Individual Learning Characteristics in Web-based Communities of Practice

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Abstract. The Knowledge Management paradigm of Communities of Practice can be efficiently realized in web-based environments, especially if one considers the extended social networks that have proliferated within the internet. In terms of increasing performance through the exchange of knowledge and shared learning, individual characteristics, such as learners' preferences that relate to group working, may be of high importance. These preferences have been summarized in cognitive and learning styles typologies, which also define implications that could serve as personalization guidelines for designing collaborative learning environments. This paper discusses the theoretical assumptions of two distinct families of learning style models, cognitive personality and information processing styles (according to Curry's onion model), in order to explore the possibilities of personalization at the group level of CoP.

Keywords: Collaborative Learning, Learning Style, Cognitive Style, Personality Theories

1 Introduction

Traditionally, the social aspect of learning from a psychometric point of view has been correlated to personality traits. For example, a widely used personality psychometric tool is the Myers Briggs Type Indicator (MBTI) classification of types [1], that separates the way people perceive and learn in mutually exclusive preferences that involve (or not) social interaction (specifically, orientation to people: Feeling vs. Thinking types).

Moreover, major factor analysis approaches to personality [2] refer to extraverted and introverted persons, whose behavior is more or less socially oriented, with consequent effects to group dynamics. It must be stated that this extraversion-

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introversion scale is not the equivalent to MBTI extraverted/ introverted types, which are derived from the work of C.G. Jung and refer to the conceptualization of the outer world.

However, personality traits and their integration in an adaptive mechanism might seem rather vague in terms of quantifying and optimizing possible implications; still, the role of social interaction in learning has already been summarized in a number of cognitive and learning style theories, providing a useful personalization guideline for web-based CoP designers.

The term Communities of Practice obviously emphasizes on collaborative learning processes that are conducted horizontally within groups of people. The three elements that comprise a Cop are [3]:

- Domain – the area of knowledge
- Community – the group of people
- Practice – body of knowledge, methods and tools

The concept of incorporating individual characteristics in the context of a web-based environment could fit both in the Community and Practice elements, since:

- The usage of adaptive tools and methods (Practice element) can increase the level of comprehension by matching the learning material to the cognitive style of the learner, or by providing different types of knowledge resources to groups of participants with common cognitive characteristics.
- Collaborative learning processes can be optimized by assigning equally distributed different types of individuals in groups. Such an allocation would increase the number of problem solving approaches, since different types of learners approach problems in distinct ways (e.g. rely on others or work alone, theoretical vs. practical etc).

At the generic level of learning, web-based environments need to integrate individual and group characteristics in order to facilitate effective learning for every single user. It has been argued that the distribution of learning material in ways that match learners' ways of processing information is of high importance, since it "can lead to new insights into the learning process" [4]. Regarding these individual differences, there have been many attempts to clarify cognitive and learning parameters that correlate to the effectiveness of learning procedures, often leading to comprehensive theories of learning or cognitive styles [5].

Amongst these theories, some deal with the most intrinsic individual cognitive characteristics, such as Riding's CSA [6] or Witkin's Field Dependence [7], whilst some also take into account group interrelationship characteristics, such as Kolb's Learning Style Inventory [8] or Felder/Silverman's Index of Learning Style [9], regardless of their theoretical classification. As a result, the selection of the appropriate cognitive or learning style theory to be integrated in a web-based application should be in accordance to the context or the goals of each environment, and of course the availability of between learners' interactions.

Communities of Practice are essentially based on participants' interactions and socializations [10], which subsequently seem to favor personalization on the basis of a theory that emphasizes on the social aspect of learning. In any case, an effort to personalize the way an individual learns through a web-based CoP environment could follow two distinct approaches:

a) By incorporating a theory such as Kolb's LSI, different types of learners that have a different approach in problem solving could be equally distributed in web-based CoPs, in order to avoid the possibility of one-sided approaches to the building of knowledge. Thus, this leads to personalization at the group level, since the CoP web-environment allocates users according to their profile.

b) By choosing a more individually focused theory (e.g. CSA), application designers could offer to users learning material that matches their cognitive preferences; at a second level, the exchange of similar material between same types of learners could be enhanced. It could also be hypothesized that interactions between same types may increase comprehension or performance, which is the case of i-Help [11].

The issue of personalizing content for each single user has already been under the scope of Adaptive Hypermedia research, and relevant functional applications have been developed [12,13,14,15], while the significance of cognitive/ learning styles and intrinsic individual parameters in hypermedia environments constitutes a main research question [16,17]. The authors have already conducted experiments that demonstrate that matching web-based learning environment to a number of cognitive characteristics increases learning performance [18].

On the basis of Adaptive Hypermedia and cognitive/learning styles research, this paper examines how these theories describe distinct ways in which individuals could fit in collaborative working groups, setting a corresponding strategic context for personalized participation in web-based CoPs.

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2 Theoretical background

The hypothesis that learning styles provide web-CoP designers a useful tool for incorporating individual and group characteristics can be supported by the argument that as implied above learning styles are a link between cognition and personality [19]. It is a fact that it would be extremely ambitious to construct a model of users or groups that involve numerous personality and cognitive traits combined together, not to mention the psychometric challenges; therefore, learning style typologies could be the "next best thing". Learning styles, on the other hand, are widely varied, and some of them fail to exhibit satisfactory reliability and validity [20]. However, as research often demonstrates, learning style is an important factor in computer mediated learning processes [21], though not always in an expected way [22, 23].

Curry's 3-layer onion model [24] classifies learning styles in a way that they are not mutually exclusive, but co-exist at different levels of learning processes. Specifically, moving from the inside to outside, the innermost layer is called *cognitive personality style*, and is the most stable trait. The middle layer is the *information processing style*, whilst the outermost consists of *instructional preferences* (see table 1).

Theories that fall into the inner layer are mostly related to cognition or traditional personality research, while more learner-centered approaches fit in the middle layer. The outer layer is more unstable, and it should be mentioned that according to Sadler and Riding [25] it is affected by the inner layer. However, the Dunn & Dunn model that belongs to the layer of instructional preferences exhibits high reliability and validity, but its implications are not discussed here, since they are not easily related to web environments.

Learning style theories are classified by Atkins, Moore and Sharpe (2001) on the basis of this onion model [26] as shown in table 1.

Table 1. Classifications of Learning Style Theories according to Curry's onion model

Cognitive Personality Style	Information Processing Style	Instructional Preferences
Witkin's FD/FI	Kolb's LSI	Dunn & Dunn Model
Riding & Rayner's CSA	Honey & Mumford Model	
MBTI	Gardner's Multiple Intelligences	
Felder & Silverman ILS	McCarthy's 4MAT model	
	Gregorc's Learning Style Types	

In educational settings, all of these well-known theories have been tested; still, most hypermedia research focuses on theories that fit in the inner layer (with the exception of INSPIRE system [27]). We believe that is strongly related to the fact that inner layer theories usually include scales of terms easily represented in hypermedia applications, such as preference for visual or verbal information, and structural organization of the presented content. On the other hand, middle layer theories provide a less cognition-based approach, since they focus on behavior and style in traditional learning environments, from a wider perspective.

2.1 Inner Layer Theories

Between theories that belong at the same layer, there are great similarities. At the inner layer, Witkin's construct of psychological differentiation (Field Dependency vs. Field Independency) is strongly correlated with CSA's Wholist/Analyst Scale, since the latter is derived from the former [28]. Felder Silverman's ILS adds to CSA's two scales (Visual-Verbal, Wholist- Analyst) the similar to MBTI scales of Extraversion-Introversion and Sensing-Intuition.

It would seem that Felder Silverman's ILS could be a very inclusive theory, but it needs yet to provide further evidence for its theoretical and statistical grounding [29]. The long history of MBTI certainly guarantees for its grounding and wide acceptance, but its extended questionnaire and personality rather than learning orientation are somehow impractical for web settings.

In our opinion, though there are still reliability and validity issues to be resolved [30], Riding & Rayner's CSA seems to be the appropriate representative of the *cognitive personality style* layer, and its individual and group implications will be further discussed.

2.2 Middle Layer Theories

With the exception of Gardner's Multiple Intelligences, all theories that have been classified in the middle layer of Curry's onion model, share common characteristics in the way they define types of learners [31, 32, 33, 34] (see table 2).

Table 2. Types of learners as defined by information processing style theories

Kolb's LSI	**4MAT Model**	**Gregorc's Learning Styles**	**Honey & Mumford Model**
Converger	Dynamic Learning	Concrete-Random	Pragmatist
Assimilator	Analytic Learning	Abstract-Sequential	Theorist
Accomodator	Common Sense Learning	Concrete-Sequential	Activist
Diverger	Imaginative Learning	Abstract-Random	Reflector

Each horizontal row of Table 2 shows types of learners that share common characteristics, according to their theoretical description. We should mention at this point that these similarities haven't been unnoticed by Gordon and Bull who have proposed a meta-model that combines multiple similar learning style models [35], taking also under consideration theories that are not mentioned here.

These middle layer models directly refer to learners' attitude towards collaborating and working in groups; speaking in terms of personality theories, some types are people oriented and some are more logical (feeling vs. thinking). This is especially true for the case of Kolb's LSI, where convergers and assimilators are thinking types, while accommodators and divergers are feeling types, according to correlations with MBTI scores. We should clarify that these types (regardless of specific theory) are not absolutely stable, but one person can gradually change style; it is possible that a learner can alter his type as years go by. Moreover, belonging to a type doesn't necessary exclude the possibility that at instances a person can perceive information in any of these four styles, even though his persistence on a specific style is relatively stable.

For the purpose of exploring the possible integration of middle layer learning styles into CoP environments, we believe that Kolb's LSI is the most appropriate representative of the aforementioned models, due to extended research on its implications and correlation with other psychometric constructs (such as the MBTI) [36]. However, analogous considerations can be projected on other models that share the same theoretical assumptions.

3 Individual Characteristics Considerations for CoPs

According to our rationale, there are two distinct ways to group users in CoP applications:

I. Learners with common cognitive styles (as classified by Riding's CSA that we use in our paradigm), could be grouped together and collaborate in an environment that serves better their preferences- this is the case with i-Help that we mentioned above. Learners, in general, prefer to send information the way they receive it, and vice versa.
II. In addition, each group of people should consist of practitioners of all different types of learners (according to LSI taxonomy that will be further discussed), in order to increase the variety of proposed problem solving approaches (with regards to social interaction) and to promote more efficient Knowledge Management practices.

These two ways of integrating cognitive and learning style typologies in web-CoPs are not mutually exclusive: the first case refers mainly to the material used and its structure, whilst the second paradigm deals rather with group composition.

3.1 The Paradigm of CSA

The CSA taxonomy is consisted of two independent scales, Imager/ Verbal and Wholist/ Analyst. The Imager/ Verbal scale affects the way learning resources are presented, and is probably less important in terms of overall CoP grouping; it important though in web-content presentation. Within adaptive web architectures, users who have been identified as Imagers or Verbals, could be presented with the corresponding learning resources (e.g. images or text).

The Wholist/ Analyst scale, though, is about organizing and structuring information (see table 3), and is consequently related to navigational patterns. It would make much sense that users with common navigational route and structural approach would work collaboratively more efficiently, the same way that matching teaching and learning style is expected to increase performance.

Table 3. Wholists/Analysts Characteristics

Wholists		**Analysts**	
View a situation and organize information as a whole	Organize material in loosely clustered wholes	View a situation as a collection of parts and often stress one or two aspects at a time	Organize information in clear-cut groupings (chunking down)
Proceed from the whole to the parts	Exhibit high assertiveness	Proceed from the parts to the whole	Exhibit low assertiveness

Otherwise, a radically differentiated approach on behalf of learners could hamper communication and the way tasks are perceived, since wholists move from the whole to the parts, while analysts follow the exact opposite route. Intermediate learners are expected to perform equally well in both structural settings.

Additionally, to the extent that the wholist/analyst scale coincides with Witkin's FD/FI scale, it can be argued that wholists are little more oriented towards other people, whilst analysts are more introverted. Moreover, wholists exhibit higher assertiveness than analysts.

Safe conclusions could be drawn only after this hypothesis is tested in a web-CoP environment, and the aforementioned matchmaking is proven as important as the matching of teaching and learning style.

3.2 The Paradigm of LSI

On the contrary, the aforementioned middle layer theories (as represented by Kolb's LSI) describe learner types also in terms of collaboration. In other words, working in groups is perceived differently by each type; some types rely on others whilst some simply do not.

As in Riding's CSA (and the rest of the middle layer theories), Kolb's 4 types are drawn from two independent scales: Concrete Experience vs. Abstract Conceptualization, and Reflective Observation vs. Active Experimentation. People-oriented types are those that tend to Concrete Experience rather than Abstract Conceptualization, which in terms of personality theories are rather Feeling than Thinking.

More specifically, by focusing on group collaboration preferences according to Kolb's LSI [37], learners' characteristics are summarized in table 4.

Table 4. Learners' Characteristics in terms of group working preferences according to LSI

Divergers	**Accommodators**	**Convergers**	**Assimilators**
Are oriented towards people	Learn by teaching others	Prefer usually to work alone	Prefer working alone
Excel at brainstorimg and working in groups	Excel at influencing others	See group work as a waste of time	Will work in groups if assigned
Learn by sharing ideas and feelings	Rely on others for information in solving problems	Appear bossy and impersonal	Prefer the instructor reader to be an authority
Prefer the instructor/leader to be a motivator	Work well in groups		

As it is clearly defined by theory, diverger and accommodator's individual characteristics demonstrate a strong preference in group working, since collaboration may be a necessary prerequisite for maximizing learning performance. It also could be argued that the present modus operandi of web-learning in general favors types of learners that prefer working alone (convergers and assimilators), than those who are people-oriented.

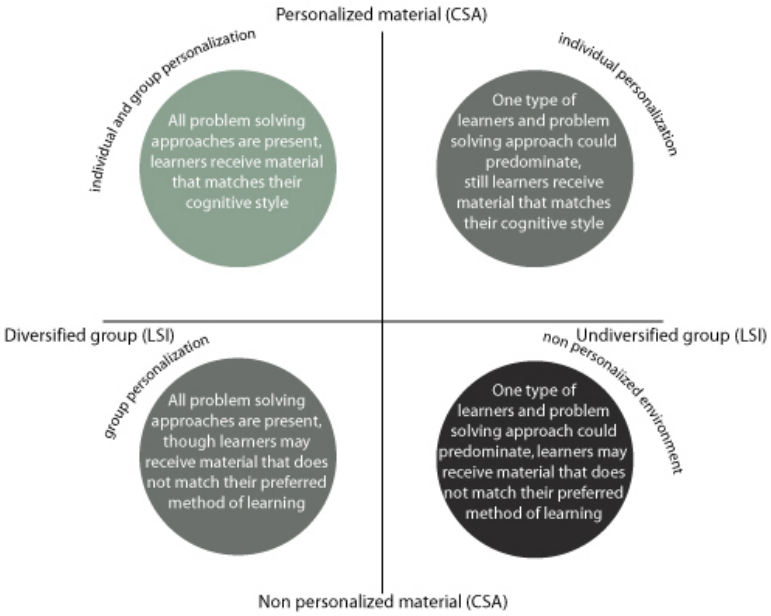
Implications for designers of CoP applications can be summarized in the equal distribution of the different types of learners, and in further motivating convergers and assimilators to participate. For example, if for any reason a group consists only of these latter two types, then the CoP's functionality may be impaired.

3.3 A Combined Approach

Whether should an information processing style theory be chosen over a cognitive personality style theory (e.g. LSI vs. CSA), and which would that theory be, is still a matter of debate. Practical and convenience reasons, as much as reliability and validity scores, determine at some extent the final selection.

On the other hand, since these theories are not mutually exclusive, it is possible that they could be combined in a unified model that separates the practical implications of each theory according to the CoP element they relate to. Theories such as the CSA focus on the individual (practice methods and tools), while theories such as the LSI can be applied on group composition (community). Ideally, the concept of personalization in a web-based CoP should address both these levels (see figure 1).

Figure 1. Unified approach to personalization in CoPs



It should be clarified that the term "problem solving approaches" refers mainly to learners' preference (or not) to work with other people to promote efficient learning through practice, since this is of relatively higher importance in the context of CoPs. Moreover, some people tend to "lead" others in collaborative learning processes, while some tend to "follow". Therefore, it is of importance to mix these types within a group.

This model demonstrates how cognitive and learning style theories may serve as well-defined guidelines for designers that are interested in expanding their center of attention to individual characteristics and their implications on group considerations, the same way that CoPs have changed the way Knowledge Management is conducted.

4 Summary and Future Work

The number and types of group interactions that learners are involved in a Community of Practice are strongly related to individual characteristics, which determine the degree of preference to group working, or at least common ways of structuring information.

Even if these social preferences are directly linked to personality factors, personality theories have far too complicated implications for CoP environments that focus on Knowledge Management, while theories that address low-level cognition processes are often too individualistic to consist a basis for user grouping.

Learning style theories could be described as a much needed link between personality and cognition; still, one must not be too optimistic until issues of reliability and validity of psychometric instruments are resolved. Nevertheless, at theoretical level, these constructs provide useful insights for Knowledge Management applications that intend to explore the integration of learning methods of group working into web-based CoPs.

As shown above, not all learning style theories address issues of group interaction at the same extent. Therefore, web-CoPs designers that wish to incorporate individual learning characteristics should distinguish that each cognitive/learning style theory addresses issues of different elements of a CoP:

- *cognitive personality style* theories relate to the Practice element, since their implications may lead to a personalized approach to methods, tools and material.
- *information processing style* theories are relevant to the Community element, in the sense that different types of learners should be combined together in order to assure the occurrence of interactions at the level of shared learning and the building of coherent knowledge.

Subsequently, this leads to the need of experimentally evaluating the positive effects of a) matching content to practitioners according to their cognitive style (personality cognitive style models like CSA), and b) assigning to each group equally distributed different types of learners (information processing style, such as Kolb's LSI).

In any case, collaborative working is not a mere result of random real-time dynamics, but also the resultant of learner characteristics that individuals carry along, whatever the circumstance. Therefore, taking into account their preferences may promote efficient cooperation, or at least alleviate difficulties that occur from widely varied methods of learning between practitioners in CoPs.

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