Foundations for a Science of Social Inclusion Systems

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Abstract: The lack of precise models to support the design and analysis of social inclusion systems, and the growing informatization of the society which connects digital to social inclusion in multiple ways, lead to the need of exploring in full the potential of information technology to support social inclusion. However, this potential can only be achieved if we can rely on precise models that can be used to inform the design and support the analysis of social inclusion systems. Taking into consideration world views that address issues that are relevant for social inclusion systems we are working on the definition of an ontology and models that can be used to make precise the design of social inclusion systems and support their analyses. The aim of this paper is to discuss some foundations for the development of a science of social inclusion systems and present an ontology and models that are based on the definition of social situations, social interactions, social processes and social affordances. The approach is being used to drive the observations and analyses that will be carried out in a project of digital and social inclusion that we are currently developing, which involves rural communities learning an internet language and using it to model their social context and address the problem of social inclusion.

Keywords: social inclusion, ontology, models, science.

1. Introduction

Social inclusion is a problem that has been largely neglected by science. One of the consequences is the lack of precise models that can be used to inform the design and support the analysis of social inclusion systems, which are systems of any kind created to promote social inclusion. Today, the potential of information technology to support social inclusion systems can only be achieved in full if we can rely on such models However, social inclusion is a complex multidisciplinary many-faceted problem that is far from having the same kind of formal basis that other scientific disciplines have achieved. Nevertheless, the formal languages of information technology used by disciplines that address social issues with a rather formal approach, like cognitive science and artificial intelligence, can provide a starting point on which to build a formal basis to support the design and analysis of social inclusion systems.

Social inclusion systems involve processes of participation, mediation and interaction in which cognition and learning are situated in broader sociocultural contexts and the notion of learning community becomes central. Taking this into consideration in the light of a conjunction of factors related to social, economic, cultural and environmental conditions that characterise a social system, we are working on the definition of an ontology and models that can be used to make precise the design of social inclusion systems and support their analyses.

As a starting point we have identified an initial set of four ontological categories that will be used to drive the observations and analyses that will be carried out in a project of digital and social inclusion that we are currently developing, which involves a careful design of content and activity and consideration of the social context, and so addresses many issues related to the design of social inclusion systems. The project involves rural communities learning an internet language and using it to model their social context and address the problem of social inclusion.

The four ontological categories that we have identified are: social situations, social interactions, social processes and social affordances. In the paper we will describe these four categories and present the rationale for them, which derives from world views that address issues of social learning. Then we will show how these ontological categories can be used to model aspects of social inclusion systems, with examples taken from the project that we are developing.

This project is being developed in a region where the rural communities have a potential for the development of an agriculture that can be used for the production of biodiesel, which is viewed as a way of generating income and promoting social inclusion to these communities. A program of training farmers to cultivate plants that can be used to produce oil is being developed in the region as part of a government plan to increase the production of renewable sources of energy by small farms in order to provide social inclusion. This is the social context of the community in which our program of digital and social inclusion is being applied. The program includes the production and use of audiovisuals on subjects of the social context of the learners as a way of providing visual representations of aspects of this social context to be used in the projects that the students will develop for digital inclusion.

Part of our work on this project involves eliciting the notions that arise, in the light of our ontology and models, so that they can be stated in precise terms to support the design of social inclusion systems and provide a framework for the development of units of analysis of social inclusion phenomena.

The next section presents a discussion of world views that can constitute the basis for the construction of a science of social inclusion systems. Then, in section three we present the ontology and models that we have developed, and in section four we discuss their application, showing some examples. Overall, the aim is to identify and discuss the issues that arise in supporting social inclusion in individual and community contexts, and explore a way to express these issues in precise terms and models to lay the groundwork for the development of scientific approaches to address and support social inclusion.

2. A World View for Social Inclusion Systems

A world view for social inclusion systems will come from the definition of the units of analysis of social inclusion phenomena, including assumptions about the role of the context, the people and the interaction between them in social inclusion systems, and considering issues of time, change and causation, as well as issues of physical and psychological phenomena related to social inclusion.

In a world view focused on social inclusion phenomena, a central issue to be addressed is the relation between people and their environment in social inclusion processes. In this regard, we follow Gibson´s theory of perception (Gibson, 1979), which treats contexts and psychological processes as aspects of a holistic unit. According to Gibson, the organism and environment uniquely differentiate to fit one another forming a distinctive ecological niche, in such a way that the structure and functioning of the organism implies the environment as well as the particulars of the niche imply the structure and functioning of the organism.

A fundamental notion of Gibson´s theory is the concept of affordances. The affordances of an environment are what it offers to an organism, such as the opportunities for actions or the dangers that exist in an environment for an organism. However, affordances are located neither in the environment nor in the organism. Instead, they are intended to capture units of analysis of perceptual activity that refer to both the environment and the organism in a complementary way.

Therefore, affordances can be interpreted as significances-to-the-organism in the environment, which lead to possibilities for action. An important aspect of affordances is its dynamic character, i.e., affordances that were not present at a certain point may become present after the organism grows, matures, and learns. In general, we can say that after certain interactions between the organism and the environment, affordances that were not present before might become present, as well as some affordances that were present might not be present anymore. In addition, there are positive and negative affordances. While positive affordances may be beneficial to an organism a negative affordance may not (Sanders, 1997).

A view that also addresses the mutuality of organism and environment in development is found in the notions of assimilation and accommodation described by Piaget (Piaget and Garcia, 1991; von Glasersfeld, 1995). According to this view, knowing and doing cannot be separated, and the activity and context of an experience become an integral part of the meaning of that experience.

It is from the way people act and organise their activities in situations that they construct their cognitive structures. These cognitive structures result from a dynamic process of successive assimilations and adaptations of elements of experience and of cognitive structures, with new meanings being attributed to experience and new cognitive structures being constructed from the existent ones.

In activity theory, Vygotsky also addresses the mutual involvement of the individual and the social context in development through the concept of activity, emphasising holistic units of analysis (Vygotsky, 1978). According to activity theory, individual thinking is a function of social activity.

Through activity, people can create their own interpretations of the situations in which they are, develop their own goals, make their own decisions concerned with what to do in the situations, and explore their own paths. They can also participate in a community of practice, accessing the views and practices of the other members of the community, and making sense of all kinds of information related to that community.

From this view comes the notion of development as apprenticeship, which involves becoming a member of a community of practice as a way of moving from peripheral to full participation in the world (Brown, Collins and Duguid, 1989; Lave and Wenger, 1991).

Finally, approaching the study of psychological and environmental aspects of phenomena in an integrated way is also in line with what has been proposed as a transactional perspective for research and theory in psychology (Altman and Rogoff, 1987). According to this perspective, however, the focus is not only on the relations between individuals and their environments, but also on the temporal qualities of these relations considered as inherent aspects of phenomena, and embodying the flow and dynamics of the individual's relations to social and physical settings.

Therefore, considering the issues that have been addressed by theories of human development under the perspective of world views that emphasise the importance of the contextual and temporal aspects of phenomena, and adopt units of analysis that address the interation between person and environment, we have outlined a world view that emphasises five aspects as holistically coexisting in any social inclusion process:

(a) **The social context**

(b) **The social development state**

(c) **The social inclusion activity**

(d) **The social inclusion process**

(e) **The affordances for social inclusion**

The aim is to develop a theory that takes into consideration the current social situation of individuals or communities (the social context) and the state of development of their social context (the social development state), including the people´s state of knowledge that is relevant for their social inclusion, and provide means to help determine how and which activity in this situation (the social inclusion activity), and from situation to situation (the social inclusion process), may provide opportunities to individuals and communities for social inclusion (the affordances for social inclusion).

In order to develop such a theory we have developed an ontology and an initial set of models based on the ontology, which are described next.

3. Ontology and Models

In the development of an ontology and models to support the social inclusion systems world view presented in the previous section, some of the research questions to be addressed are:

- How do particular aspects of an environment (physical and social contexts) affect how people (individually or in group) can achieve a social inclusion goal? (the role of the social context)

- What particular social development states allow people (individually or in group) to achieve a social inclusion goal from engaging in particular kinds of interactions? (the role of social development states)

- What will people do in a given environment (individually or in group) to achieve a social inclusion goal? (the role of the social inclusion activity)

- What particular ways in which interactions can evolve allow people (individually or in group) to achieve a social inclusion goal from engaging in particular kinds of interactions at particular times? (the role of the social inclusion process)

- How do particular kinds of affordances of an environment allow or preclude people (individually or in group) to achieve a social inclusion goal from engaging in particular kinds of interactions at particular times? (the role of social inclusion affordances)

Addressing and integrating these issues, according to the perspective of the world view presented above, we have arrived at an ontological perspective in which the elements of social inclusion systems are conceptualized and organized in terms of four main ontological categories: *social situations* (addressing issues of the social context in which social inclusion is to be promoted), *social interactions* (addressing issues of social interactions, including aspects of the connections between social contexts, social development states and social inclusion activities), *social processes* (addressing issues of the process of social inclusion, including aspects of the sequence and time-extension of social interactions) and *social affordances* (addressing issues of the opportunities for social inclusion afforded by social contexts to people).

4. Modelling Social Inclusion Systems

Our approach to the modelling of Social Inclusion Systems is based on the four ontological categories introduced above. These categories are described in more detail in the following sections, presenting some examples that show how the models help to elicit the issues that are relevant to address in the analysis of the social context in which a project of social inclusion is being carried out.

4.1 Social Situations

In order to address issues of the social context in which social inclusion is to be promoted, we have developed a model to describe *social situations*. According to this model, social situations are described in terms of their structure and dynamics.

The structure of a social situation is defined in terms of *social components*, which are the units that constitute social situations, *relations* between social components, *properties* of social components, potential *states* of social components and possible *transitions of state* between them, and *images* of social components. The structure of a social situation also includes relations of *abstraction* and *aggregation* between social components. In addition, in order to describe more complex structures of social situations, we may also define hierarchies of *abstraction* and *aggregation* of social situations. Some examples, are:

social situation: a community of agricultural families
social component: income
state of social component: low
transition of state: from low to higher
image: people being trained in agricultural techniques
abstraction of social component: income is a kind of benefit
aggregation of social component: income is part of production
abstraction of social situation: a community of agricultural families is a kind of rural community
aggregation of social situation: a rural school is part of a community of agricultural families

The dynamics of a social situation is defined in terms of *social actions* and the *agents* that perform social actions in the social situation. The definition of the dynamics of a social situation includes the identification of the structure elements of the social situation that are the *preconditions* and *effects* of a social action, the *causes* and *consequences* of a social action, or the *context* of a social action. In addition, there can be relations of *abstraction* and *aggregation* between social actions. Some examples are:

social action: plantation of oleaginous plants
agent: farmer
precondition: proper soil
effect: agricultural product
cause: need of income
consequence: family benefit
context: biodiesel production
abstraction of social action: plantation of oleaginous plants is a kind of agricultural activity
aggregation of social action: plantation of oleaginous plants is part of biodiesel production

4.2 Social Interactions

From an explicit account of the structure and dynamics of social situations, it is possible to conceptualize some issues of social interactions, exploring connections between aspects of structure and dynamics, which have a meaning in terms of social inclusion phenomena that

social actions alone cannot provide. For example, relating certain aspects of the structure and dynamics of social situations we can denote the changes that are caused in a social situation by social actions.

In this regard, three aspects of a social situation that may be considered to provide an account of social interaction that can contribute to the interpretation of social inclusion phenomena, are:

− the structure of the social situation in which the social interaction occurs,
− the state of social development of the people involved in the social interaction, and
− the nature of the activity that is developed by the people in the social situation through the social interaction.

The relations that develop between these three aspects as social actions occur may give rise to social interaction regularities that can denote aspects of what has been achieved in terms of changing social development sates to promote social inclusion.

For example, the action 'plantation of oleaginous plants' per se has no meaning in terms of social inclusion. However, if we consider the structure of the social situation, the nature of the activity, and the state of social development (in which particular kinds of seeds are to be planted to generate material for the production of biodiesel as a way of increasing income), we may be able to identify a pattern of social interaction in which agents of a social situation (the farmers) *use* components of a social situation (the seeds and farm available) to *generate* a new component of the social situation (material for biodiesel) that *change* the state of a component of the social situation (increase the farmer´s income) promoting social inclusion.

Therefore, in order to support this kind of analysis, our ontological account of social interaction is given by the notion of ***pattern of social interaction***. Patterns of social interaction are defined in terms of the concepts that constitute our model of social situations. So, for example, a pattern of social interaction that relates an agent's social action to a social component of the social situation in which it occurs can be defined in terms of the occurrence of the agent's social action, and the preconditions or effects that connect the social action to the social components of the social situation. In the example above, use, generate and change are patterns of social interaction that can be defined in this way.

4.3 Social Processes

Modelling patterns of social interaction will allow various kinds of analysis involving social interactions, as shown above, including the analysis of sequences of social interactions. Sequences of social interactions in which certain patterns of social interaction are connected in time, denote particular kinds of social processes or, according to our terminology, courses of social interaction that possess particular properties, which is the focus of our ontology of social processes.

Therefore, to provide a higher-level of analysis, addressing the relations that develop over time between aspects of social interactions that are meaningful in terms of interpreting social inclusion processes, our ontological account of social processes involves the definition of ***properties of course of social interaction***, which are defined from the meaningful ways in which patterns of social interaction developed in different times relate to each other.

So, for example, in the first level (social situation) we have an account of social actions like plantation of oleaginous plants. In the second level (social interaction) we have a more meaningful account given by patterns of social interaction like generate material for biodiesel, or increase the farmer´s income. In the third level (social process) we have a still more meaningful account of social inclusion phenomena given by properties of course of social interaction like the property of a course of social interaction in which people use, generate and change aspects of their social context. Modelling these properties will allow to develop a conceptualisation of social processes in terms of their characteristics that can promote social inclusion, which will be used in the analysis of the affordances of social situations for promoting social inclusion.

4.4 Social Affordances

Following Gibson (1979), we can say that the potential of a social situation to promote social inclusion at a certain time is determined by the affordances of that social situation with respect to certain kinds of social interactions.

Among the more basic kinds of affordances are the social actions whose occurrence a social situation can afford to an agent. These affordances denote opportunities in a social situation for particular kinds of social actions. For example, if there is an archive in a social situation with a certain kind of information, and if it is possible for an agent to access that archive (perhaps using the internet), then we can say that the particular social situation affords to an agent accessing that information. These basic kinds of affordances may depend on the particular state of development of the social situation (like the availability of internet access).

In addition to these basic kinds of affordances, other higher-order kinds of affordances may be defined, which denote opportunities in a social situation for the development of social interactions that possess particular characteristics, or denote particular patterns of social interaction. Furthermore, focusing on sequences of social interactions we can consider particular characteristics of courses of social interaction that may be described in terms of affordances, denoting affordances for particular properties of courses of social interaction.

Therefore, in order to provide an ontology that allows to conceptualise the opportunities for social inclusion in social situations, we have identified some kinds of social affordances that may be related to the achievement of social inclusion goals in social situations. According to this conceptualization of social affordances, following the previous conceptualization of social situations, social interactions and social processes, a social situation may afford to an agent: the performing of particular ***social actions***, causing particular changes in the ***social components*** of the ***social situation***, thus affording the

development of particular ***patterns of social interaction*** and of particular ***properties of course of social interaction*** that can lead to social inclusion.

5. Conclusion

In this paper we have presented an ontology and models to support the design of social inclusion systems under a precise basis. It includes four main ontological categories: social situations, social interactions, social processes and social affordances. The main characteristics of this ontology are: its broad scope, so that issues of world views that put emphasis on the context, activity and process of development can be addressed, and its focus on the integration of the various aspects involved in creating and analyzing systems to promote social inclusion.

The concern with the context of social inclusion points to the need to address in precise terms the notion of social situation, including the consideration of its structure and dynamics, leading to work on the development of a social situation theory in a similar line of situation theory (Barwise and Perry, 1983). The interactions developed in social situations, connecting issues of the structure and dynamics of social situations, including social development states, give rise to patterns of social interaction which is the central notion in the development of a theoretical account of social interaction, according to our perspective. Similarly, as we move from the analysis of interactions to the analysis of how interactions are connected in time, we need to address the notion of social inclusion as a process, and then address the development of a theory of social processes based on the definition of the properties that such processes should possess to enable social inclusion. Connecting all these theoretical approaches comes the need to develop a theory of social affordances to provide an account of how social situations can afford to people whose social context is in a certain development state the opportunities for social interactions and processes that lead to social inclusion. The work reported in this paper is exploring these directions in order to provide a precise basis on which to analyse, understand, and improve social systems to promote social inclusion.

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