members review pattern descriptions for alignment with the understood essence, quality of writing, and necessary improvements (left), and Practitioners' Review, where pattern seeds and descriptions are validated with practitioners to confirm accuracy (right).

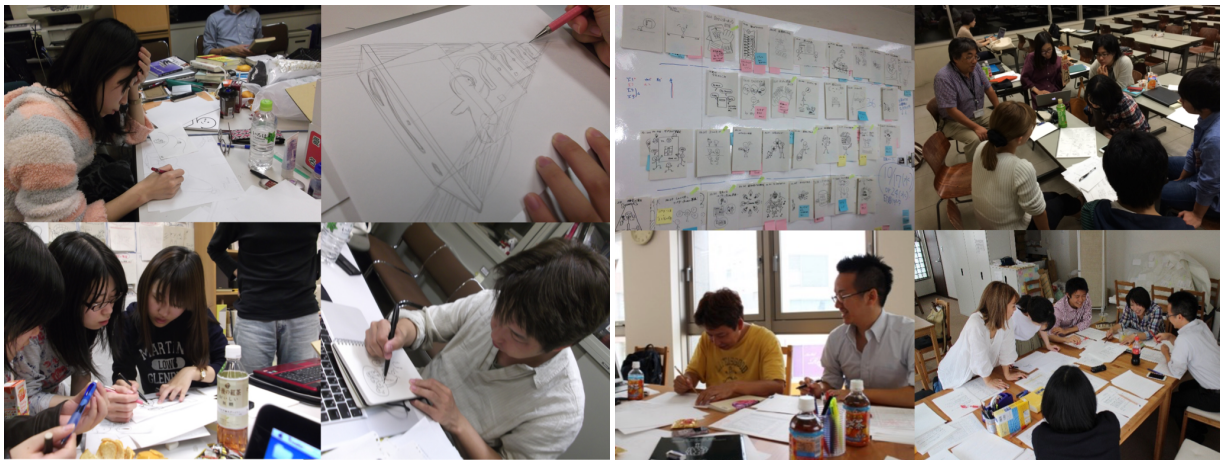

Fig. 13. Scenes from Pattern Illustrating (left) and Project Members' Reviews of the drawn pattern illustrations (right).

3.3 Pattern Symbolizing

For Pattern Naming, the principles and patterns are discussed in Iba (2021a) and Shibata et al. (2016). For important insights on Pattern Illustrating, please refer to Harasawa et al. (2012, 2014, 2015), Iba and Iba Lab. (2015), Miyazaki et al. (2015), and Iba et al. (2021). Furthermore, when creating pattern names and illustrations, it is essential to do so with a clear understanding of the *contrast* between the states described in the Solution and Consequences sections and the state described in the Problem section. For more detailed information on this approach, please refer to Iba (2021c). Pattern names and illustrations, like pattern descriptions, undergo project members' review (Figure 13, right) to ensure they do not become self-indulgent or disconnected from the practical experiences they aim to represent.

In terms of expressing patterns symbolically and attractively, Pattern Symbolizing involves making flowers bloom on trees. We make different flowers bloom on each tree. The flowers have unity, but each has its own individuality. People will be attracted by the charm of the flowers and approach each tree. In this way, a single pattern language is completed. The pattern seeds grow and develop into trees consisting of trunks, branches, leaves, and flowers. These trees (patterns) come together, coexisting symbiotically to form a living forest (a pattern language). Readers of the pattern language will live with the forest and obtain the fruits (results) of their respective practices.

In this section, I introduced the operational aspect for language construction in pattern language crafting. Fundamentally, the activities that are actually performed and observed within pattern language crafting projects are the operations I have examined thus far. However, merely executing these operations may produce something in the form of a pattern language but will not necessarily create a high-quality pattern

language that captures the essence of the practice. This is because the exploration and description of patterns constitute an endeavor with scientific inquiry, not merely a process of information aggregation and editing.

Therefore, the second aspect, the reasoning aspect for scientific inquiry, becomes crucial. In the next section, I will explain the reasoning aspect for scientific inquiry, focusing on abduction and essence intuition employed in pattern language crafting.

4. REASONING ASPECT FOR SCIENTIFIC INQUIRY

I have defined the crafting process of pattern languages, which I mentioned in the previous section, and have taught and guided students using it. Despite their faithful adherence to the crafting process, I have repeatedly encountered situations where they failed to identify or write good patterns. For some time, I thought that the process was flawed and made numerous and thorough revisions.

However, at one point, I realized that the issue might not lie in the process itself, but rather in the thinking of the pattern creators during the process. The problem was not about the tasks to be performed in each phase of the process, but about the thought processes. I came to consider whether the problem was the lack of proper reasoning. Alexander stated, regarding the specification of patterns:

> "*the pattern is an attempt to discover some invariant feature, which distinguishes good places from bad places with respect to some particular system of forces.* It tries to capture just that essence—that field of relationships—which is common to all possible solutions to the stated problem, in the stated context. It is the invariant behind the huge variety of forms which solve the problem. There are millions of particular solutions to any given problem; but it may be possible to find some one property which will be common to all these solutions. That is what a pattern tries to do." (Alexander 1979, p.260)

This point is particularly important because the creation of pattern languages involves a process from interviews to language construction, but this is not merely about editing information or knowledge; rather, it encompasses scientific reasoning. I then concluded that what was missing was precisely the thinking proposed as *abduction*—retroductive reasoning to understand the cause from the result—and *essence intuition* for grasping the essence of practices.

Here, I address two forms of reasoning employed in pattern language crafting: abduction, which involves retroductive hypothesis formation, and essence intuition, which involves grasping the essence of phenomena.

4.1 Abduction for Hypothesis Formation in Scientific Thinking

Abduction is a form of inference that retroactively derives causes from conclusions, as proposed by the American philosopher Charles S. Peirce (Peirce 1931, 1958a, 1958b). Peirce pointed out that, in addition to deduction and induction, which had been traditionally discussed as forms of logical reasoning, a third form of reasoning called abduction plays an important role in scientific reasoning. Abduction is a form of reasoning that forms hypotheses, and Peirce argued that scientific thinking cannot exist without it. When we observe a phenomenon, abductive reasoning involves retroductively considering hypotheses about how that phenomenon came to occur.

To help understand the significance of abduction in scientific reasoning in an accessible way, I will explain using the well-known example of Newton's discovery. The anecdote recounts Newton observing an apple falling from a tree and conceiving the idea of universal gravitation. If Newton had observed several apples falling from trees and concluded, "In general, ripe apples fall from trees," this would have been an inductive inference. He would have generalized from observing multiple apples falling to infer that "all apples fall from trees."

However, Newton did not merely generalize the phenomenon of apples falling from trees to apply to other apples. Instead, he discovered the force of attraction between the apple and the Earth. Such a force cannot be derived through inductive generalization by collecting numerous instances of "apples falling from trees." Newton inferred the underlying principle behind the phenomenon. He discovered the explanatory principle that, if the Earth and the apple attract each other through gravity, it explains why "apples fall from trees." This is abductive reasoning.

The authors of pattern languages engage in a process similar to Newton's. This is not a coincidence; pattern language crafting requires scientific thinking, and therefore, abduction, which is essential for such thinking, is naturally employed in the process. Creating a pattern language is not merely about finding commonalities among case studies that produce good results and generalizing them to other cases (although this aspect is included); it is about discovering the underlying principles. The factors that lead to good results imbued with an unnamed quality are identified as essential aspects (patterns) in design and practice. Additionally, the problem of how issues arise is understood by identifying the conflicting forces behind them. Abductive reasoning is employed in such instances. Thus, in pattern language crafting, we are not simply engaging in inductive reasoning; rather, we are employing abductive reasoning.

Abduction creatively derives causes from results. This involves a leap (hence, it is a fallible form of inference with the possibility of error), since causes cannot be deduced from results in the same way as in deduction. The ability to make this leap appropriately and effectively determines whether one can discover good patterns as principles or merely generalize and summarize. Alexander was aware of this, which is why he stated, "*Of course, even now the pattern is still tentative.* It is an *attempt* to define an invariant: but always only an attempt" (Alexander 1979, p. 269), yet "*the pattern is clearly sharable*" (Alexander 1979, p. 268). Therefore, the attempt can be evaluated by anyone, as Alexander pointed out:

> "Anyone who takes the trouble to consider it carefully can understand it. It has a clearly formulated problem, based on empirical findings that anyone can check for themselves, and check against their own experience" (Alexander 1979, p.269-270).

As he states, it is crucial that "the pattern is open enough to become empirically vulnerable" (Alexander 1979, p. 268). In this way, the identification and description of patterns constitute part of the cycle of scientific thinking.

Abduction was proposed by Charles S. Peirce as a third mode of inference, alongside the established forms of deduction and induction, emphasizing its importance in reasoning. He defined reasoning as a controlled thought process that derives conclusions from known premises. Abduction is a distinct mode of inference, explained as "the process of forming an explanatory hypothesis" (Peirce 1958a, p. 106) and "Abduction consists in studying facts and devising a theory to explain them" (Peirce 1958a, p. 90). Peirce describes abduction as the following form of hypothesis-formation reasoning:

> "The surprising fact, C, is observed;
>
> But if A were true, C would be a matter of course,
>
> Hence, there is reason to suspect that A is true." (Peirce 1958a, p.117)

Abduction becomes particularly important during the process of inquiry, with scientific investigation being the prime example. Peirce describes the process of inquiry that begins with encountering "some surprising phenomenon, some experience which either disappoints an expectation, or breaks in upon some habit of expectation of the *inquisiturus*" (Peirce 1958a, p. 320), then forms plausible hypotheses, verifies them, and ultimately arrives at belief, as follows:

> "The inquiry begins with pondering these phenomena in all their aspects, in the search of some point of view whence the wonder shall be resolved. At length a conjecture arises that furnishes a possible Explanation, by which I mean a syllogism exhibiting the surprising fact as necessarily consequent upon the circumstances of its occurrence together with the truth of the credible conjecture, as premises. On account of this Explanation, the inquirer is led to regard his conjecture, or hypothesis, with favor. As I phrase it, he provisionally holds it to be "Plausible"; this acceptance ranges in different cases − and reasonably so − from a mere expression of it in the interrogative mood, as a question meriting attention and reply, up through all appraisals of Plausibility, to uncontrollable inclination to believe." (Peirce 1958a, p.320)

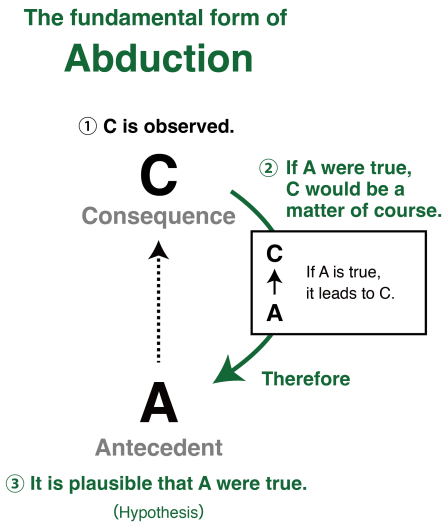

Fig. 14. Diagrams depicting the fundamental form of abduction, illustrated by Takashi Iba based on Charles S. Peirce's explanation: an illustration using Peirce's original alphabetical notation (left) and an illustration using alternative alphabetical notation and modified visualization by the author to better represent the content (right).

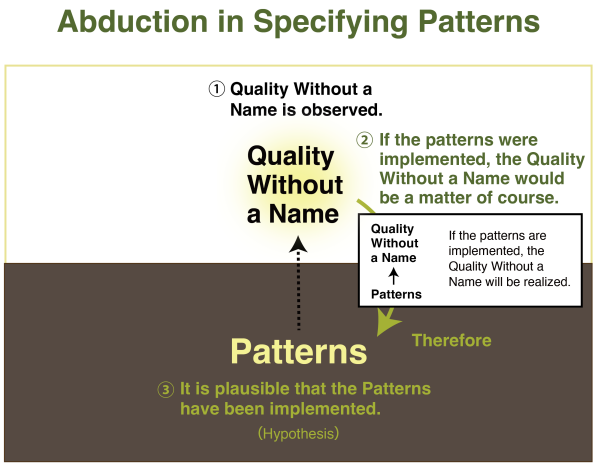

Fig. 15. Identifying patterns is essentially an act of abduction—inferring what patterns produce consequences that embody the 'quality without a name' in a retroductive manner.

In my visualization of Peirce's explanation shown in Figure 14, we can verify that when observing C, if we know or find it self-evident that "if A, then C," we can infer the hypothesis that A might have been the origin. This diagram employs Peirce's original letters C and A.

Examining this fundamental form of abduction reveals that pattern discovery is inherently abductive in nature. When examining objects that possess good quality—or what Christopher Alexander terms "quality without a name"—we identify the common cause that produces this quality and hypothetically conceptualize it as a pattern, as shown in Figure 15.

Alexander states, "In order to discover patterns which are alive we must always start with observation" (Alexander 1979, p. 254), and further acknowledges that even patterns that seem to produce good results remain provisional: "We have a general sense that something is 'right' there; something is working; something feels good; and we want to identify this 'something' concretely so that we can share it with someone else, and use it over and over again" (Alexander 1979, p. 249). He describes this progression from observation to patterns as follows:

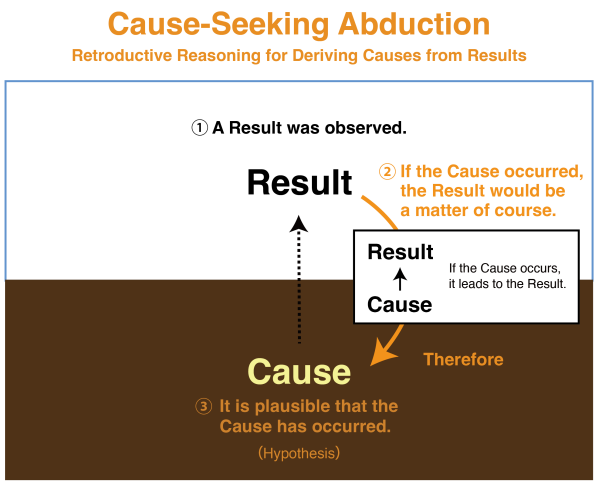

Fig. 16. Cause-Seeking Abduction—retroductive reasoning for deriving causes from results.

> "Start by walking around, looking at house entrances, paying attention to whether they feel right to you or not, whether they feel comfortable, alive ... Put the entrances in two classes: those in which the process of entering feels good, and those in which it doesn't. Now try to discover some property which is common to all the ones which feel good, and missing from all the ones which don't feel good. Of course, you won't be able to do this perfectly. One entrance may not feel good, but be beautiful in some entirely different way; however, with all the imperfections of experiment, come as near as you can to defining some property which all the good ones have, and which all the bad ones lack: in short, look for the critical property which makes the difference." (Alexander 1979, p.254-255)

I introduced the fundamental form of abduction in Figure 14, but in pattern language crafting practice, abduction manifests in three specific implementations: *Cause-Seeking Abduction*, *Goal-Oriented Abduction*, and *Matching Abduction*. In what follows, I will explain these three types in order.

4.2 Cause-Seeking Abduction: Retroductive Reasoning for Deriving Causes from Results

The first type is *Cause-Seeking Abduction*, which is retroductive reasoning for deriving causes from results (Figure 16). As can be readily seen, this involves directly applying the fundamental form of abduction in a straightforward manner. From the perspective of the person performing this type of abduction, it is a form of reasoning that begins with an observed result in the present and seeks to trace back to a past cause that may have led to it.

Cause-Seeking Abduction is used as shown in Figure 17. In Mining Targets Selection, where case studies and practitioners to be mined are chosen, one abductively thinks, "This person, who has achieved good results, must have rules of thumb." In Mining Dialogue or Mining Interview, the interviewed practitioners abductively consider, "It is important to do this (what/how) to achieve good results." When identifying the Problem in Pattern Writing, one abductively thinks, "The importance of that lies in avoiding such problems," and when identifying Forces, one abductively considers, "The problem likely arises because such forces are at play." These are examples of Cause-Seeking Abduction in practice.

In addition, when reviewing one's own descriptions at intermediate stages, discomfort is used as a guide to identify and correct the source of that discomfort. As shown in Figure 18, throughout the creation process, corrections are made based on the abduction, "This discomfort seems to stem from this part of the content or expression." Such abduction is performed in Ingredients Writing, Seeds Writing, CPS Writing, Full Description Writing, Full Description Improvement, as well as Pattern Naming, Introduction Writing, and Pattern Illustrating. Furthermore, in Practitioners Review and Writers' Workshop, descriptions are revised based on the discomfort felt by readers. Cause-Seeking Abduction is also employed in these cases.

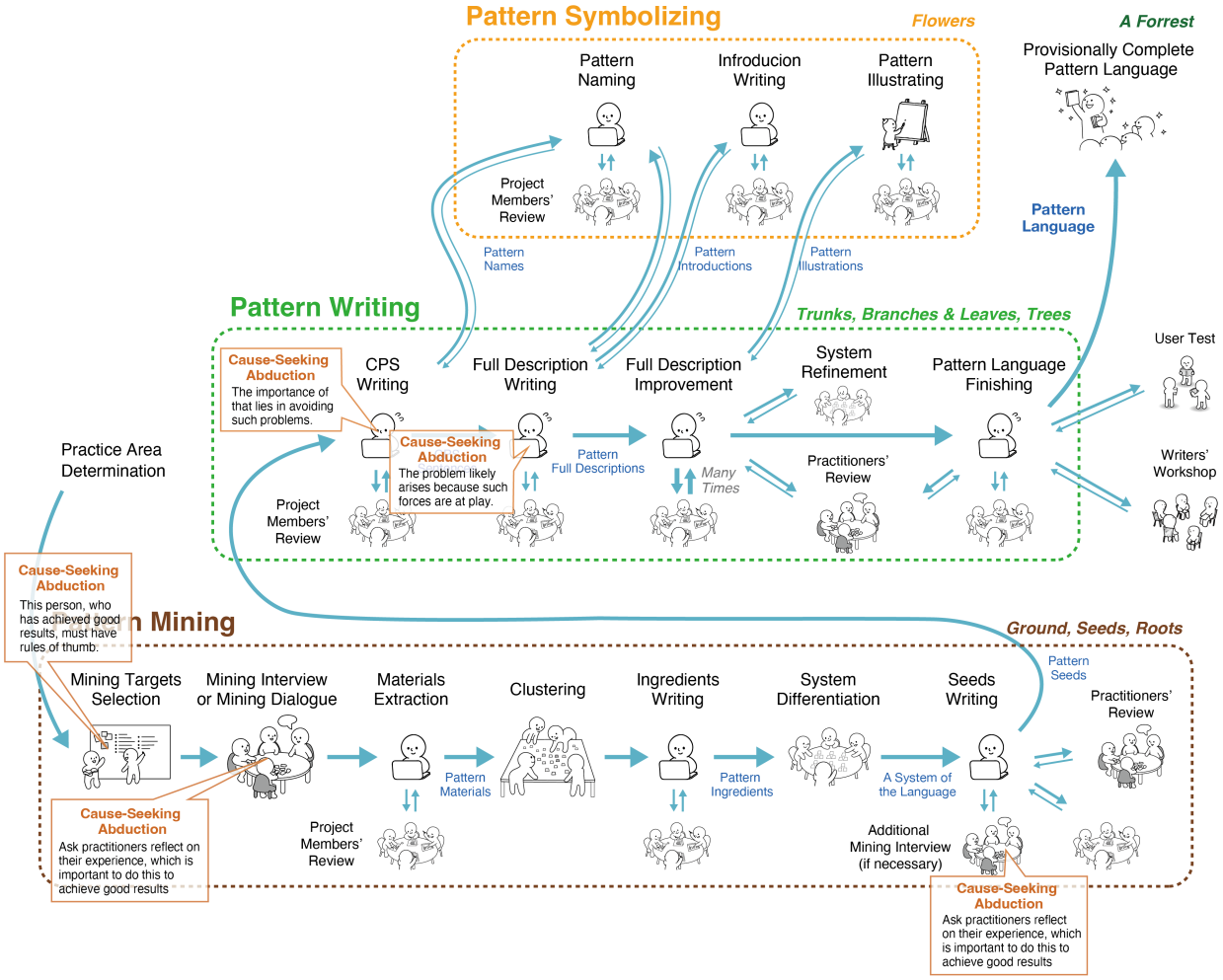

Fig. 17. The steps in the pattern language crafting process where Cause-Seeking Abduction—retroductive reasoning for deriving causes from results— is conducted, specifically for identifying the content of the underlying pattern.

4.3 Goal-Oriented Abduction: Retroductive Reasoning for Determining Means from Goals

The second type is *Goal-Oriented Abduction*, which is retroductive reasoning for determining means from goals (Figure 19). From the perspective of the person performing this type of abduction, it is a form of reasoning that starts with a goal state in the future (result) and works backward to identify what must be done (cause) to achieve it in the present.

Goal-Oriented Abduction is practiced when crafting expressions aimed at the desired result (Figure 20). In Ingredients Writing, one abductively thinks, "If these materials belong to the same group, then they must share this meaning." In System Differentiation, one abductively considers, "It seems that the entire high-quality practice is composed of these." In Seeds Writing, one abductively thinks, "If this pattern is in this position, then it should have this content."

In Pattern Naming, one abductively considers, "The name representing the content of this pattern should probably be words like these." In Introduction Writing, one thinks, "As an attractive introduction to this pattern, it should probably be a sentence like this." In Pattern Illustrating, one considers, "To craft an illustration that symbolically represents the content of this pattern, it should probably be expressed like this." In Re-Systematization, one thinks, "It seems that such content is currently lacking to achieve high-quality practice." In Full Description Improvement, one considers, "To ensure readers feel the intended sentiment, the expression should be like this."

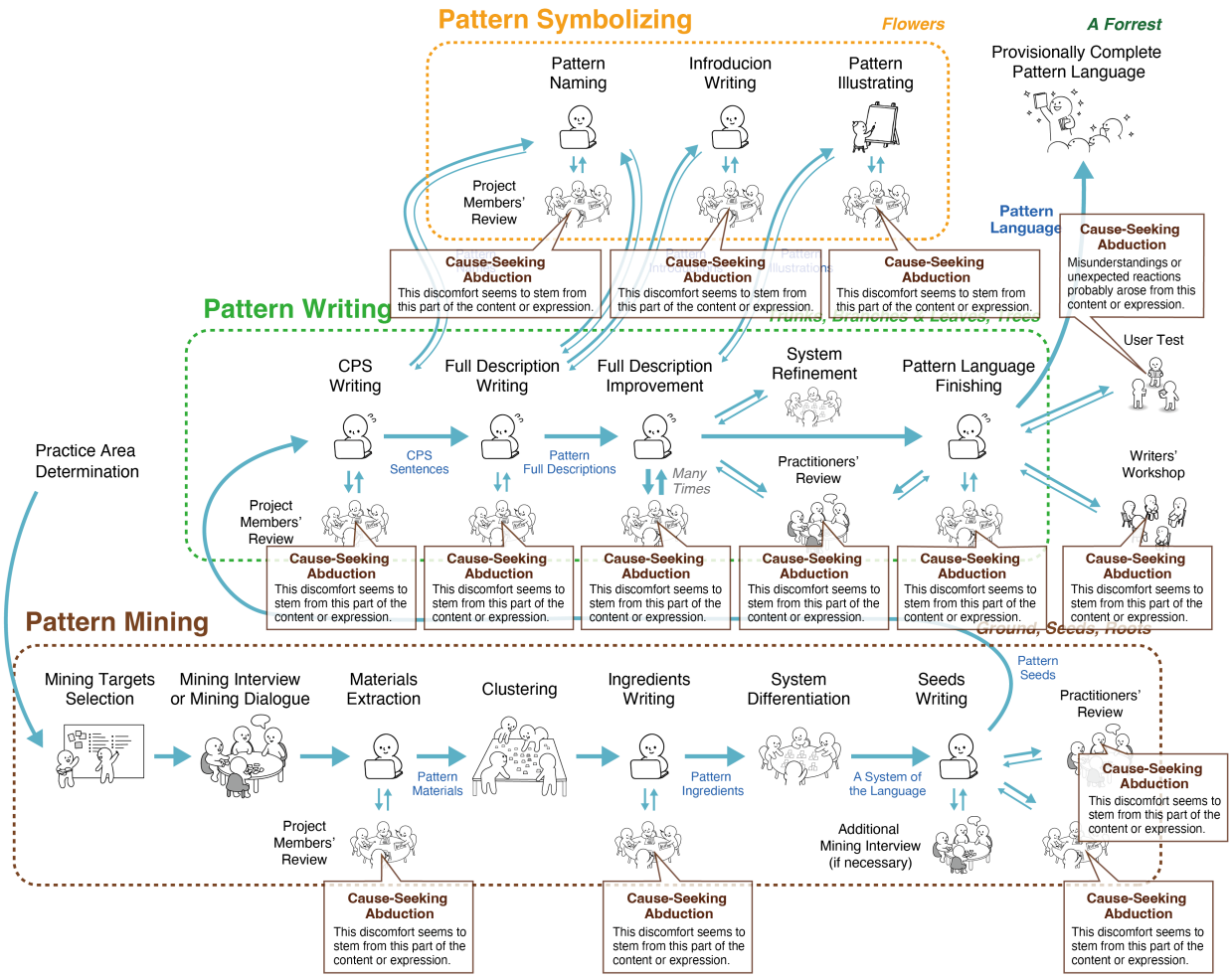

Fig. 18. The steps in the pattern language crafting process where Cause-Seeking Abduction—retroductive reasoning for deriving causes from results—is conducted, specifically for identifying and addressing the sources of sensed discomforts for improvement.

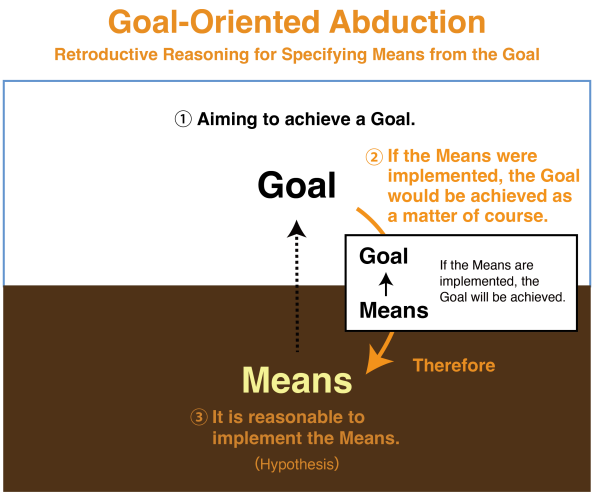

Fig. 19. Goal-Oriented Abduction—retroductive reasoning for specifying means from the goal.

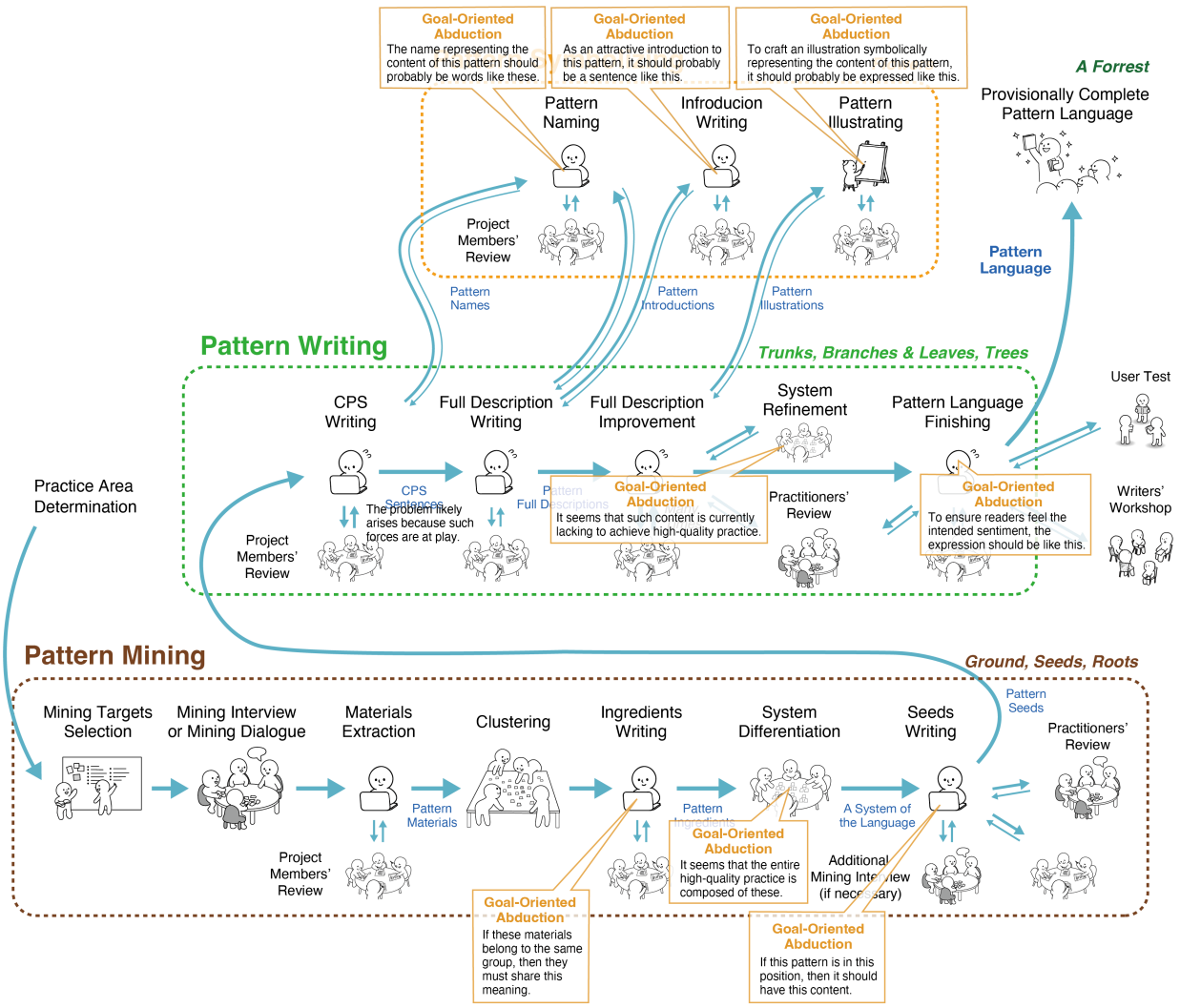

Fig. 20. The steps in the pattern language crafting process where Goal-Oriented Abduction—retroductive reasoning for specifying means from the goal—is conducted, specifically for crafting content and expression that embody the desired qualities and effects.

4.4 Matching Abduction: Retroductive reasoning for Identifying Wholes Based on Commonality of Components

The third type is *Matching Abduction*, which is retroductive reasoning for identifying wholes based on commonality of components. At first glance, this may seem to describe something distinct from the fundamental form of abduction. However, in a paper, Peirce describes abduction in a way that encompasses this type of reasoning as follows:

> "Hypothesis is where we find some very curious circumstance, which would be explained by the supposition that it was a case of a certain general rule, and thereupon adopt that supposition. Or, where we find that in certain respects two objects have a strong resemblance, and infer that they resemble one another strongly in other respects." (Peirce 1931, p.375)

In the latter part of this passage, abduction (hypothesis) is described in a way that differs from the previous explanations. It can be represented as follows:

"M is, for instance, P', P", P"', and P^{IV};
S is P', P", P"', and P^{IV}:
∴ S is all that M is." (Peirce 1931, p.257)

Here, M is a concept established prior to abduction, and S is the object of consideration in performing abduction. In this case, partial features are extended to the whole. Although the correspondence of P', P", P"', and P^{IV} is only a necessary condition for the correspondence between M and S, sufficiency is attributed to it without proper justification. This type of abduction is also fallible, but the explanatory hypothesis is formed through this schematic representation. Given the condition that "M is, for instance, P', P", P"', and P^{IV}," the hypothesis is derived that the reason "S is P', P", P"', and P^{IV}" is because "S is M." Let us examine an example provided by Peirce:

> "I once landed at a seaport in a Turkish province; and, as I was walking up to the house which I was to visit, I met a man upon horseback, surrounded by four horsemen holding a canopy over his head. As governor of the province was the only personage I could think of who would be so greatly honored, I inferred that this was he. This was a hypothesis. Fossils are found; say, remains like those of fishes, but far in the interior of the country. To explain the phenomenon, we suppose the sea once washed over this land. This is another hypothesis." (Peirce 1931, p.375)

In this case, the major premise is that in Turkey, the "local lord" (M) rides on horseback (P'), is surrounded by four horsemen (P"), and the horsemen hold a canopy over his head (P"'). The minor premise is that the "man" (S) encountered was riding on horseback (P'), surrounded by four horsemen (P"), and the horsemen were holding a canopy over his head (P"'). From these premises, the hypothesis is derived that the "man" (S) encountered is likely the "local lord" (M). Another example provided by Peirce involves the discovery of fish fossils inland:

> "Fossils are found; say, remains like those of fishes, but far in the interior of the country. To explain the phenomenon, we suppose the sea once washed over this land. This is another hypothesis." (Peirce 1931, p.375)

The major premise is that fish fossils are buried in "places that were once sea" (M) (P'). The minor premise is that fish fossils were buried in "this area" (S) (P'). From these premises, the hypothesis is derived that "this area" (S) was likely a "place that was once sea" (M). Of course, this inference can be mistaken. It is not impossible that someone transported a large number of fish to this location for some purpose, even though it was not a sea.

A more familiar example is when we see someone walking ahead of us and think it is an acquaintance based on their height, hairstyle, body shape, gait, and fashion. We infer that the person with those partial features might be our acquaintance. We are extending the partial features (necessary conditions) to the whole (sufficient condition) of being that acquaintance. Of course, if we actually call out to them, we may find that it is a different person. Abduction (hypothesis) is an inference that can be mistaken and contains fallibility.

While this form of abduction initially appears different from the one previously introduced, as shown in Figure 21, it is actually convertible to and isomorphic with the fundamental form of abduction shown in Figure 14. This inference suggests that when parts share identical or similar elements, their wholes may also be regarded as identical or similar.

In pattern language crafting, Matching Abduction is used in the Pattern Mining phase (Figure 22). In Mining Dialogue or Mining Interview, one thinks, "This episode of experience is probably the same as that one of mine," while asking questions that incorporate one's own and previous episodes. Clustering is where this type of abduction is most heavily employed. In Clustering, pattern material sticky notes with similar meanings are placed close together, involving the abductive thinking, "The meaning of that material and this material is semantically similar." It is worth noting that Jiro Kawakita, the proponent of the KJ method on which this Clustering method is based, described it as a method of abduction.

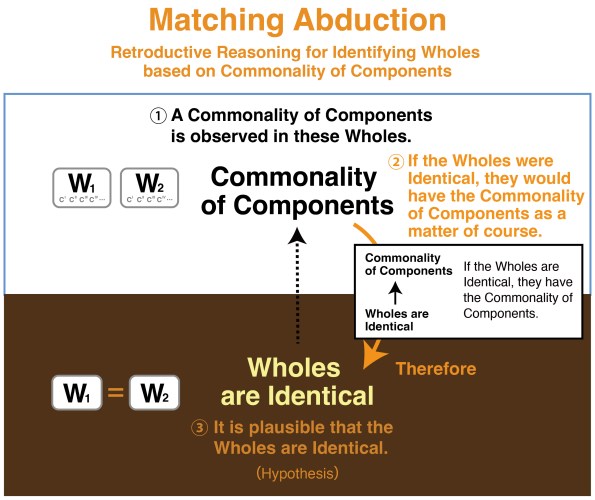

Fig. 21. Matching Abduction—retroductive reasoning for identifying wholes based on commonality of components.

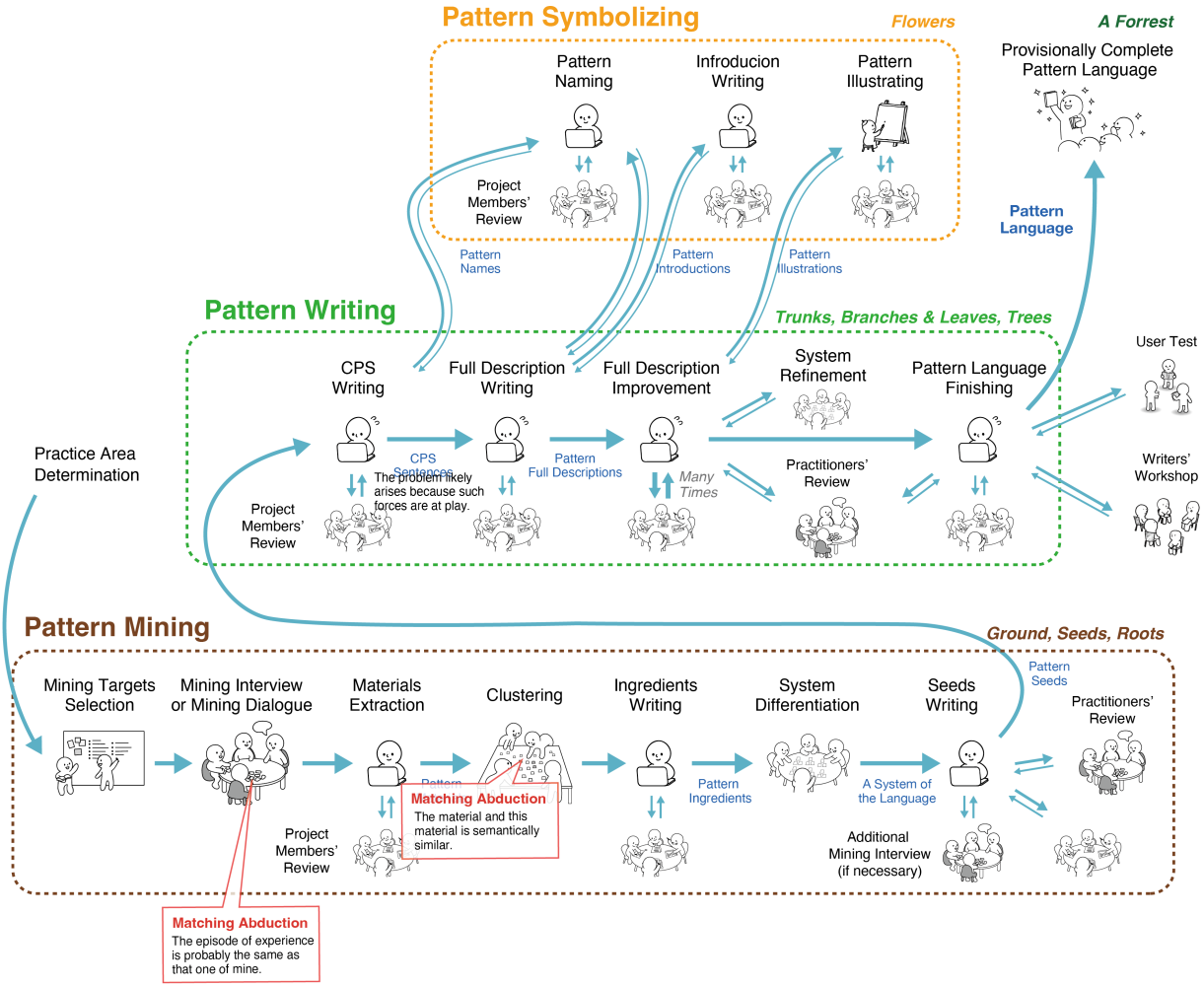

Fig. 22. The steps in the pattern language crafting process where Matching Abduction—retroductive reasoning for identifying wholes based on commonality of components—is conducted, specifically for grasping similarities among multiple cases.

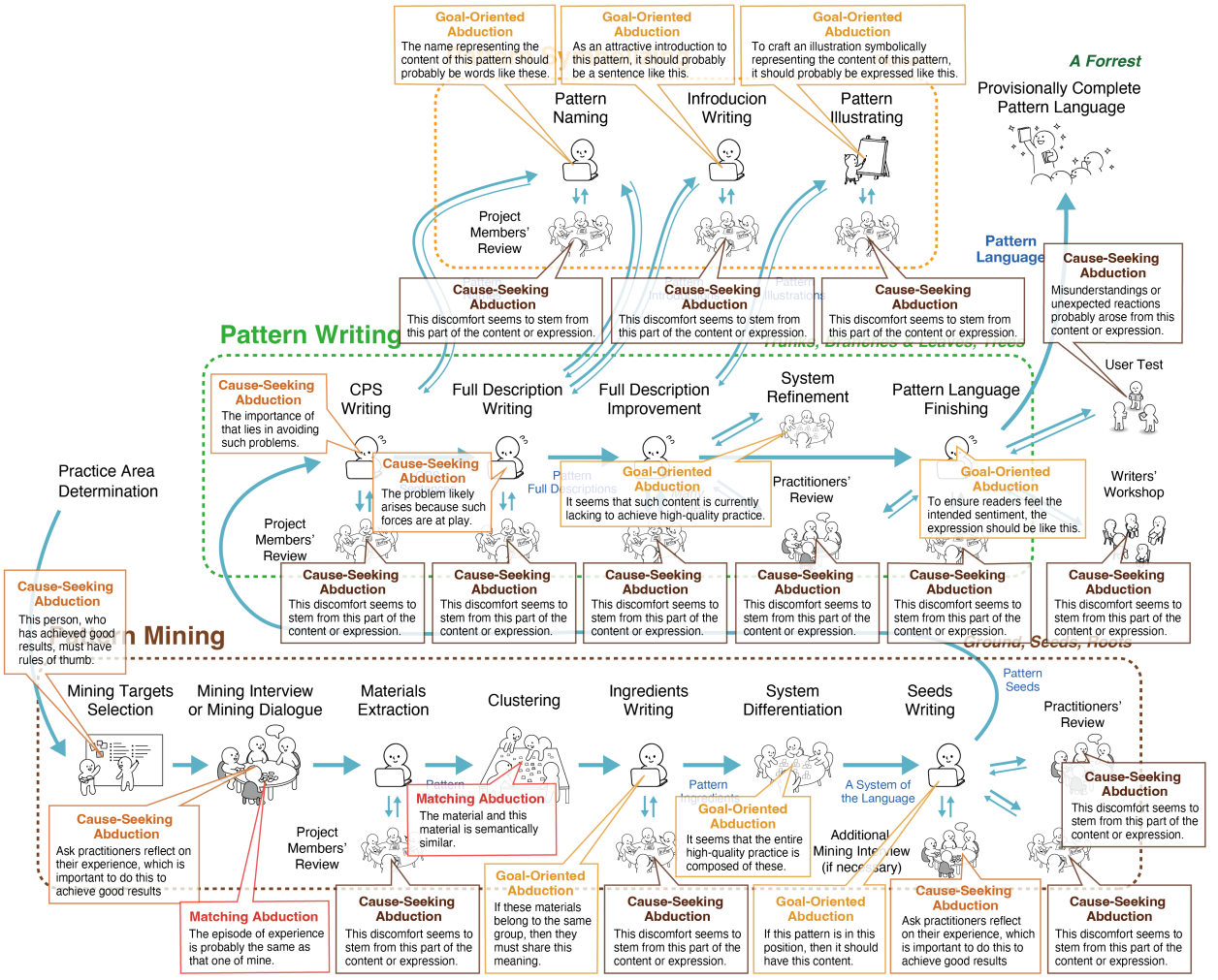

Fig. 23. Overview of the timing of each type of abduction, Cause-Seeking Abduction, Goal-Oriented Abduction, and Matching Abduction, conducted throughout the pattern language crafting process.

The above has been an explanation of abduction and its use in pattern language crafting. Figure 23 shows an overview of when and what types of abduction are performed in pattern language crafting. We have shown that in pattern language crafting, Cause-Seeking Abduction and Goal-Oriented Abduction are frequently performed at each step, and that in addition to these, Matching Abduction is also performed at the beginning of the Pattern Mining process. As we have seen, the pattern language crafting process is not simply a matter of working operationally; it cannot be overemphasized that it involves this level of reasoning and scientific thinking.

To conclude this section on abduction, I would like to add a brief note on nurturing the ability of abduction. I propose to call this ability 'abductionability.' I currently have a hypothesis regarding the way of nurturing abductionability: that debugging in programming fosters abductionability.

Debugging is the process of identifying the cause of errors or unexpected behaviors and fixing them. In other words, it involves developing hypotheses about the causes of surprising and unexpected results (since no one intentionally programs errors or unexpected behaviors), verifying those hypotheses, pinpointing the problem, and then fixing it. Like this, debugging is an activity that extensively employs abduction. When a bug is found and corrected, the problem is resolved. It means that, once identified, one immediately knows whether the hypothesis was correct. This clarity serves as a check on whether the hypotheses generated through abduction are plausible.

As we have seen in this paper, abduction is extensively used in the crafting of pattern languages. Considering this, it may not be coincidental that pattern languages, originally proposed in architecture, were readily accepted and widely created in the software field. People in the software field have honed their abductionability through debugging, which may have enabled them to create patterns effectively.

There are other professions that involve retroductive reasoning from effects to causes. Engineers, including automotive and machinery repair technicians, physicians, and business professionals or consultants who solve organizational problems all employ Cause-Seeking Abduction from problem symptoms, thereby cultivating their abductionability. Additionally, teachers who adjust curricula and teaching methods for student development, welfare professionals who provide care to improve quality of life, entrepreneurs who guide organizations toward their envisioned goals, and designers who design something to achieve intended effects all routinely use Goal-Oriented Abduction, developing their abductionability in the process. Furthermore, those who frequently employ methods such as Jiro Kawakita's KJ method to synthesize disparate information cultivate their abductionability through Matching Abduction. As you know, people from these professions have participated in crafting pattern languages, and pattern languages have been created in these respective fields.

The above represents my own abduction regarding the ability of abduction to generate hypotheses and is, of course, merely a hypothesis. However, it seems plausible, doesn't it? I look forward to further verification and discussion in the future.

4.5 Essence Intuition in Pattern Language Crafting

The crucial form of thinking process in the reasoning aspect for scientific inquiry in pattern language crafting is essence intuition. In pattern language crafting, we repeatedly grasp and describe the essence of the subject practices at each stage, and this deliberative process embodies the philosophical method known as essence intuition (eidetic intuition) in Edmund Husserl's phenomenology.

Those who adopt Husserl's phenomenological stance, through "a method of 'phenomenological reductions' of psychological experience" (Husserl 1983, p. XIX), focus on phenomena occurring in consciousness within the field of consciousness to clarify the essence of the object's meaning. Phenomenology is "to be nothing else but a theory of essences produced within pure intuition" (Husserl 1983, p. 151) and "to be a descriptive eidetic doctrine of transcendentally pure mental processes as viewed in the phenomenological attitude" (Husserl 1983, p. 167), as Husserl repeatedly states:

> "Obviously here, as elsewhere in phenomenology, this does not mean to engage straightforwardly in actual experiences, i.e., to proceed empirically, as if the empirical thesis, which binds itself to contingent facts, would be pertinent. The task is rather to examine, in eidetic intuition, the essence of the experienced in general and as such, precisely as it is made explicit in any experience, whether carried out actually or imaginatively (by means of a fictional transfer of oneself into a possible experience) in order then to grasp intuitively, in the unfolding of the intentions essentially involved in such an experience, the sense of the experienced as such—the sense of the relevant class of regional objectivities—and to express this sense in rigorous analysis and description." (Husserl 1989, p.97)

What phenomenology undertakes is to identify the essence—what Husserl also calls "invariant structural systems" (Husserl 1997, p. 165) or "invariant essential structures" (Husserl 1997, p. 165)—without which a conscious object would no longer be what it is. It is crucial to note that 'essence,' also called 'eidos,' differs from so-called objective 'truth' (Takeda 1989, 2017, Kobayashi and Nishi 2015, Takeda and Nishi, 2020). While truth is considered to exist objectively on the side of the world, essence refers to the core of meaning as grasped in our consciousness. In essence intuition, the essence as the core of meaning is extracted and refined for description.

The identification and description of each pattern in pattern language is precisely the application of Husserl's essence intuition and essence description to the practice in question. In the pattern language crafting process, pattern creators discern the essence of what constitutes good practice in the target domain and describe it accurately.

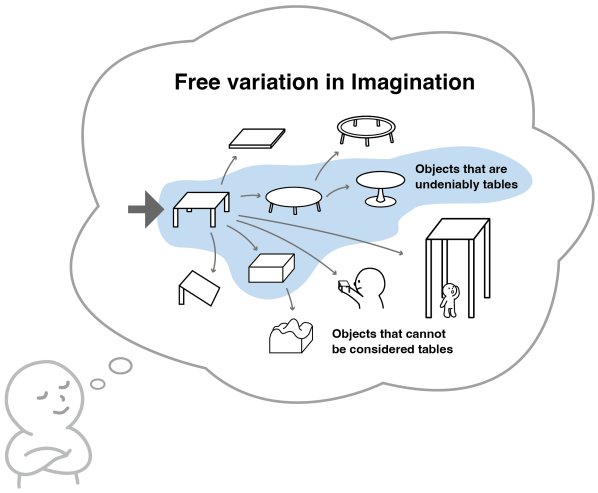

Fig. 24. In the essence intuition of 'table,' one imagines various tables and explore what constitutes the necessary and sufficient meaning for something to be called a 'table,' thereby seeking its essence of the meaning.

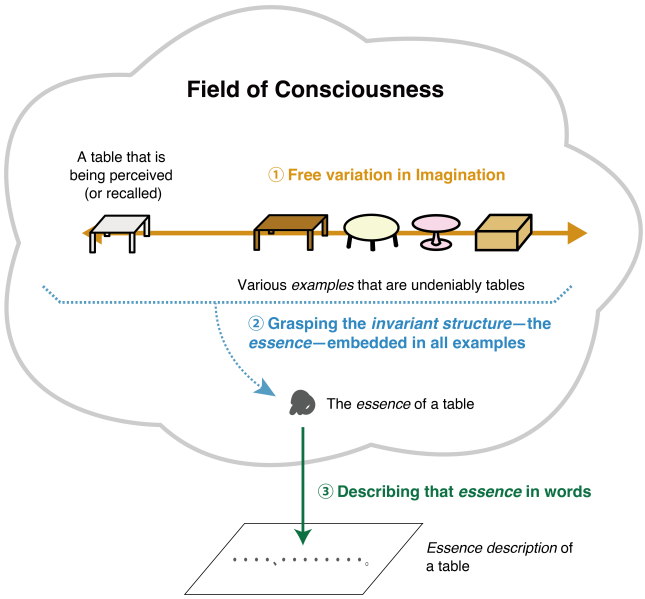

Fig. 25. Essence intuition of 'table,' where one modifies various characteristics of the target through free variation in imagination and grasps the invariant factors common to them all.

Husserl articulated essence intuition—also called "eidetic reduction"—as a method. To clarify the essence of an object's meaning, one must strip away the individual, concrete—"contingent" in the sense that "it could be otherwise" (Husserl 1950, p. 7)—aspects from what appears in consciousness and grasp the "invariant structural systems" that hold true for other similar particulars. For this purpose, essence intuition employs imaginative free variation. By "presentifying to oneself (if need be, by free fiction) series of perceptions connecting up together in a continuous way" (Husserl 1989, p. 37), one grasps "what lies in it, what belongs to its essence" (Husserl 1989, p. 37).

Let us first explain imaginative free variation using Husserl's own example of essence intuition of a "table." In table essence intuition, "Starting from this table-perception as an example, we vary the perceptual object, table, with a completely free optionalness" (Husserl 1960, p. 70), as shown in Figure 24. That is, beginning with a table having specific characteristics (for example, two meters on each side, square, made of wood, dark brown), we explore various modifications of these characteristics to extract as essence the indispensable features for being a "table" (Figure 25). This is the imaginative free variation performed in essence intuition.

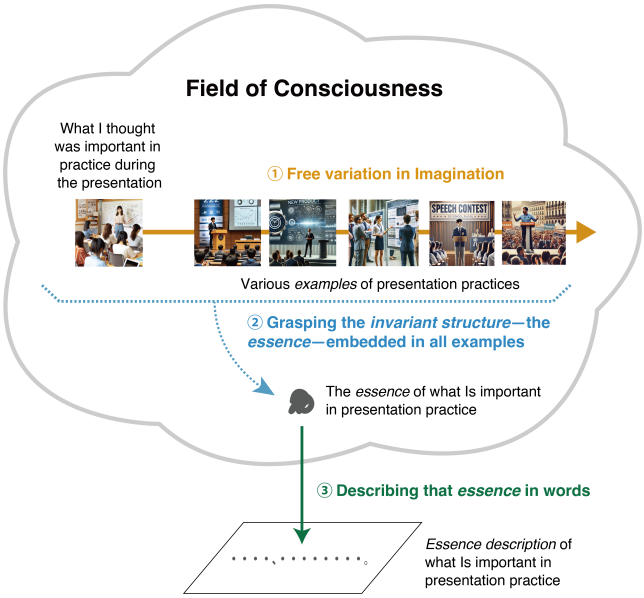

Fig. 26. Essence intuition of 'presentation,' where one modifies various characteristics of the target through free variation in imagination and grasps the invariant factors common to them all.

A same process occurs in pattern language crafting. For instance, when creating a pattern language for presentations, in the essence intuition of a pattern's Solution, we imagine various variants of concrete situations where this Solution is actually implemented—in schools, companies, academic conferences, etc.—and grasp the "invariant structural systems," that is, the essence that holds true in all these cases (Figure 26).

In pattern language crafting, such essence intuition is performed at every phase. Figure 27 illustrates this overall picture. Here, let us examine essence intuition in Pattern Writing. In Pattern Writing, we perform essence intuition regarding: what is the essence (core) of what the Solution recommends; what is the essence of the problematic situation for the Problem; and what is the essence of the circumstances and conditions where the Problem tends to occur for the Context.

Furthermore, we conduct essence intuition for: what is the essence of factors causing the Problem for Forces; what is the essence of actions realizing the pattern's Solution for Actions; and what is the essence of consequences arising from implementing the Solution in that Context for Consequences.

Such essence intuition (eidetic reduction) must be executed with meticulous care to avoid biased, dogmatic judgments based on individual subjectivity. In Husserl's phenomenology, this corresponds to "intersubjective reduction." In intersubjective reduction, we pursue "not a matter of merely subjectively valid judgments, the validity of which is limited to the empirical subject, and objectively valid judgments in the sense of being valid for every subject in general" (Husserl 1999, p.37). In pattern language crafting as well, it is essential to pursue essence while fully activating not merely the sense that "it seems so to me" as a researcher, but also "it must be so for others too." Note that a pattern language summarizing what is important to practice when conducting essence intuition has been published in Iba and Nitta (2024).

In discussing where phenomenology is positioned, Husserl distinguished between "science of matters of fact" and "science of essence," stating that phenomenology, which seeks to clarify the essence of meaning, is a "science of essence" (Husserl 1983, p. XX). "Science of matters of fact" is a discipline that investigates facts of "factual existence" (Husserl 1980, p.37)—"how things actually are/were." In contrast, "science of essence," also called "eidetic science" (Husserl 1983, p. XX), "pursues the essence, and the same essence that makes up the 'content' of the factually existent and the possible factual existent in general" (Husserl 1980, p.37)—it investigates semantic essence.

Pattern language crafting has a strong aspect of what Husserl calls "science of essence" because it thoroughly performs essence intuition to investigate the essence of good practice. It clarifies the essence of meaning regarding what constitutes good practice in the target domain (presentations or teaching methods). Rather than simply revealing facts about what someone did, it is an inquiry into the meaning of the practice's substance—how we can understand how the goodness of that practice emerges.

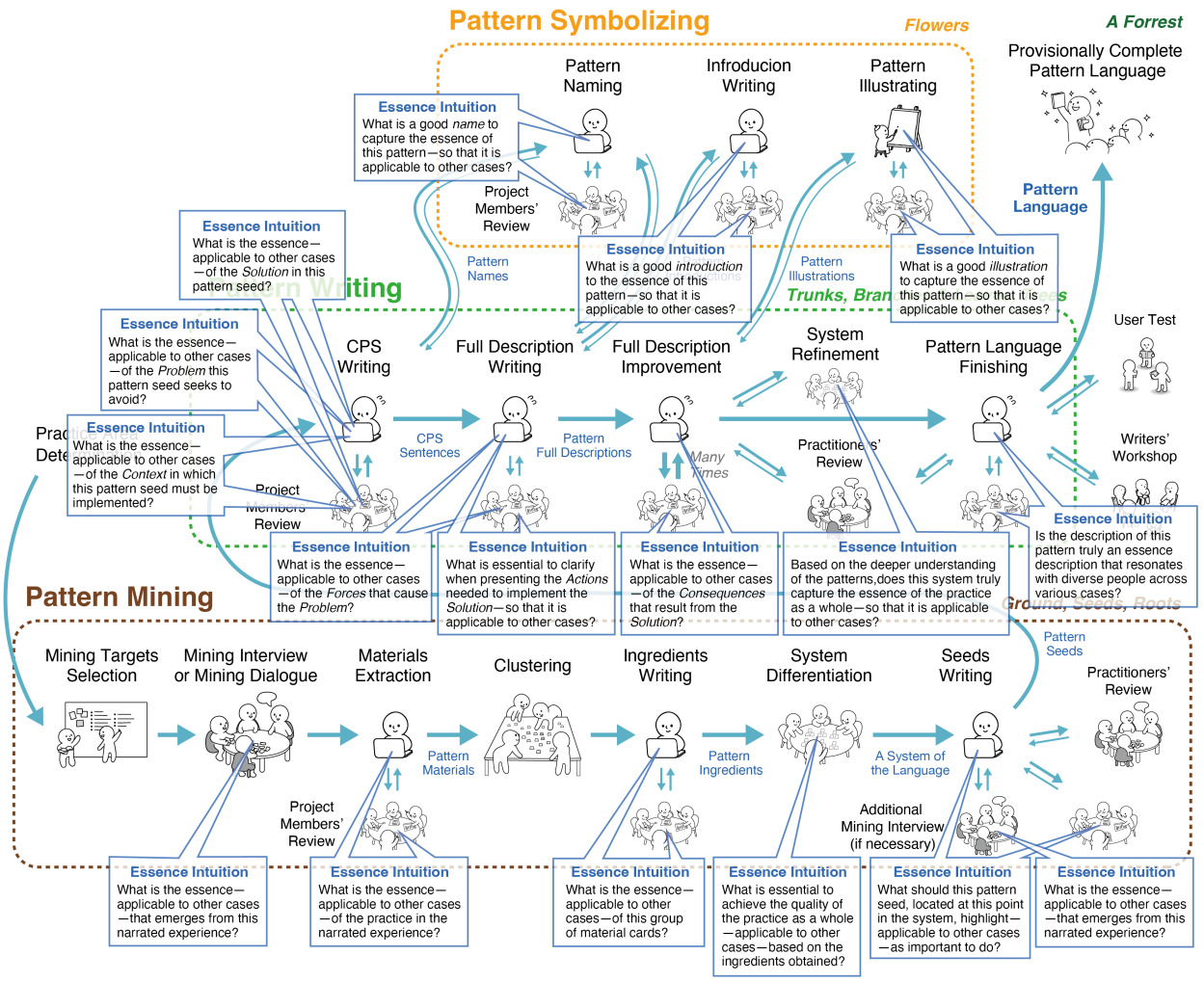

Fig. 27. Overview of the timing of when essence intuition (eidetic intuition) is applied throughout the pattern language crafting process.

However, pattern language creation is not "pure eidetic science" (Husserl 1983, p. 16) like what Husserl envisioned as "pure logic, pure mathematics, and the pure theories of time, space, motion, and so forth" (Husserl 1983, p. 16), but should rather be called "science of essence grounded in facts" (Iba 2023c). Therefore, research using pattern language goes beyond merely clarifying essence in the phenomenological sense; it can be employed as a method of qualitative research in which these essences are connected to experience. Regarding pattern language crafting as a method for academic qualitative research, I call the approach that investigates essence through essence intuition while grounding it in experience the "Grounded Essence Approach" (GEA), which I will discuss in the next section.

5. ACADEMIC ASPECT OF QUALITATIVE RESEARCH: GROUNDED ESSENCE APPROACH (GEA)

As we have seen, although the crafting of a pattern language is inherently an eidetic inquiry, this does not mean it cannot be subjected to empirical scientific scrutiny at all. Since pattern languages are crafted based on practitioners' narratives, observations, and other qualitative data, they are not completely separate from empirical science. In this way, I believe that the eidetic science of everyday experiences is not pure eidetic science, but rather an eidetic science that also takes factuality into account.

As we have seen, although the crafting of a pattern language is inherently an eidetic inquiry, this does not mean it cannot be subjected to empirical scientific scrutiny at all. Since pattern languages are crafted based on practitioners' narratives, observations, and other qualitative data, they are not completely separate from empirical science. In this way, I believe that the eidetic science of everyday experiences is not pure eidetic science, but rather an eidetic science that also takes factuality into account.

In order to refer to such essences grounded in realities as 'grounded essence,' I would like to propose calling the approach that explicitly aims for this the Grounded Essence Approach, or GEA for short. The pronunciation of GEA is intended to be the same as "gear." Note that the Grounded Essence Approach (GEA) is named after the Grounded Theory Approach (GTA) in qualitative research, which was proposed by sociologists Barney Glaser and Anselm Strauss as a method that aims to construct concepts based on qualitative data and generate 'theory' that can be used in the field (Glaser and Strauss 1967).

In fact, several people had long pointed out that our pattern language crafting process seemed similar to what is done in GTA. While we do appear to be doing similar things overall (e.g., basing on qualitative data, creating concepts), I had responded that our approach is similar but distinct, as the actual steps we take in the process differ. Moreover, GTA's aim to construct useful theory was another point of similarity yet difference.

Furthermore, from the perspective of this paper, what GTA aims for is theories grounded in realities, whereas we aim for eidetic essences grounded in realities. Therefore, borrowing the word 'grounded' to emphasize the importance of grounding in qualitative data, and replacing their 'theory' with our 'essence,' I termed our approach the Grounded Essence Approach. I also named it with the hope that, just as GTA has become a widely used qualitative research method not only in sociology but also in nursing, education, business, and other fields, our approach will also take root as a qualitative research method.

The Grounded Essence Approach (GEA) grounds the crafting process in empirical data through two main aspects: constructing internal validity during crafting and confirming external validity after crafting. The former involves treating practitioners' narratives from Mining Interviews as qualitative data, and having practitioners review the crafted pattern language at intermediate and final stages to ensure its content and expressions match their practical realities and sensibilities. The latter confirms the crafted pattern language descriptions from three perspectives: Pattern Description Confirmation, Pattern Existence Confirmation, and Pattern Effectiveness Confirmation. By combining these, GEA creates touch points with real-world facts during and after the crafting of a pattern language to check for subjective and dogmatic deviations in the researcher's essence intuition, and to verify that the descriptions are well-formed.

In what follows, I will explain the two major stages in the Grounded Essence Approach (GEA): Constructing Internal Validity during Crafting and Confirming External Validity after Crafting.

5.1 Constructing Internal Validity during Crafting a Pattern Language

The first stage concerns ensuring the validity of content during the crafting of pattern language. Figure 28 summarizes the overview of constructing internal validity during crafting in GEA.

The rectangular space in this diagram represents the Field of Consciousness, which is the domain of Meaning. This is where meanings are explored in-depth and essence intuition takes place. At the top of this space is the Interface with Deep Feeling, the researcher's (i.e., the pattern language creator's) point of contact with their unconscious realm and the source of meanings and real sense given to consciousness. The researcher constantly relies on the meanings and real sense given to their consciousness as they proceed with the essence intuition of patterns.

On the opposite side, at the bottom of this space, is the Interface with Facts. This is where grounding in data occurs as qualitative research, an essential aspect of making it qualitative research as empirical science. Methods for collecting data include Mining Interviews with practitioners, Mining Dialogues where researchers reflect on and discuss their own experiences as practitioners, and Mining Research investigating literature and videos where practitioners discuss their practice. Here, we will focus on the case of Mining Interviews.

Mining Interviews are video or audio recorded, transcribed, and transformed into easily accessible text data. Based on this, pattern materials are extracted, clustered according to their similar meanings in the practice, and used to describe pattern ingredients, differentiate the system of the pattern language, and create pattern seeds. At this stage, the system and pattern seed contents are shown to practitioners (especially the Mining Interview subjects) to confirm alignment with their experiences and real sense. If they point out content or expressions needing revision, modifications to those parts are considered. Additionally, if there are missing elements or aspects in the system at that stage, practitioners point those out, and additional interviews are conducted to understand what is lacking.

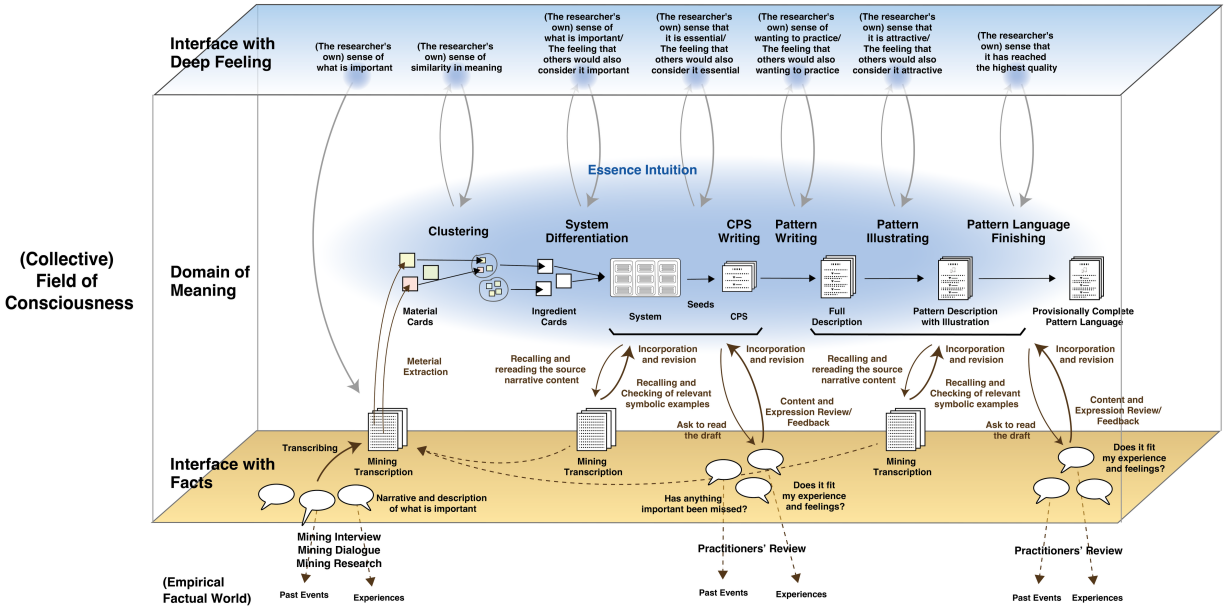

Fig. 28. Overview of the pattern language crafting process with constructing internal validity, as suggested in the Grounded Essence Approach (GEA).

Subsequently, Pattern Writing is performed, referring back to the interview transcripts as needed to incorporate nuances and examples. The tentatively written patterns are again reviewed by practitioners to check the content and expressions. At this stage, having not only the Mining Interview subjects but also other practicing individuals review the patterns can confirm that those patterns are implemented by people other than the interviewees and help correct biases in content or overly idiosyncratic wordings. Through this process, the patterns are revised and finalized, completing the crafting of the pattern language.

The above is the data-based method of constructing internal validity. It allows checking the alignment of content and verifying appropriate descriptions during the essence intuition in pattern language crafting. Since essence intuition of meanings is performed by exploring meanings in the domain of consciousness, separate from the original factual data, there remains a possibility of unintentional deviations or distortions by the researcher. Therefore, having practitioners review the work-in-progress multiple times during the crafting process corrects dogmatic deviations and distortions, ensuring the quality of the content and expressions in the crafted pattern language.

5.2 Confirming External Validity after Crafting a Pattern Language

The second stage concerns ensuring the validity of content after the crafting of pattern language. Figure 29 summarizes the overview of confirming external validity after crafting in GEA.

This involves verifying the appropriateness and quality of the content and descriptions after finalizing the pattern language. It consists of three main components: A. Pattern Description Confirmation, B. Pattern Existence Confirmation, and C. Pattern Effectiveness Confirmation. Researchers can select and apply the methods they deem necessary based on the research objectives and requirements.

The first component, A. Pattern Description Confirmation, can be conducted using three methods: A1. Writers' Workshop, A2. User Review, and A3. Expert Review. A1. Writers' Workshop is a method that has been used for over 30 years at pattern language conferences such as PLoP and EuroPLoP, where participants engage in discussions to improve each other's crafted pattern languages. The workshops include both experts and non-experts in the pattern language domain, providing insights into how the patterns are read and understood by people from different countries and cultures.

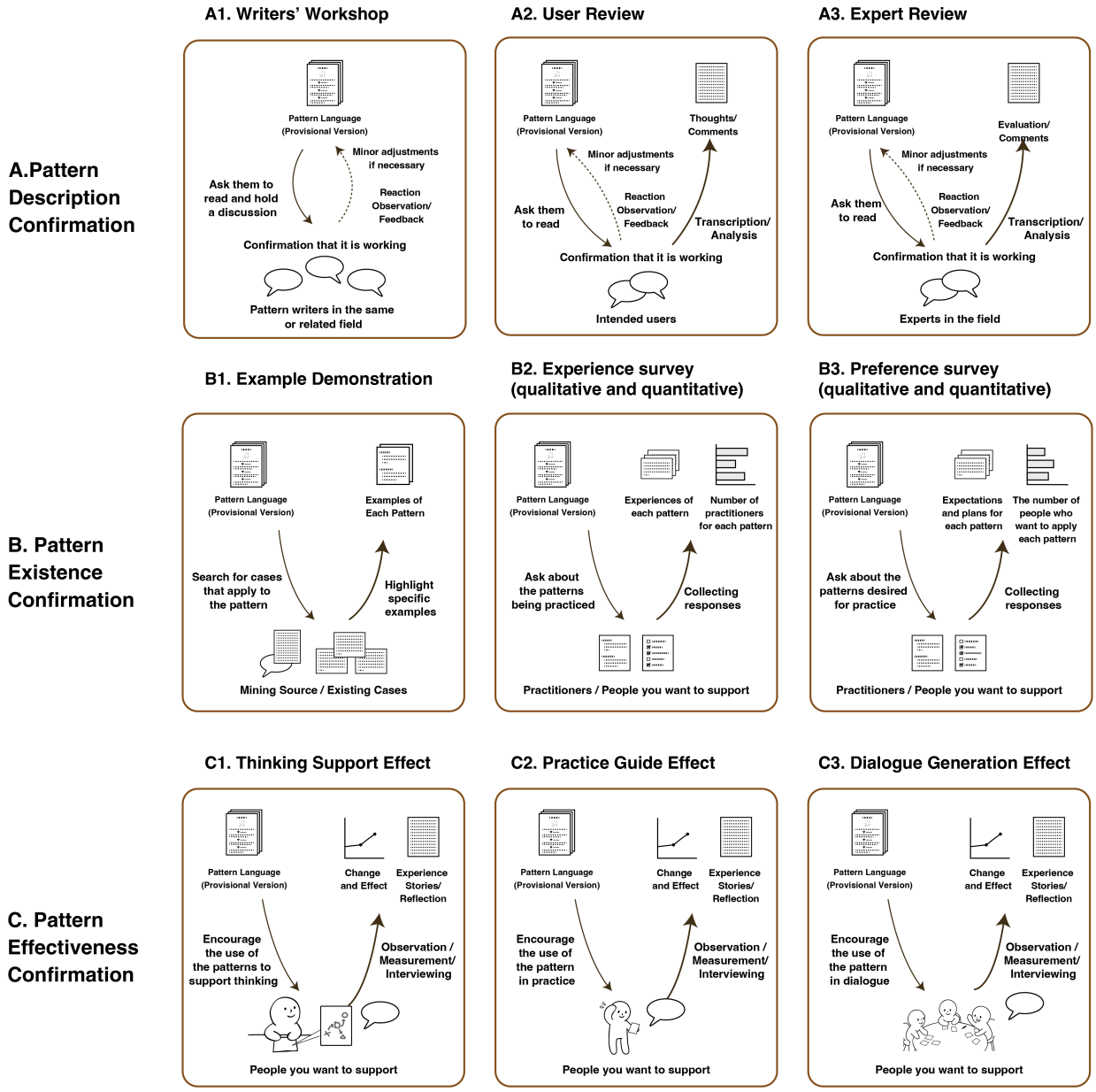

Fig. 29. Overview of ways of confirming external validity after crafting a pattern language, as suggested in the Grounded Essence Approach (GEA).

Papers published through PLoP and EuroPLoP have undergone Writers' Workshops, and the responses and feedback from these workshops have been incorporated into the final versions. In addition, at these conferences, shepherding is conducted to enhance the quality of patterns before they are presented at the Writers' Workshop; in this process, an experienced person serves as a shepherd who provides feedback to guide the author(s) as sheep toward higher quality, thereby improving their descriptions.

A2. User Review involves having the target readers of the patterns read them and observing their reactions or collecting their impressions. Every pattern language should have a target audience it aims to support. By having a subset of these future readers, i.e., the support targets, read the patterns, the appropriateness and quality of the content and expressions can be confirmed. We employed this method in our research on a pattern language for elderly care (Kaneko and Iba 2022, Kaneko et al. 2025), incorporating the target readers' impressions into the paper (Kaneko, 2020).

A3. Expert Review involves having experts in the theme of the crafted pattern language review its content and expressions, using their feedback for revisions or as evidence of appropriateness and quality. This overlaps with the Practitioners Review in constructing internal validity during crafting, but the reviewers in Expert Review do not necessarily have to be practitioners; the distinctive feature is the evaluation of the pattern language from an expert perspective. In our research, we had experts review the crafted pattern language in a study on a pattern language of collaborative practices for the conservation of biodiversity and natural capital (Kamada 2025).

The second component, B. Pattern Existence Confirmation, can be conducted using three methods: B1. Example Demonstration, B2. Experience Survey, and B3. Preference Survey. B1.

B1. Example Demonstration involves presenting real-world instances alongside each pattern in papers or other publications. Due to space limitations, it is usually only possible to include one to a few examples, which can be obtained through mining or by finding examples from other sources. Presenting these examples demonstrates that the patterns can be found in the real world. Many papers presented at pattern language conferences like PLoP and EuroPLoP include example demonstrations, and some authors even consider it part of their format. We have used example demonstrations in our papers on the *Online Education Patterns* (Hayashi et al. 2021, Adachi et al. 2021, Inoue et al. 2023) and *Music Composition Patterns* (Suzuki et al. 2022).

B2. Experience Survey involves surveying and presenting individuals who have experienced each pattern. Since patterns are modularized, it is possible to quantitatively show the proportion of people who have practiced them (Iba 2014b). We conducted a large-scale survey with thousands of participants and presented the results in our paper on the *Learning Patterns* (Iba 2014c). In addition to quantitative data, qualitative experiences with each pattern can also be collected and included in papers (Iba 2017b).

The aforementioned methods focus on past experiences with each pattern, but B3. Preference Survey can also be conducted to investigate the proportion of people who have not experienced the pattern but would like to practice it. A pattern language should not only have practitioners but also be compelling enough to make people want to practice the patterns. This survey confirms that aspect and can be conducted both quantitatively and qualitatively. We have done this in our paper on the *Learning Patterns* (Iba 2014a).

The third component, C. Pattern Effectiveness Confirmation, can be conducted using three methods: C1. Thinking Support Effect, C2. Practice Guide Effect, and C3. Dialogue Generation Effect.

C1. Thinking Support Effect verifies whether the pattern language can support individuals in reflecting on their own practices. In our research on a pattern language for elderly care (Kaneko and Iba, 2022, Kaneko et al. 2025), we introduced the patterns in actual facilities and conducted experiments to confirm if they made planning easier (Kaneko 2020).

C2. Practice Guide Effect verifies whether the pattern language can support practice. While it can be challenging to track and verify the effects of practice support in the open real world, it is not impossible if the research is well-designed. In our research, we have a paper that empirically verified how architectural design performance differed between classes that introduced a pattern language related to architectural education and those that did not (Yamano et al. 2024a). When such verification is not feasible, a common method is to provide accompaniment support, ask participants to reflect on how they practiced, and observe the changes.

C3. Dialogue Generation Effect verifies whether using the patterns from the pattern language as vocabulary has communicative effects. Our research includes papers examining the effects in educational settings (Yamano et al. 2024b) and in the field of elderly welfare (Kaneko and Iba 2023). Additionally, we have older papers on the effects of dialogue workshops using the *Learning Patterns* (Iba 2014c, 2017b).

As described above, confirming external validity after crafting in GEA allows evaluating the appropriateness and quality of the content and descriptions of the crafted pattern language using various methods or combinations of methods from A. Pattern Description Confirmation, B. Pattern Existence Confirmation, and C. Pattern Effectiveness Confirmation, enabling the assessment of the research outcomes as qualitative research.

6. CONCLUSION

In this report of my plenary talk, I first provided an overview of the development history and impact of our process and methods for pattern language crafting. Then, I discussed our holistic way of pattern language crafting from three aspects: the operational aspect for language construction, the reasoning aspect for scientific inquiry, and the academic aspect for qualitative research.

In this plenary talk and this report, due to time and page constraints, I have not been able to provide detailed cases and examples for each part. I have clearly indicated my previously published papers in the references, and I encourage you to read those papers for further information. Additionally, for more comprehensive discussions on abduction and essence intuition, I encourage readers to explore the works of Peirce and Husserl. I sincerely hope that by employing the methods presented in this report, readers will craft pattern languages in their own domains of practice to support people who engage in those practices.

ACKNOWLEDGEMENTS

First, I would like to express my sincere gratitude to the members of Iba Lab. at Keio University and of CreativeShift, Inc., who have collaborated with me on crafting pattern languages and exploring methodologies together. I also extend my appreciation to our research collaborators and members of the pattern community with whom we have engaged through our research endeavors. Finally, I wish to thank Program Co-Chair Mary Lynn Manns for organizing the "Imagination Run Wild" program, as well as Program Co-Chair Valentino Vranić and Conference Co-Chairs Indu Alagarsamy and Rebecca Wirfs-Brock for their invaluable contributions to this conference.

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