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Human Factors in End-User Development of Marketing-IS: A Behavioral User Profiling Approach

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Abstract

Marketing-IS research has recently focused on the development of personalization systems that are based on the modeling of consumer behavior and consumer heterogeneity regarding their distinct needs and preferences. However, personalization approaches in the design and development stage of Marketing-IS have not been widely studied in the End-User Development (EUD) research area. The lack of such research studies results in the development of Marketing-IS tools that neglect the differences in the end-user behavior, and artifacts of low performance and reusability. Attempting to figure out how end-users can participate in the design and construction of Marketing-IS in an efficient way, research suggests the 'construction' of end-users behavioral profiles based on human factors. Recent evidence reveal that human factors such as gender and expertise level can influence and even determine the end-users', behavior, and consequently performance, while end-users interact with EUD environments. This paper presents a methodological approach in which we identify different behavioral user-profiles, named 'user-categories' based on behavioural attributes derived by the human factors of gender and expertise level. The resulting user-categories can be applied in the modeling mechanism of adaptive EUD system environments. Such an approach is projected to implicitly assist the end-users in the enhancement of their performance during the development task of Marketing-IS

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1. Introduction

Requirements concerning Information Systems (IS) of modern organizations change frequently. Due to a lack of resources and expertise, especially small and medium sized enterprises (SMEs) suffer from their inability to customize used enterprise software to their needs. Actually, they have to adapt themselves to the possibilities offered by the used enterprise software, resulting in long and costly adaptation processes (Brehm, L., Heinzl, A. and Markus, M. L. 2001), (Markus, M. L. and Tanis, C. 2000). Developing software which is supporting end-users in performing adaptations on their own, improves the achievable efficiency and effectiveness of SMEs by increasing the fit between the offered functionality of the software and the needed functionality by the users (Roth, A. and Scheidl, S. 2006). Although Marketing Information Systems (Marketing-IS) are a significant part of the IT infrastructure of modern enterprises, little research has been done addressing a reduction of the expertise tension in this domain.

Over the last years many researchers tried to figure out how end-users can participate in the design and construction of information software systems in an efficient way (Dorner, C.; Heß, J.; and Pipek, V., 2007). The need of SMEs for highly adaptable software products, contributing to their various needs, can be met by providing appropriate end-user development tools within their software systems (Dorner, C.; Heß, J.; and Pipek, V., 2007). According to Wulf, and Jarke (2004), providing end-users with the tools to construct and tailor their working environments leads to IT productivity improvements, and hence cost reductions.

However, the technological evolution in the area of Human-Computer Interaction (HCI) has proved insufficient to resolve essential existing problems resulting in end-users' incapability of creating information systems comparable to the professional ones. The reasons for this are manifold and seem to mostly consider human-oriented factors. Thus, late researchers support the thorough survey of human nature from a behavioral angle and its integration in the End-User Development (EUD) studies. The recently emerged field of Gender HCI considers gender as one of the most determinant factors in end-users' behavior.

Our suggesting approach includes gender and expertise based adaptation and personalization technologies because of their ability to enhance the end-users' performance while developing information software. It is though true that the effectiveness of personalized services highly depends on user profile completeness and thus, appropriate behavioral user profiles have before all, to be generated. Unfortunately, little attention is given to designing EUD environments that support different end users' profiles (regarding their gender and expertise based behavior and preferences) throughout their "lifetime" on the system.

In the current study we attempt to suggest behavioral user profiles (named 'user categories'), based on the human factors of gender and expertise level of the end-users. Our final goal is the implementation of appropriate user profiles to be used in the design and development of adaptive EUD tools targeted at the development of Marketing-IS by the end-users.

In particular, we initially provide a theoretical review concerning the behavioral part in the EUD field, presenting a basic overview of the gender and expertise behavioral EUD research findings. Based on these findings we then develop our end-user classification approach resulting in four main behavioral 'user categories'. Following, we suggest a user profiling formation based on certain behavioral attributes detected in our literature research. Moreover, we assign a relative weight value of importance to each behavioral attribute for each user category, attempting to reflect the degree of influence each attribute has in the category. Then, we present the user categorization logic (using a qualitative correlation function), and explain all the pre-described steps. In the end of the paper we summarize our conclusions and suggest some important options for future work.

Here introduce the paper, and put a nomenclature if necessary, in a box with the same font size as the rest of the paper. The paragraphs continue from here and are only separated by headings, subheadings, images and formulae. The section headings are arranged by numbers, bold and 10 pt. Here follows further instructions for authors.

2. Literature review

It is true that user computer-behavior is being influenced and many times determined by a set of attributes mainly reflecting to the user's generic personality (Nunes, M. A. S. N., Cerri, S. A. and Blanc, N. 2008) and psychology and in particular to the so called user characteristics (e.g. age, gender, location, level of education, expertise, interests, habits, goals, mood, personality traits, learning style etc.). These are the characteristics user modeling techniques use to model the user's behavior and to provide them with the appropriate task environment.

However, we cannot model all of the users' characteristics at once, since each task and/or application is targeted at different user groups (regarding their needs, preferences, goals etc.) and user roles (programmers, power users, end-users, etc.). But, Gender and Expertise Level could be two strong and determinant factors of the end user's generic behavior, since they can many times predict the users' actions, needs and preferences (recommender systems is a characteristic example of systems that based on the customers' gender try to predict the customer's needs and preferences on many products and services).

In this section we present the basic literature research work concerning the influence of Gender and the Expertise Level on the end-users' behavior in EUD system environments.

2.1. Gender in End-User Development

In the past decades numerous studies reported on marked gender differences interacting with computers, such as different conception of computers, different motives for using computers, different preferences, different styles (Costabile, M.F., Mussio, P., Provenza, L.P., and Piccinno, A. 2008), (Upitis, R., & Koch, C. 1996) and even different cognitive styles (Inkpen, K., Klawe, M., Lawry, J., Sedighian, K., Leroux, S., & Hsu, D. 1994), (Voyer, D. 1996). Behavioral studies also accept and explain the existing grounded differences in the way male and female end-users process information and generally behave while interacting with computer systems (Waber, D.P. 1982), (Subrahmaniyan, N., Beckwith, L., Grigoreanu, V., Burnett, M., Wiedenbeck, S., Narayanan, V., Bucht, K., Drummond, R., Fern, X. 2008), (Subrahmaniyan, N., Beckwith, L., Grigoreanu, V., Burnett, M., Wiedenbeck, S., Narayanan, V., Bucht, K., Drummond, R., Fern, X. 2008). Gender has also been singled out as an important variable in the design of user interfaces and visualization techniques. It is also considered as an important user diversity issue for achieving 'universal usability' of web-based and other computer services (Saadé, R. G., Kira, D., & Otrakji, C. A. 2012).

Researchers are now beginning to report theory and empirical data pointing to gender differences in the use of end-user programming (or EUD) environments. Evidence of these differences has accumulated, indicating gender differences in programming environment appeal, playful tinkering with features, usage and attitudes toward end-user programming features, as well as end-user debugging strategies (Hubona, G. 2004), (Burnett, M. 2009), (Burnett, M., Wiedenbeck, S. Grigoreanu, V., Subrahmaniyan, N., Beckwith, L., and Kissinger, C. 2008), (Burnett, M., Fleming, S., and Iqbal, S. 2010), (Subrahmaniyan, N., Beckwith, L., Grigoreanu, V., Burnett, M., Wiedenbeck, S., Narayanan, V., Bucht, K., Drummond, R., Fern, X. 2008). In these studies, the two genders have been shown to both use different features and to use same features in a different way. The most important conclusion of these studies is that the features most conducive to females' success are different from the features most conducive to males' success (Burnett, M. M., Beckwith, L., Wiedenbeck, S., Fleming, S. D., Cao, J., Park, T. H., Grigoreanu, V., et al. 2011).

According to Burnett et al (2011), ignoring the gender issue, while designing end-user programming environments, would miss the opportunity of enhancing the effectiveness of end-user programmers. As they explain, such a solution could be achieved by incorporating appropriate mechanisms to support gender-associated differences in decision-making, learning, and problem solving.

In recent gender HCI research regarding end-user issues, (Hubona, G. 2004), (Burnett, M. 2009), (Burnett, M., Wiedenbeck, S. Grigoreanu, V., Subrahmaniyan, N., Beckwith, L., and Kissinger, C. 2008), (Burnett, M., Fleming, S., and Iqbal, S. 2010), (Burnett, M. M., Beckwith, L., Wiedenbeck, S., Fleming, S. D., Cao, J., Park, T. H., Grigoreanu, V., et al. 2011), (Subrahmaniyan, N., Beckwith, L., Grigoreanu, V., Burnett, M., Wiedenbeck, S., Narayanan, V., Bucht, K., Drummond, R., Fern, X. 2008) the researchers study the users' gender based differences while developing debugging strategies and/or using features while working on spreadsheet environments. Moreover, they have designed and implemented features for spreadsheet prototypes that take the gender differences into account. In their work, Kulenza et al (2009) present an innovative machine learning approach to determine arisen debugging issues, both in general and also separately for male and female end-users. Other recent studies focus on the usability provided by different interface designs as related to gender (Hubona, G. 2004) and in differences between men and women regarding their perceptions and effects on the relationships among the constructs that affect the behavioral intention to use computer based assessment systems (Jason, B., Calitz, A., and Greyling, J. 2010).

2.2. Expertise level in End-User Development

As already mentioned, gender is not the only one determinant factor in the end-user developers' behavior. McLeod, and MacDonell (2011) state that developers possess a range of characteristics that can influence how they approach and practice development. In McLeod, L., and MacDonell, S. G. (2011) the authors also explain that these characteristics include technical skills, capabilities, expertise, and experience, interpersonal, communication and social skills, application domain knowledge, commitment, motivation, trustworthiness, norms, values and beliefs. They also concern the attributes of personality type and organizational status.

It is well accepted that user expertise and skill affect the way users interact with software. Furthermore, as the end-users' perception is mainly based on previous experience, different end-users have different perceptions. Thus, it is common for users to be separated into novices and experts. Many differences in the working and thinking mode have been detected to exist between these expertise related groups and various interface styles have been adapted to serve better their distinct needs and preferences (Jason, B., Calitz, A., and Greyling, J. 2010), (McLeod, L., and MacDonell, S. G. 2011), (Angeli, A. D., & Battocchi, A. 2011).

The fact that we refer to end-users should not exclude the existence of different expertise levels among them. End-users can never be experts (that's why they are called 'end-users') but as Costabile et al (1996) explain they can belong to different classes according to their task-activity nature (development or customization) and their computer familiarity and/or experience degree which can be reflected to the way the users choose to complete their tasks (e.g. macros, domain-specific languages, web development etc).

Thus, we regard expertise level as a crucial factor in the formation of the EUDs overall behavior. Moreover, we also consider reasonable the fact that gender-based behavior could influence and even change many aspects of the expertise-based behavior and vice versa. Such an observation has been verified by Burnett et al (2011).

There are some personalization technologies that have been adopted in EUD approaches to enable end users to receive optimized advice based upon their expertise level. A good example is the Wire system, developed by Angeli and Battocchi (2011), which is used as a EUD recommendation tool. However, little research has indeed tried to base such personalization implementations on the detection of gender-associated behaviors of novice and expert end users.

3. End-user classification

It may now be clear that all the aforementioned descriptions underline the differences existing among end-users of different gender and different expertise level and thus, we can use all the acquired data and information to form specific end-user categories.

In this section we attempt to create four user-categories able to reflect most of the end-users' developing behavior. In particular, we use the factors of Gender and Expertise as stepping-stones for the construction of representative behavioral user-categories (i.e. types of generic user profiles). In the second subsection we attempt to 'construct' the user profile structure (that is reflected in each category) based on six particular behavioral attributes we 'collected' from our literature research. Then, in the third subsection we assign a value of relative weight of importance to each attribute-category combination, in an attempt to provide a basic idea of the degree of influence each attribute imposes on the user in each one of the will user categories. Finally, in the last subsection we present the adaptation logic of the correlation function the system will use to 'realize' the suggested user categorization and profiling approach. The system's 'decision making mechanism' will be based on explicit feedback gathered from the user in order to assign him/her to the corresponding user category. Then the user profile can be formed by assigning to each attribute the corresponding value of relative weight of importance. The final step is to provide the end-users with the appropriate adaptation responses based on their profiles, using a system adaptation mechanism.

3.1. End-user behavioral categories

Based on the fact that end-user developers can never be experts- that's mostly the reason why they are 'end-users' anyway- we discriminate their expertise in two levels: novices and advanced, i.e. more experts, trying to reflect their degrees of knowledge and experience.

In the current work we separate the end-users in four broad user profiles, named user-categories, reflecting their gender and expertise level combinations.

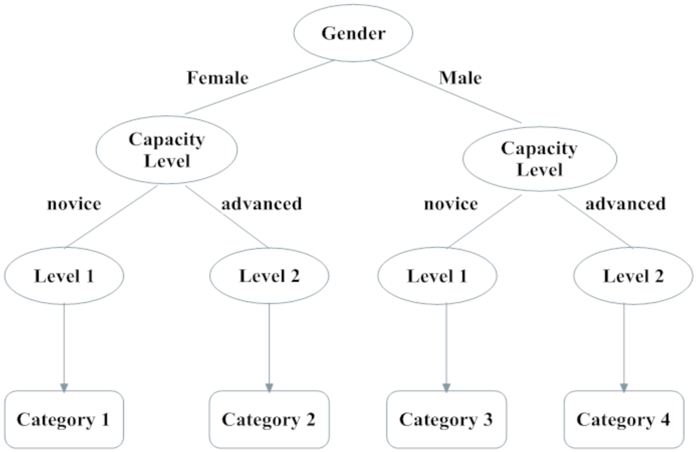

Fig.1. End-User gender and expertise based classification in four categories

In general, for each user we can state that, C(u) = C1 if (U ϵ C1), C2 if (U ϵ C2) and so forth, where C(u) is the category the end-user belongs to and Ci (i=1,2,3,4,) is each one of the gender-expertise based categories (Fig 1).

3.2. User Profile Formation based on Behavioral Attributes

Based on extended qualitative research on the studied literature, we can conclude that in each one of the aforementioned user categories, there are some (indicative) behavioral attributes that tend to influence in a significant degree the end-user behavior and overall developing performance.

These attributes 'impose' a different degree of influence on the user behavior depending on variables such as gender, and expertise level. We have isolated six such attributes, both for simplicity reasons and because we believe them to be the most feasible to measure in the end-users behavior in order to 'construct' their user model in our future works. These six attributes are: Self-Efficacy, Overconfidence, Risk-Perception, Tinkering, Willingness-To-Learn (new features) and Ease-Of-Use-Perception.

The further explanation of these attributes significance and influence on the end-users behavior and performance can be extracted by the combined conclusions of the aforementioned literature works (in section 1). In this section, we take such conclusions as granted and we focus on the aggregation of the data we need to build our suggested user profiles.

Let the end-user profile be Up ϵ U, where t=1,2…n, n being the total number of user profiles.

Let S be the set of the behavioral attributes and Si ϵ S, where i=1,2…6 be every behavioral attribute.

Our behavioral attributes (Si) are defined, as following:

- S_1= Self-Efficacy
- S_2= Overconfidence

- S_3= Tinkering
- S_4= Risk-Perception
- S_5= Willingness-To-Learn
- S_6= Ease-Of-Use-Perception

Now, we can represent each end-user profile (Up) as a set/combination of these attributes.
Up ={Si}, where i=1,2,..,6
Moreover, each attribute can be assigned to a numerical set (from 0 to 1), reflecting its relative weight of importance in each category.

Let wij be the relative weight of importance of each attribute (j) in each user-category (i) , where i=1,2,3,4 and j=1,2,..6.

Now we can have a basic initial knowledge about the behavioral attributes composing each user profile as well as its generic ‘structure’. Such knowledge can be used by the system’s decision-making mechanism during the user-system interaction to provide the user with the appropriate adaptation state (which is out of the current paper’s s cope).

The figure below summarizes the generic attribute-category correlation type.

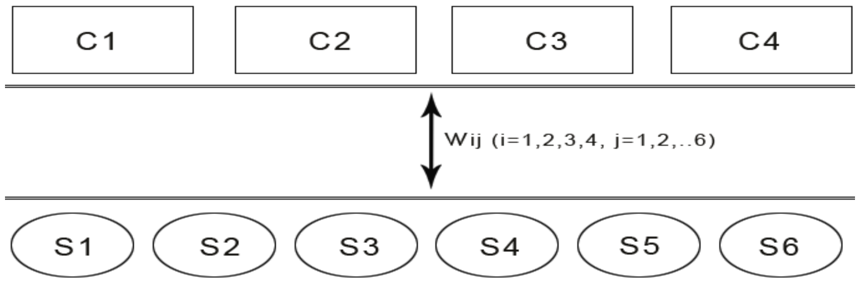

Fig.2. The six behavioral attributes in the four user-categories

3.3. *Attributes’ relative weight of importance in each user-category*

In this sub-section we determine the relative weights of importance, based on our studied literature information (denoted as wij, for i=1,2,3,4 and j=1,2,3,4,5,6), for each attribute in every user category, reflecting their degree of influence on the users’ behavior and hence, performance. Such an influence could be either positive or negative (or neutral). For example w11=0.40 revealing that Self-Efficacy is a highly determinant factor to the users’ performance when belonging to category C1. Similarly, w12=0.01 (revealing almost no influence), w21= 0.10 (revealing low influence) etc.

We should also mention that the attributes’ weight values in each category always sum up to one. These weight values are about to change during the user - system interaction, resulting in different ‘adaptation states’ by the EUD environment.

Initially we assign arbitrary values to the attributes’ weights based on the degree of influence the attributes have on each user category, to create an initial user profile at the system start.

The table below shows the initial values of the attributes’ relative weights of importance in each category:

Table 1. Relative weights of importance - wij

Attribute	C1	C2	C3	C4
S1	0.40	0.10	0.35	0.30
S2	0.01	0.25	0.05	0.10

S3	0.20	0.15	0.15	0.15
S4	0.05	0.30	0.20	0.30
S5	0.14	0.05	0.10	0.10
S6	0.20	0.15	0.15	0.05

3.4. Qualitative correlation function

Good initial performance is an incentive for the user to continue using the EUD environment. Thus, an important aspect of personalization is to develop a EUD environment that works well initially with less explicit user feedback. Hence, when a new user enters the system, the system's 'decision making mechanism' will be triggered and according to the replies regarding his/her gender and his/her self-estimated capacity level, the system will assign him/her to the corresponding user category (Fig 1). Then the user profile will be formed by assigning to each attribute the corresponding value of relative weight of importance.

The next step is to apply a correlation function to assign each user to the category he/she belongs to.

Let f (d|C) be our function where d is the input (user explicit feedback, i.e. gender and expertise level) and C is the associated desired output (in our case the user-category the user is assigned to).

The basic correlation function logic is depicted in Fig 3 where we can see the initial user-system interaction while the system 'assigns' the user to the user category he/she belongs to, based on the explicit feedback (gender, expertise level) the user has provided to the system. The relative weight of importance is also assigned to each attribute in each category, so as the adaptation process can be applied on the user's specific profile.

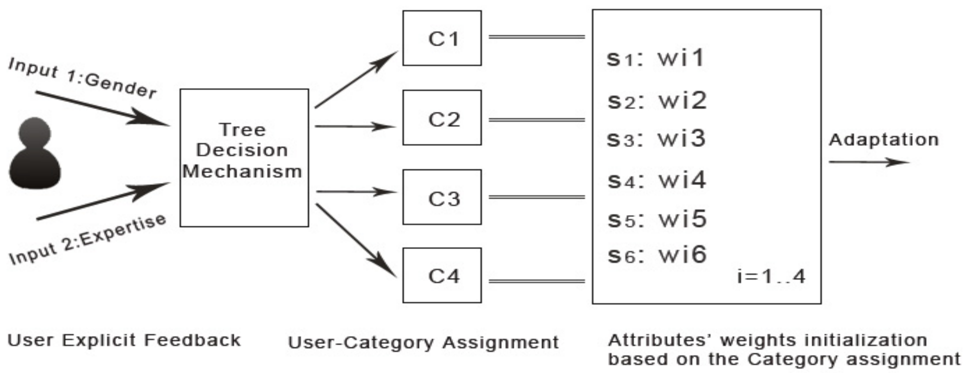

Fig.3.User- to- Category Assignment (Correlation Function Logic)

4. Conclusions

This paper presents a EUD classification consisted by four main categories (user profiles), based on gender and expertise associated behavioral attributes, and combined with existing literature research. Such an approach aims to contribute in the development of adaptive EUD tools within SMEs that assist the users in the development of information software, and in particular, of Marketing-IS. Since end-users contribute significantly in the development of IT infrastructures in SMEs and efficient software produced by end-users is missing, it is important to encourage the development of adaptive and personalized EUD environments that will enhance the performance and efficiency of the end-users.

According to our approach Gender- and Expertise- based behavioral differentiations can be used as stepping-stones for the suggestion of particular end-user developers' behavioral categories. According to our approach:

- Gender and expertise level can be used as stepping-stones for the suggestion of particular end-user categories, one for each gender- expertise pair.
- Each user profile is composed by a set of behavioral attributes, proved to influence users' behavior and preferences.
- Each attribute has a different relative weight of importance in each category, based on its influential degree on the user's behavior, preferences and consequently performance.

The results of our study suggest that more research in this direction seems worthwhile. The primary contribution of our work is to reveal the feasibility of User Profiling when integrated in the area of IS-EUD. Moreover, by highlighting the significant difference in end-user mentalities, we insist on the importance of user profiling in EUD software. Hopefully, our approach will shed light on the necessity of such adaptations resulting in EUD environments that take under consideration the end-users' distinct psychological and cultural factors and enhance the end-user's ability to create usable and functional software in SMEs.

5. Areas of future work

Several challenges have emerged from our work that may be targeted by future research. In the following we propose a few research areas we consider to be of significant importance:

- The construction of a self-adaptive system that will react appropriately in each of the four user categories. Such an implementation is already included in our own research agenda.
- A profound literature study may assist in the creation of a EUD environments where the construction of static new potential user categories or even the discovery of dynamic new categories on the fly is possible. This could be achieved for instance if our system, based on different relationships and interactions existing among the attributes in each category, could make predictions about the user's future behavior and dynamically create a corresponding category (if not already exists).
- Further information material collection regarding the gender and expertise based differences among end-users in EUD.
- The development of optimized monitoring tools to capture 'implicit user feedback' by various devices and/or sensors the user uses such as mouse, keyboard, camera etc.
- An essential enrichment of the system's 'intelligence' with machine learning techniques (e.g. learning association rules, classification and regression) to enhance its performance and the users' experience as well.

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