

12 Challenges for Ambient Intelligence: Empowering the Users

Claudia BETTIOL, Cinthia CAMPI

Abstract The present study tries to understand the relation between an individual and an ambient intelligent environment. Three cases have been taken into consideration: resident of popular housing projects, students of a domotica centre of education, and last generation vehicles maintenance technicians. The research is based both on qualitative studies, such as focus groups, and on quantitative analyses, through surveys using direct questionnaires. The interaction between the individual and the technology has been brought back to a linguistic problem and to the representation of the individual intelligences variety. The results underline that individuals should establish positive relations with an intelligent environment, suitable to their intellectual characteristics. Finally, the centrality of individual appears to be in a double direction: not only the simple user, but also the *auxiliary mediator*, who accompanies the user along the road of technology management.

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12.1 Introduction

The present study initiates from the need to understand the relation which establishes itself between an individual and an intelligent environment [1, 2].

Three cases have been taken into consideration: resident of popular housing projects realized according to bioclimatic techniques, with the use of solar systems activated for the production of hot water and centralized costs of heat, students of a domotica centre of education, and last generation vehicles maintenance technicians, representing the maximum comfort for the driver, with electronic control panels able to autonomously deal with many situations.

The methodology adopted for the basic research was based both on qualitative studies, such as focus groups carried out on specific samples, representative of individuals that should have had familiarity with intelligent environments, and on quantitative analyses, through surveys using direct questionnaires [3]. The technique adopted for the conduction of the focus groups was particular, and could be defined "spiral mode", inasmuch as after each round the participants were given new information to elaborate their own opinions.

From the results of the analysis, it emerged that the electronic implementations [4, 5], in some cases, would estrange the intelligent environment in which one is immersed.

The research continued according to two lines: the identification of mediators, able to eliminate or at least mitigate the sense of unease, and the characteristics of a project of domotica [6], characterized by a wavelength between the intelligence of the individuals and that of the environment [7, 8]. In the second case the point of departure has been the representation, of Gardner [9, 10] and Sternberg [11; 12; 13], of the individual intelligences variety, that has to find a parallel in the organization of the environment, in order to establish multi-intellective contacts between domotica and the individual.

12.2 The intelligent environment

The first step to enter an intelligent environment is the comprehension of the meaning of the words used to synthetically describe the reality, in order to transmit the representation also to third individuals.

It appears rather difficult to describe the meaning of the word intelligence, inasmuch as being multidisciplinary. It then appears easier to define the word environment. Both terms include objective and subjective meanings linked to single individuals.

As far as the environment is concerned, there are noticeable differences between its use and the relationship with the users. In fact, in the home one establishes basically personal relationships, while in a school (work environment) or in a vehicle one establishes mainly interpersonal relationships.

An intelligent environment, objectively speaking, is a place where the main point is the characteristics of comfort to those who relate to it. In a home, for example, the following characteristics may exist: temperature, humidity, luminosity, security from external intrusion, and the possibility to have fast and efficient access to Internet or satellite television.

But one can go further describing the functions of internal accessories in a home, like intelligent domestic electrical appliances: refrigerators that can compute a shopping list, ovens that will autonomously define the cooking temperature of food, washing machines that choose washing programs according to linen and to energetic savings.

Still this may not be sufficient to describe an intelligent home, since the rational management of consumptions and the direct production of energy have not yet been

described. By means of photovoltaic panels, electric energy can be produced, using solar rays and the home exposition to the south and south-east.

This energy may be sold or exchanged with the local carrier of electric energy, and the price may be defined on the basis of the legislation of the country. The daily production of renewable energy is generally sold at a price three times as much as energy produced by traditional sources. This implies a reformulation of the use of the electric domestic appliances and the family habits, in order to maximize the sales profits.

Moreover, the sun may contribute by means of thermal solar panels, which, by heating a fluid in a close circuit and exchanging the heat produced with a water reservoir, allow having at one's disposal a thermal mass, able to feed a heating unit at low temperature, like a floor or wall heating plant where the water runs at a temperature of 35-38 degrees centigrade. In this case, an intelligent system should provide management and possible integration of this thermal potential, related to internal comfort and external climatic conditions.

A passive home, highly respectful of the environment with a consumption of 15 KWh/square meters year), uses lateral walls with a high ventilation capacity through adjustable fissures (like the Trombe wall or the Barra-Costantini system). In this case, one will have to make use of an automatic and computer based regulation of the openings, considering the internal and external climatic characteristics of the homes. The same situation proposes itself for adjustable sunscreens used in buildings. The description of these new homes, both traditional and ecological, represents a complex system [14].

The same situation can be found in many other circumstances: for instance, the electronic implementations applied to vehicles, which in a short period have been included in a series of optional, improve the quality of cabin interior life and interact directly with the driver. For example, the new performances of vehicles are internal air-conditioning, a high-way speed control, road map on a world wide scale, internal telephone and television.

In reality, all control instruments are already entrusted to microelectronic sensors guided by internal control panels, which have substituted many mechanical parts.

The two cases described can objectively be confronted, but they cannot subjectively.

The reasons for these differences, between the case of the home and that of the vehicle, can be brought back and understood using the Maslow's scale model, the scale of human needs.

The home is located on the first step, and belongs to the primary needs of shelter and protection, while the vehicle is connected in part with the need of transport (for example, to reach the place of work), situated still at the second step, but also at higher steps, among the needs to represent one's being. As a consequence, if it is easy to accept a representation of a subjective image through an intelligent vehicle, delegating and transferring upon the vehicle the definition of our characteristics, it is not easy to express this relation with the home.

The word, and the representation of the term, intelligence, can be transferred from the vehicle to the individual, expanding positively the self representation of our being, but not from the home to our being. In this case, in fact, the relation is of a more intimate type, and a sense of unfamiliarity and uneasiness prevails.

The complexity is always a factor difficult to be dealt with, as if on the one hand it simplifies some processes, on the other it poses new scenarios that have to be dealt with, according to rules not definable beforehand, or which have to be learned through a knowledge and learning process.

12.2.1 The case of popular housing

These affirmations are directly connected with a focus group carried out among the inhabitants of a recent popular residential realization of the IACP (Autonomous Institute of Popular Housing) of Rome, situated in the area of Cinquina. It concerns a building at low consumption, which receives contributions of solar heat by means of some panels situated on the roof [14].

This realization is the object of frequent visits by technicians and journalists, and it has been described on various magazines. Therefore it is not exactly representative of the totality of ecological constructions, but it represents a significant case. A sample of tenants is represented by simple individuals, the destination of the house being in favor of lower class population.

The result of the analysis was surprising. In all condominiums there was a contemporary presence of a sense of pride and one of uneasiness. Only half of inhabitants had fully accepted the use of solar panels and interacted positively with them, while for others it constituted only an element of representation.

The more surprising fact is that even those that today accepted and used correctly the solar panels, had passed through a phase of diffidence, in which they had dismantled and resold the pieces of the solar collector, or had wasted the hot water produced, leading the pipes to a rapid calcification. To mitigate this situation, the designer intervened, in a series of encounters, and illustrated the existing technology, familiarizing with the new element, in order to accept it completely.

Another natural consequence of the introduction of this new technology has been the starting of a sociological experimentation on self management of the maintenance of the building. One could say that the introduction of new elements redesigns managerial model of those who have to provide maintenance of the intelligent environment. High technology introduces both the role of a mediator as well as new forms of organization of users and management of maintenance technicians.

12.3 Ecology and domotica

From our studies, a contraposition emerges between the term domotica and the term ecology, in a perception that differentiates an environmental correct situation from a completely artificial one.

We have analyzed the attitude of the individuals through a focus group, conducted among the students of the specialist degree course in Environmental and Territorial Engineering of the University of Rome "Tor Vergata".

The discrepancy between the two psychological attitudes has emerged. The students belonged to a technical discipline, followed the course in Renewable sources of energy, and were aware of the new European Directives that will impose, from 2006, an energetic certificate of buildings, introducing a classification of housing units in function of their consumption. One of the systems to rationalize consumptions in a house and favor energetic savings is that of using the implementation of domotica, which optimizes the report between internal and external climatic conditions.

The objective of the focus group was to perceive elements which could lower the general level of extraneousness of domotica in a group of future technicians, who will have projected houses and intelligent environments. Notwithstanding the explanations of all possible applications of domotica to the control of internal comfort and energetic savings,

the perception remained for sometime that of dualism between a natural and an artificial situation.

Finally, after having illustrated the systems of integration between natural and intelligent building, the number of students who were not at ease imagining an intelligent home had considerably diminished. In this case, however, questions relative to the cost of the implementations had not been mentioned at all.

The perception of unease corresponds to a component of diffidence towards the outsider and the unknown very similar to that which is being studied in sociology to define the different and the study of intercultural communication.

The result of this analysis can be resumed with the consideration that an estrangement of the domotica exists in the natural context of the reality of the home which makes the electronic element third in respect of the individual.

12.4 Direct and mediated relations with reality

The preceding results show that the perception of integrated systems still encounters residual diffidence between experts. It can be easily imagined what kind of situation one may find in society, as can be seen from market trend data.

From an analysis conducted in 2002 by the Chamber of Commerce of Florence on the type of inhibition that hampers the realization of intelligent buildings [15], it results that 25% depends on the user's culture, 35% on the installer's know-how, 20% is due to the cost, and 18% to the lack of standardization (this can be summed with the other 35% and grouped together in a macro-system relative to technology production).

These data confirm the fact that, for a real diffusion of the domotica implementation in the residential buildings, the importance is that of the *auxiliary mediator*: the technician.

He should support the user in understanding technology, to be able to project and if possible realize an intelligent home, according to his particular needs.

The focal point can be reduced to two central questions: the choice of the project, so it can be coherent with the intelligence of the individual, and the organizational structure of the enterprises, with the new auxiliary mediators.

The second affirmation is being supported by the results of a quantitative test conducted among professors, auxiliary personnel, and students of the School of domotica "Elis" of Rome. About 80% of the interviewed declared that the development of domotica will need the formation of new professionals capable of interacting with the users, providing technical and practical support.

This aspect of new professionals implies a new organizational design of the enterprises that operate in this sector, and imposes managerial schemes centered on updating of knowledge, rather than the sole transfer of knowledge from the part of more expert professionals, and implies knowledge, in the field of sociology, on the unease towards technology among users.

In practice, the situation repeats itself as the one described for the building in Cinquina, where it had become necessary to have a meeting with an auxiliary mediator (a term often used in environmental fields), who could assist the familiarization between the inhabitants and the new technological equipment.

All these considerations refer to the minimum dimension of the number of technicians of an enterprise, which will no longer be the traditional one of small dimensions, but will have to expand and become multi-specialized.

In the recent past, we can make a concrete example of the traditional figure of a garage mechanic, who now needs the electronic assistance of a computer to decode signals and

diagnose mechanical and electronic breakdown of vehicles. The computer becomes the mediator which interpreters the reality, and every motor brand has its own decoder.

The situation is perfectly comparable to the building constructions, where traditional knowledge of a static type must be integrated with a dynamic knowledge and the capacity of continuous knowledge transfer between technicians and users, especially where ambient intelligence is concerned.

12.5 High technology and electronic language

Electronics can be proposed as an element of union or separation from reality, depending on the willingness of the single individual to accept the new imposed linguistic forms. It concerns, in fact, a new language, which does not grant much flexibility and adaptability to reciprocal comprehension.

In a sense, the major difficulties are due to the awareness that the report between the user and the electronic apparel is asymmetric, inasmuch as one presents sometimes exasperating rigidity, while the other is generally used to being elastic. Furthermore, in our occidental economy, more and more based on knowledge, elasticity corresponds to a gift and to an individual peculiarity that one tries to cultivate by means of all the techniques of lateral thinking.

The situation becomes more complex in relation to the typology of the individuals.

Should one take an individual who is in a commanding position, not only at the top of an enterprise but also simply at the head of small groups, one encounters people who generally cover a role in which they are used to the fact that the others make an effort to understand them.

In this case, the relation between an intelligent environment and the individual could evolve from a conflict of contents to a conflict of relations. Consequently, the individual may become unable of accepting an intelligent environment, by a complete cut down of all channels of communication.

The auxiliary mediator has then not only to operate mediation with reality, but also do a true and proper linguistic de-codification. The problem of visibility in an intelligent environment will thus be led back to a problem of learning, and the choice of language understood in a much larger meaning of linguistic form, according to some logics of Steiner's pedagogics.

12.6 Learning a new language

It would be useful to analyze how to transfer knowledge according to some known theories of knowledge management.

Knowledge can be schematically divided in explicit, which the individual believes to transfer voluntarily, and implicit, which the individual does not believe necessarily exchanging in certain circumstances. Generally, the solution of problems and creativity develop during the exchange of implicit knowledge, when, having overcome defensive barriers and unease, everyone will feel free to study whatever interests him subjectively.

Electronic language understood as interface of instruments or as an instruction manual, completely lacks that part relative to the transfer of implicit knowledge, which one can find only in a direct relation with an expert, like the salesman, or a maintenance technician: the auxiliary mediator.

Referring to the results of another focus group, carried out among students of Environmental and Territorial, and of Computer Science Engineering, in the cases where there exist the curiosity and specific interest of some individuals, more often that not there exists a reciprocal indifference, even though they realize the necessity to share their respective roles.

The result, once again, offers indications of new management organization of the interconnection between disciplines, and therefore between operators who will have to learn to work in multi-disciplinary groups.

12.7 The intelligences according to Gardner

After having verified this recurrent diffidence, and the sense of unfamiliarity between individuals and domotica, it has been attempted to comprehend how to eliminate, or attenuate, the sense of unease due to the perception of unfamiliarity. The starting point has been a model of the intelligence characteristics, as described by Howard Gardner [9, 10].

A focus group of restricted type has been conducted, with the participation of those individuals that had demonstrated major diffidence, aimed at analyzing the way to structure a project of domotica in order to raise their interest. During the meetings, many channels of communication have been stimulated: visual, auditive, and coenesthetic, in order to arouse the individuals' respective peculiarities. At the end, the participants have demonstrated forms of open mind and interest towards a definition of a personalized environment.

Gardner reflects on the existence of more forms of intelligences and proposes an educative model that centers on the learning individual in all his complexity, insisting, at the same time, on a chosen and intentional use of contents and of expressive forms.

According to his analysis, individuals possess at least eight (in reality he points out nine) different forms of intelligence, each one with the potential to solve problems or to focus on those products appreciated in one or more cultural environments. For example, the traditional intelligence tests, by their nature, intercept only linguistic and logic-mathematical intelligence, perhaps with the added samples of spatial intelligence, and they overlook others.

Each type of defined intelligence presents specific forms of mental representation, and it is itself a form of mental representation.

1. Linguistic: command of the use of language
2. Logical – Mathematical: evaluation and confrontation of objects and abstractions
3. Spatial: perception of the visual word
4. Musical: distinction of musical tunes in relation to height, rhythm, and time
5. Coenesthetic: control of body movements
6. Personal: intrapersonal (recognition and evaluation of one's own feelings) and interpersonal (interpretation of feelings and state of mind of other)
7. Naturalistic: recognition of the categories of natural objects
8. Existential: reflections on fundamental questions of existence.

An individual possesses any of these diverse intelligences in different percentages, so someone will be more intelligent linguistically, someone more spatially, and so one. A subjective peculiarity follows, because in an intellectual configuration the different intelligences are present not only in different grade, but also in different relations among each other.

The auxiliary mediator should understand the single peculiarities of individuals and promote them based on respective potentialities. Therefore, the relations that each one establishes with the intelligent environment depend on his particular structure and personal characteristics, that is on a mix of different forms of intelligence and on the feelings towards that. The more the feelings, the more is the subjective motivation to commit oneself to establish a positive relation with the ambient intelligence.

Attributing to an individual a role not connected to the subjective peculiarities may contribute to creating situations of personal stress. This is due to the fact that individuals do not feel appreciated and produce a general disaffection to ending up to forms of closure towards technological novelties.

A different intelligence language and channel of communication corresponds to each form of intelligence, and is grouped, by the neuro-linguistic programming, in auditive, visual and coenesthetic, giving origin to different cognitive styles. It is the task of the auxiliary mediator taking into account the subjective peculiarities; he must be able to interact linguistically with all individuals, in order to be really effective.

In fact, individuals can vary not only because of cognitive style, but also for their preference and use of sensorial modalities, with which they interact with the environment, using in particular one of the five senses [16].

12.8 The theories according to Stenberg

According to Robert Stenberg [11; 12; 13], there exist different forms of intelligence and ways of learning, which consent to individualize the process of teaching-learning and to create ties between forms of knowledge.

These forms are grouped together in three macro-systems: analytic, creative and practical. A triarchic theory of intelligence is then defined, whose components would be the traditional capacity of calculation, the sensibility to contextual factors, and the reaction towards novelty.

In relation to the distinction between capacity and style, Stenberg underlines, in his researches on ways of thinking, that the differences in individuals' learning are not strictly tied up to their intelligence and to their level of ability, but rather to modalities of use of such intelligence and of such capacities.

For the author, the styles are propensions and preferences in using proper capacities: they are not the capacity we possess, but the way we like and find easier to use them.

Therefore, a style is not better or worse than another, but only different.

Always according to Stenberg, the style as well as preference, is fluid and variable, depending on the circumstances, on the task faced, and the age. Everyone therefore possesses a fund of styles, which we use according to the situations and capacities required; they are not decided at birth but determined and developed in large part by the environment they belong to (family, culture, school).

Among the learning styles, it can be mentioned: the global-analytic one, the dependent-independent from the subject, the verbal-visual, the converging-diverging, the systematical-intuitive, and the impulsive-reflective style.

Referring to the previous considerations, added to the constant requests of development of creativity in the working context, one can understand the difficulties encountered by many individuals to accept an instruction manual that uses only national languages based on a minimum of probability.

Such a users' manual teaches exclusively the use of logic tools, favoring individuals with logic-mathematical and spatial intelligence, but not prone to new interpretations of reality, new inventions. It stimulates only the processing of what already exists.

From our researches it emerged that the sense of uneasiness and unfamiliarity is brought about mainly from the necessity to comprehend new languages and new logics, and the relative encountered difficulties. During a learning process, unavoidably a social-cognitive conflict is brought about, which represents a challenge created by problematic situations, constituting a provocation for rational and creative thought.

As long as a conflict is caused by the content and not by the relation between individual and environment, this stimulates curiosity which motivates continuing exploration. It also creates satisfaction, initiating the succession of phases in which one measures, confronts and resolves the problems, thus exercising a critical thinking (converging and diverging).

The positive position towards the conflict is that which identifies and represents the correct solution to problems through processes of elaboration of information, which will see the individual consciously use plans and strategies to obtain cognitive and rational objectives.

In case such confrontation transforms itself from the very beginning in a conflict of relations between the individual and the environment, this virtuous process interrupts itself.

To avoid this degeneration, or simply to increase the possibility to have a strong motivation to continue, two circumstances should occur: the environment to present forms of intelligence close to the user's ones, and the manual, or the auxiliary mediator, to be able to solicit the individual's preferential channels of communication, and to adapt to his cognitive style.

In substance, in order to render an intelligent environment familiar to the user, it is necessary the individual to be repositioned at the center of the system, concentrating his attention not so much to specific gifts of the environment as much as on the characteristics of the relations that can be established with it, in relation to subjective peculiarities of his own intelligence and preferred channels of communication.

We know, organize, and develop our knowledge of reality through education and transformation of mental models of reality. We succeed inasmuch as experiences of learning allow us to develop systems of mastering respect to different cognitive dominions; they are defined as complex capacities or meta-cognitive capacities. This term means the capacity to observe and comprehend mechanisms with which we structure our thinking, specific ways we use to analyze problems, formulate hypotheses, and find solutions. One must reach a personalization of the learning process through mediators (manuals and operators) who are able to use all channels of communication and to interact with the different intelligences.

12.9 Multi-intellective relations between domotica and the individual

In the light of the above, it is possible to re-define the meaning of intelligent environment in a subjective way and in function of the users' perception of a single particular environment.

To be exhaustive and comprehensible towards any individual, the projection of an intelligent environment should therefore comprise a variety of stimuli able to interact with all intelligences, as identified by Gardner or Stenberg. This process could motivate the user to learn the technological language and to lower the threshold of diffidence which intervenes between the artificiality of the intelligent environment and the naturalness of the traditional home.

We list possible implementations of an intelligent home, which could involve directly one of the types of intelligence of the user, with the consideration that, however, any individual represents a mix in which some forms may prevail. We have chosen the home inasmuch as it represents the place in which the more personal and direct relations are established with all individuals, everyone with his own peculiarities of intelligences.

- Linguistic: command of the use of language. Corresponds to an environment provided with satellite connections with the rest of the world, which can constantly connect the individual with the exterior. But it is also important to be equipped with sound diffusion of excellent quality, like in the case of home theatres, interactive television or cable radio. For these individuals it is very important to have the possibility to establish contacts with the intelligent environment which use the auditive channel. This should be the channel preferred by the mediator
- Logical – Mathematical: evaluation and confrontation of objects and abstractions. In this case the environment should solicit the possibility of a direct interaction between the control system and the user, who should be able to personalize autonomously the management of the control panel. For these individuals, the control system should be of an open type, like Linux for the computer, and flexible. Furthermore, it is important to have the feeling to have the environment under control through a series of sensors, positioned strategically in it. The sensors should also comprehend control both of consumptions and of the trend of the observed characteristics
- Spatial: perception of the visual word. In this case the system needs to establish a connection with the exterior, continuing, at the same time, to exercise a security function. For these individuals, it is very important to have a relation with form, aesthetics, of the intelligent object. Familiarity with electronics is reached by familiarity with the form of electronics itself
- Musical: distinction of musical tunes in relation to height, rhythm, and time. In this case, the same considerations as Linguistic can be applied
- Coenesthetic: control of body movements. Such a home should have a high environmental quality and a good livability. The criteria of well-being should be kept constantly under control; configuration of temperature and humidity should be in function of external climatic characteristics. An individual who uses the body as an element of communication will concentrate on equipment which will enable him to relate with olfactory channels, as well as tactile and taste, and will demonstrate great interest for kitchen, bathroom and saunas
- Personal: intrapersonal (recognition and evaluation of one's own feelings) and interpersonal (interpretation of feelings and state of mind of other). In this case, the same considerations as Coenesthetic can be applied.
- Naturalistic: recognition of the categories of natural objects. The home, for this individual, has to comprise the maximum respect for the environment and, possibly, utilize techniques of energetic savings, the use of renewable sources of energy and integration with its location. Therefore, the implementations should be almost invisible, and have a proper general ergonomics. An individual of this kind, like the previous one, takes pleasure in establishing direct relations with those who install and perform the maintenance. Like in the case of Linguistic, the intelligent environment should be able to promote human relations even between individuals far away from each other
- Existential: reflections on fundamental questions of existence. The same considerations apply to those of Naturalistic.

Added to these considerations are those relative to the scale of human needs, elaborated by Maslow, which succeed in being applied in all statistics taken into consideration, like those of marketing analyses, conducted by various associations of category.

From data collected by the Chamber of Commerce of Florence, who has created a specific session on domotica, we get a picture which reflects the primary needs of human kind in their evolution, taking into account age and subjective conditions.

For an elderly person, primary necessity appears to be security, ease of use and energetic savings, while personal representation, by means of a status symbol, does not appear. For a single person, the scale presents, in a first place, personal representation by means of a status symbol, and then comes the need for security and energy saving, while ease of use is not essential. For a working woman, the scale of values, even with slight differences, appears to correspond to that of elderly persons, while for a professional the needs are indicated by security, status symbol, energetic savings, and ease of use.

The ISTAG (Information Society Technologies Advisory Group), who help advise the European Commission, in 2000 elaborated substantial studies to define possible scenarios at 2010 of some environment like that of the home, the vehicle, the office, and health, to better understand the possible familiarity between intelligent environment and ordinary people [17, 18].

From these researches it appears again how this environment implies the necessity to continuously learn new forms of expression, which should be able to facilitate the relations with the individual. Learning, and the motivation to learn, represents then the elements with which all those who live in a knowledge-based economy will have to relate.

12.10 Learning techniques

The motivation to learn is not spurred if one tries to stimulate concepts which do not integrate with those preexisting in the individual's mind. In fact, motivation needs a link between the effort to learn and the pertinence of new knowledge in function of a recognized growth of the individual. Otherwise, learning would be mechanical and not significant. In this case, it would not consent the assimilation of new concepts and propositions in the cognitive structure.

In the same way in which one proceeds to the design of an intelligent environment, one will have to study the way to help the individual to learn the technological language.

Taking into account both the questionnaires carried out at the Elis Centre of Rome, and the study of the Chamber of Commerce of Florence, the users' preferences are directed towards forms of learning mediated by a professional. This system, which allows the transfer of implicit knowledge, cannot be the principle element as interface between the equipment, the individual, and the instruction manual.

Learning is subjective; therefore the personal integrated cognitive history is the foundation of new knowledge, which we encounter in everyday life. A users' manual has to favor this natural and often unconscious process, creating situations which allow the individual in the process of learning to discover their "natural knowledge", using, where possible, different channels of communication.

One needs to recognize the other from oneself, to accept cognitive and communicative styles different from one's own, and to exercise divergent thinking and creativity. Many and diversified strategies of learning should emerge, which, recognized by each individual through his own process of elaboration, constitute a precious asset to transfer learning into active life.

12.11 Conclusions

The research carried out on ambient intelligent environment has produced results which have led to the centrality of individual in a double direction: not only the simple user, but also the *auxiliary mediator*, who initiates the relation and accompanies the user along the road of technology management. He who uses an intelligent environment should be able to establish positive relations with it.

This is possible only to the extent the design of the environment is on the same wavelength with the peculiar characteristics of the individual. One must not think that the term intelligent environment takes on the same objective meaning for everyone, inasmuch as each individual sees the context in function of the characteristic peculiarities of the structure of his own intelligence.

Without this centrality, many individuals will continue to view the intelligent environment as being artificial, and they will feel it as contrary to natural environment and will feel unease towards forms where the environment interacts with the individual.

With these considerations, the interaction between the individual and the technology has been brought back to a linguistic problem and to the learning of both expressive modes and the culture of the unusual and unknown.

Domotica foresees the elaboration of multi-competencies: transversal, meta-competencies, specific and general. Every individual, according to the characteristics of his intelligence, will personalize the intelligent environment in a different manner.

Competence is dynamic and evolves itself in function of a continue re-elaboration and new learning, and is linked with research, with development of professions, with the job organization, and with more usual technologies. Without the notion and the information, there exists no evidence of competence, and intelligence becomes a potential without object.

The study has highlighted how this dynamic knowledge of the unusual and unknown, which needs continuous learning, represents an obstacle to many individuals who request forms of mediation and of support, which help to establish positive relations with an intelligent environment, suitable to the intellectual characteristics of all concerned, and which use the preferred channel of communication.

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