TRIALOGICAL LEARNING – A CONCEPT FOR ENHANCING INTERACTIVE FOREST PLANNING

Teppo Hujala[1], Henna Höglund[2], Lauri Mehtätalo[3] and Jouni Pykäläinen[4]

[1] Finnish Forest Research Institute, Vantaa Unit, P.O. Box 18, FI-01301 Vantaa, Finland, teppo.hujala@metla.fi

[2] University of Eastern Finland, School of Forest Sciences, P.O. Box 111, FI-80101 Joensuu, Finland, hoglund@student.uef.fi

[3] University of Eastern Finland, School of Computing and School of Forest Sciences, P.O. Box 111, FI-80101 Joensuu, Finland, lauri.mehtatalo@uef.fi

[4] Finnish Forest Research Institute, Joensuu Unit, P.O. Box 68, FI-80101 Joensuu, Finland, jouni.pykalainen@metla.fi

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Introduction

Small-scale family forest owners vary increasingly in terms of how they value different purposes of forest and what they pursue regarding their own land (Hogl et al. 2005, Kendra and Hull 2005, Karppinen 2012). Forest ownership is fundamentally a matter of perceived identity in connection with the owner's actualized lifestyle (Bliss and Martin 1989, Ziegenspeck et al. 2004). Therefore, forest advisory can no longer rely purely on the expert-driven mode of extension and technology transfer, assuming a predominantly economic view on timber production.

Increasing the role of the small-scale forest owner's perspective in forest advisory and management planning has been considered one way to tackle the challenge of changing forest ownership patterns. In a broad sense, this principle has been actualized, for example, in voluntary forest conservation programmes (Kauneckis and York 2009, Mäntymaa et al. 2009). In turn, forest research has produced the concepts of owner-driven forest planning (Hujala 2009) and adaptive decision analysis (Leskinen et al. 2009) as well as customer segmentations for policy and market services based on various forest owner typologies worldwide (e.g. Boon et al. 2004, Salmon et al. 2006, Hujala et al. 2012).

Due to changes in forest owners' objectives and their operational environments, interactive forest planning may have an important role especially in the forthcoming forest planning practices. Interactive forest planning can be defined as a learning-oriented form of forest advisory, which focuses on finding a documented chain of planned actions in forest by means of assessing the owner's objectives and the holding's production possibilities with the aid of discussions, computer simulations and comparison of alternatives (e.g. Pykäläinen 2000, Pykäläinen et al. 2006). Interactive planning characteristics may also be realized in computer-supported participatory planning processes (e.g. Tyrväinen et al. 2006, Salter et al. 2009).

One of the main ideas in interactive planning is that the forest owner (or the stakeholder participant in the participatory case) learns to know the production possibilities (alternative forest plans) of the forest area under planning and the connections between different forest uses in general. Typically the owner's forest management goals also become clearer during the planning process. On the other hand, the planner learns as well about the production possibilities and about the owner's goals. Hence, interactive forest planning can be seen as a process of collaborative learning (see Dillenbourg 1999).

Thus far however, the research work of interactive forest planning has mainly focused on technical method development, not so much on the actual root-level communication and learning. An example of such research approach is a video analysis of owners' and the planner's discussions in forest-planning meetings (Virkkula et al. 2009).

Meanwhile, the science of higher education has developed useful new concepts for approaching the learning processes among advisory interlocutors. This paper introduces the concept of *'trialogical learning'* as a promising theoretical framework for improving collaboration and mutual learning in the context of interactive forest planning. Furthermore, to demonstrate some important viewpoints of the trialogical learning approach, two interview-based case studies from eastern Finland are presented. The general aim of this paper is to acquire evidence of the usefulness of the trialogical learning

approach and devise related recommendations to enhance interactive advisory and management planning services.

Learning in Interactive Forest Planning

Learning can be approached with the aid of knowledge acquisition, participation, and knowledge creation metaphors (Figure 1). The former two have been contrasted by Sfard (1998) and the latter one added by Paavola et al. (2004). The knowledge acquisition metaphor describes learning as an individual's own process of storing new information in her/his mind (monological learning). The participation metaphor highlights the meaning of interaction in various activities as a base for coming up with new knowledge (dialogical learning). The knowledge creation metaphor (see Paavola and Hakkarainen 2005) considers knowledge as the outcome of developing shared learning objects (trialogical learning).

In Finnish forest planning, forestry experts have traditionally taught the principles of sustainable forest management – striving for continuously high wood production measured in cubic meters – to forest owners. This kind of planning culture mainly promoted forest owners' knowledge acquisition (monological learning). However, it neglected the fact that many forest owners have multiple forest management goals. Lately, the dialogical learning features has become more common in planning because the forest owners have been given more opportunities to take part in the planning process (see Tikkanen et al. 2010). Hence, the planners have more often learned, among other things, the owner's forest managament goals during the planning process. However, the participation metaphor may still lead in a situation where the forest owner and the planner do not really understand each other because of their very different experiental backgrounds.

The trialogical learning promotes mutual understanding among the planning participants. Together with the methodology of interactive forest planning, trialocigal learning thus offers promising opportunities to enhance for client-oriented and multi-objective forest planning. For example, the use of thematic interviews (Pykäläinen 2000) and cognitive mapping (Tikkanen et al. 2006) for inquiring after the owner's objectives include central features of trialogical learning. The planner and the forest owner recognize the starting point and objectives that frame the interaction. The interview guide or the cognitive map acts as a tool of preference inquiry and as an object of joint development and concurrently gives structure to the meeting.

In trialogical learning, collaborative knowledge is created via shared knowledge objects, i.e. mediating artifacts, which can be classified in material and conceptual artifacts (Paavola and Hakkarainen 2009). The essence of mediation originates in the pragmatic philosophy by Peirce (see Bergman 2004) and in the thinking of Vygotsky (1978). Mediation means a shared cognition when focusing attention to the artifact at hand. Recognition of the meanings that the other person gives to each artifact is significant for the trialogical approach (Stahl 2003), because it allows shared representations and thus jointly generated meanings for the knowledge objects (Wartofsky 1979).

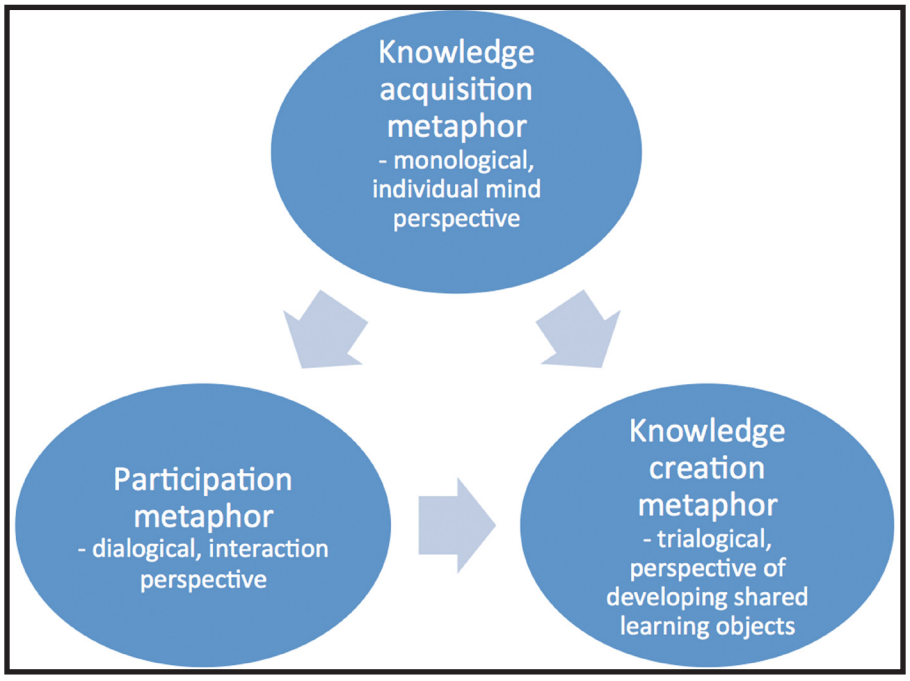


Figure 1. Three metaphors of learning (adopted from Paavola and Hakkarainen 2004).

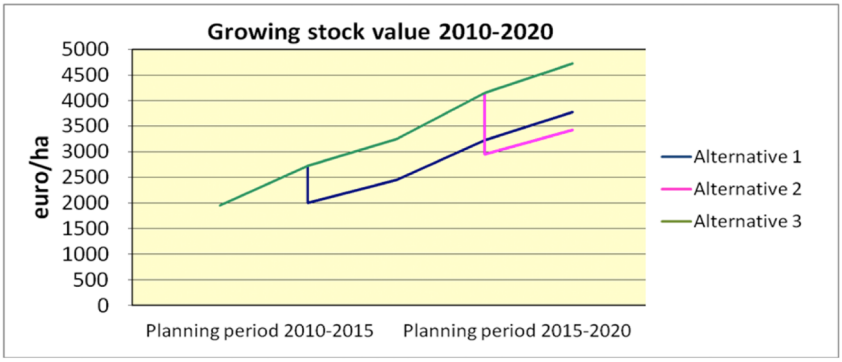
Artifacts may have different functions in trialogical learning. On one hand, they may act as tools for development and on the other hand, they may be the objects of development (Miettinen 2001). For example, in a process of writing a joint research article, the article acts as a mediator on which each collaborant in turn focuses.

An interactive forest planning process includes several mediating artifacts. For example, a joint field trip with a forest expert has a shared meaning among forest owners and it is thus a conceptual artifact, while the forest plan is a concrete artifact, as it is an object of the process and a source of discussion topics (Hujala and Tikkanen 2008). In the phase of compiling the forest plan or comparing forest-management alternatives iteratively (e.g. Pykäläinen 2000), the planning software showing forest resource data and draft plans forms the mediating artifact in the forest owner's

Stand 876 at present (Year 2010)

Main species	Pine
Area	0.7 hectares
Site class	middle rich, blueberry type
Age	29 years
Mean height	13.9 m
Diameter (thickness)	14.4 cm
Basal area	21.0 m^2
Trees/ha (n of stems)	1468/ha
Monetary value	3000 euros

Plan for treatments 2010-2020 (planning periods 2010-2015, 2015-2020)
Alternative 1: Thinning on 1. period, no treatments on 2. period
Alternative 2: No treatment on 1. period, thinning on 2. period
Alternative 3: No treatments within the planning periods



Aim of the thinning is to increase the growing space of the remaining trees and thus accelerate their growth. After thinning the forest is clearly more spacious than before the thinning. When one third of the growing stock volume (biomass) is removed, approximately half of the number of stems is removed. In future the stand may be thinned once or twice before optional final harvest.

Stand characteristics and economic outlook 2020

	Height, m	Dia-, meter, cm	Basal area m^2/ha	Number of stems, /ha	Volume, m^3/ha	Stand value 2010	Net income 1. period	Net income 2. period	Stand value, 3% 2020
Present, 2010	13.9	14.4	21.0	1468.0	130.0	3000			
Alt 1, 2020	17.4	18.3	20.7	877.0	161.0		495	0	4000
Alt 2, 2020	17.4	18.0	19.0	838.0	149.0		0	855	4000
Alt 3, 2020	17.4	17.2	28.2	1369.0	218.0		0	0	5000

Figure 2. Illustration of a forest stand fact sheet with combined manners of representation.

and the forest planner's action. The fact that the plan can be modified during the meeting is an asset of interactive planning software – indeed, trialogical learning suits well with computer-supported communication where it has already had several applications (e.g. Tzitzikas et al. 2006, Paavola and Hakkarainen 2009).

Materials and Methods

The study applied the model of two separate case studies (Yin 2003 p. 53–55) to investigate how different mediating artifacts receive meanings when forest owners talk with a forest planning expert about their forests, forestry operations and their forest-related anticipations. The motivation behind this procedure was to strengthen the evidence base of results and inferences via gathering data in two different interview campaigns (Table 1).

For special test artifacts, '*forest stand fact sheets'* were designed and compiled. In this context, the fact sheets mean an illustration of the present stage of a forest stand and its future development, alternative treatments and their economic consequences within the next ten years (Figure 2). The fact sheets were produced with forest planning software Monsu (Pukkala 2007) and Microsoft Excel. The fact sheets were used in semi-structured interviews, which resembled interactive forest advisory situations. The interviewer acted in a double role of a forest expert and a researcher. In both case studies, the discussions, following a brief interview guide, were recorded and transcribed (with two exceptions due to technical reasons), and the interviewer's field notes were added in the transcribing phase.

The analysis combined theory- and data-driven approaches (see Layder 1998). The basic unit of analysis was 'a meaning entity', which could consist of one or more sentences. First, the transcripts were organized thematically. Second, the original statements were reduced to squeeze and simplify the material. Third, the responses were clustered by searching similarities and differences. Fourth, the clustered statements were further linked, and after that, the resulting classes were labeled. The analysis not only included the discussions concerning the alternative treatments of forest stands but also the feedback concerning the stand fact sheets and the discussion in general and the interviewer's observations (i.e. field notes) about the functioning of different artifacts as mediators of discussions.

Results

The qualitatively analysed evidence from the case study 2 shows that a map of stands (or an aerial photograph) worked as a uniform mediator for conversations. Owners' own material, such as earlier maps, forest plans and photographs or records of conducted operations or timber sales, complemented the material used during the discussions. The more experienced owners wanted

Table 1. Overview of the materials and methods of the two case studies.

Feature	Case study 1	Case study 2
Study region	North Karelia, SE Finland	Kainuu and North Karelia; i.e. NE and SE Finland
Number of interviewed forest owners	11 (female 5, male 6)	15 (female 2, male 13)
Timing of data acquisition	December 2009	Autumn 2010
Duration of interviews	Average 41 min (28–78 min)	Average 50 min (30–80 min)
Material used		
1) Stand fact sheets	From generic *exemplary stands* representing different developmental classes; three manners of representation: picture-illustrated, narrative and graphical	From genuine forest resource data of 2–3 different stands of *each participant's own holding*; with combining the different manners of representation
2) Map	Not used	Map of holding's forest stands with basic map or aerial photograph background, raster illustration of developmental classes
3) Forest plan	Part of forest owners mentioned their forest plan in the discussion and fetched it during the meeting to support the discussion	
Aim of analysis	To study in particular, what kind of manner(s) of representation appeals to owners when learning about forest matters	To study in general, what kind of role the utilized artifacts may have as a part of an forest advisory situation
Collecting feedback	Orally at the end of each interview	Both orally at the end of the interview and anonymously by mail afterwards

to bring their own material to the discussion more often; they were also less interested in focusing their attention to the forest stand fact sheets.

The owners used a map as a mediator to start talking about specific sites in their holding, with e.g. moose and wind damages, ecologically valuable habitats and conducted silvicultural treatments. Some owners even pondered the treatment order of stands with the map. It seemed to help the owners remember things and bring out their viewpoints. Evidently, the availability of a concrete, familiar mediating artifact encouraged the owners to drive the discussion.

According to the interviews, treatment alternatives that the stand fact sheets presented, received a meaning as tools to make operational decisions or as support for individual learning or interactive decision-making. In more detail: owners thought that the presented alternatives allowed them to adjust the forest treatments with their everyday life, to make decisions with greater self-reliance or to get inspiration in advisory discussions. The owners showed interest in seeing the consequences of suggested treatments and in understanding cause–effect relationships.

A preference choice between manners of representation of the stand fact sheets was done 22 times in the case study 1. Among these, the narrative fact sheet was picked up 15 times. The graphical fact sheet was selected 14 times and the picture-illustrated fact sheet was chosen 6 times. The most frequent choice was a narrative fact sheet accompanied by a tabular representation of incomes and expenses.

The narrative fact sheet was praised of clearly stating the purposes of the treatments. However, the owners thought that the narrative fact sheet supported the other fact sheet types like a figure caption so that neither the graphical nor the picture-illustrated fact sheet would necessarily work alone. The interviewees regarded comparability of alternatives and seeing the economic consequences and future development of the stand as the strengths of the graphical fact sheet. Those owners who liked the graphical fact sheet felt that it is quickly and easily understandable; as a whole, however, the graphical fact sheet received some doubts and some owners gathered it only when explained.

Figuring quickly out the consequences of treatment alternatives appeared as a clear strength for the picture-illustrated stand fact sheet. The picture illustration was perceived useful in the case of stands with special scenic values but useless when the owner has predomi-

nantly other than scenic objectives, e.g. economic ones. Forestry terms (e.g. basal area, seed tree cutting) were problematic for some owners, because they did not understand the terms and thus the comprehension of the stand only came via the pictures. Most owners, however, felt that numbers meant more than pictures, which only vivify and thus increase the meaningfulness of contemplating the fact sheets.

Discussion and Conclusions

The findings encourage using artifact-focused approach in further action research aiming to improve interactive forest planning and advisory. In both case studies, the stand fact sheets worked as stimulating mediating artifacts making the forest-use alternatives visible. When seeing and understanding stand-level alternatives, owner's power on driving the advisory discussion and making forestry decisions increases. Presenting alternatives seems to be a feasible way to go deeper in mutual learning about the owner's objectives and motivations.

The results indicated that the role of a map was essential as a general tool to guide the discussions. There were signs that the map did function as a mediator for shared cognition of the interlocutors. The phase of forest ownership of the interviewees seemed to affect the choice of material used as mediating artifacts: the less experienced owners applied the given forest stand fact sheets while the more experienced rather used their own material. There are two probable reasons for this: on one hand, the more experienced owners more often have such material of their own, and on the other hand, the fact sheets present basic knowledge of forest treatments, which usually is of interest among owners with less prior knowledge.

The results indicate that fact sheets could be used as tools in marketing forest plans and other advisory services, because they have the potential to give more understandable view on the contents of the service. The observed essence of map as structuring the advisory interaction should be utilized when organizing meetings with forest owners. Concurrently, owners' own material should be given more room in discussions, because to allow using those as mediating artifacts will reshape the forest planner's role from advice giver towards situation-sensitive consultant (see Hujala 2009). This, in turn, could contribute to the commitment to plans among owners and the effectiveness of planning.

To sum up, the approach of trialogical learning encourages developing advisory services towards such interaction that begins with recognizing the participants' backgrounds and continues with organizing the interaction around joint mediating artifacts. Trialogical learning offers forest professionals grounds and tools to i) prestructure advisory meetings and ii) make owners elicit their preferences. Both forest professionals and forest owners should be encouraged to using concrete mediating artifacts as a help in highlighting their viewpoints. That way the interlocutors can affect the learning of each other.

The inherent demand for flexibility is an evident challenge for trialogical learning, because for following that approach only direct-giving features can be given. It may also be that part of forest owners and forest professionals are not yet familiar with interactive planning culture. Mitigating this challenge will require active public discussion about reshaping planning services as well as trainings and experiential workshops. In addition, because forest planning software suitable for iterative interactive services are currently in their infancy, research and development should focus on computer-mediated interaction and related tools. With more profound interactive planning software and higher awareness of how artifacts enhance participants' mutual understanding, the promises of trialogical learning in forest advisory would be closer to fulfillment.

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