Tracing Concepts in Designing for Change

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ABSTRACT

In this paper we demonstrate the usefulness of tracing concepts through theory and practice in a complex design situation. In the context of a large design project with many partners (technical and non-technical) we demonstrate how valuable ideas may be altered in the transitions that occur when concepts are treated differently by domain experts, researchers and developers. In some cases, this constitutes a clear loss of value. We also demonstrate how by tracing a given concept through the process and going deeper into theoretical considerations, the value loss may be reduced.

General Terms

Design, Human Factors,

Keywords

Tracing concepts, rewards, evaluation, autism.

1. TRACING CONCEPTS

Designing ICT systems for specific purposes is often a very complex task in which ideas emerge between partners with different expertise. It is not unusual – even in highly participatory design processes – to find that ideas and needs are interpreted differently by domain experts, software programmers, interaction designers, and end user practitioners. Despite ongoing quality checks, e.g., as in agile development to combat this loss of value, it can be a source of frustration to see how good intentions may end up as 'dead' functionalities, left out of actual use. This is not necessarily somebody's fault in the sense that needs are deliberately misinterpreted or user demands and wishes are overruled by designers and programmers in the design process. In fact, the loss of value may very well occur in design teams where each partner conscientiously strives to understand and accommodate all relevant aspects of a common goal. This loss of value may have many different explanations, such as *lack of sufficient communication between partners*. It may be difficult to bridge a gap between non-technical domain experts and design teams. It is a big challenge to establish a common language that allows the substance of ideas to be maintained across traditional boundaries. But value loss may also arise from *growing knowledge,* because preliminary theoretical knowledge may be insufficient to support the design process. Conceptual models (formal or semiformal) of a domain may bring about a wish for deeper understanding of processes and principles in the domain from all kinds of partners. This increased knowledge may then in turn result in a different understanding of the domain than what was originally planned.

In addition to traditional software methods of ensuring consistency in specifications and implementation, we propose a method of Tracing Concepts through the entire design process from early user descriptions, to specification, implementation, and evaluation. We will demonstrate the notion of Tracing Concepts by applying it to 3-year development project on E-inclusion with 10 partners located in 5 European countries.

In the next section, we provide a brief overview of the HANDS project and argue for the selection of a concept. This is followed by a review of current theoretical positions and perspectives on rewards in Section 3. In Section 4 design and implementation of these persuasive principles are considered, and section 5 contains empirical findings from two partner schools. In Section 6 we propose a model for employing rewards. Finally, in Section 7 we conclude.

2. DESIGNING FOR CHANGE

In this paper we consider the design, implementation and actual use of specific reinforcing strategies (i.e., *praise* and *rewards*) in the HANDS Toolset, an ICT toolset designed for Helping Autism-diagnosed Navigate and Develop Socially (HANDS). For further information on the HANDS project see [5-9]. Autism Spectrum Disorder (ASD) is a pervasive developmental condition with no known cure. Treatment is based on repeated interventions and must be highly individualized.

It is argued that people with ASD generally lack motivation to initiate and engage in social interaction due to general deficits in cognition including the ability to evaluate past experiences and to regulate own actions in achieving future goals [11]. These motivational deficits are further aggravated by feelings of anxiety caused by presumed lack of control. The HANDS toolset is intended to enhance the ability to evaluate past experiences, to exercise self-influence and to calculate the possible outcomes of actions [10]. This design is intended to change attitudes and behaviors with the informed consent and voluntary cooperation of the individual in question, thus incorporating the very definition of persuasive technology [12]. The toolset consists of a mobile application targeted at the pupils and a web server through which the teachers maintain the toolset. For further elaboration on the functionality of the toolset see [5-8, 11].

In early stages of the project, collections of user narratives was collected from four partner schools in the UK, Hungary, Sweden, and Denmark, respectively. Teachers and other care givers would convey their domain knowledge of difficult situation the children

in their schools would encounter. Usually, the narratives were centered on situations where a cognitive support system on a mobile phone was thought to be helpful. These collections of user narratives formed the basis of a set of use cases, which were then formalized by the programming team in charge of software development. The development of the toolset is based on the principles of Persuasive Design informed by psychology, pedagogy and the etiology and pathology of the target population, and aims at supporting this group in daily situations, thus improving their social and self-management skills, and thereby supporting social integration and independence [10]. In Persuasive Design research increasing attention has been paid to specific target groups and areas, that could benefit from technologies' potential to shape, reinforce or change behavior and/or attitudes, e.g. attempts to facilitate eco-friendly behavior [1, 2] or to encourage physical activity [3, 4].

This overall design of the project leads to two things. In the first place, the consortium has gone to great length in order to gain mutual understanding of problems related to the different kinds of research, pedagogical practice and development. This collaboration is held in high regard by the partners of the project. In the second place, this means that the product consists solely of elements that were first in the hand or the mind of a teacher, but in order to reach a functional stage, each element has passed through the teams of researchers and developers.

This paper presents our findings related to various approaches to certain persuasive principles and includes an empirical study of prototype 1 of the toolset.

2.1 Selecting concepts

Several persuasive strategies have been considered in designing the toolset [10]. The use of reinforcing strategies (i.e., praise and rewards), however, seem somewhat essential, due to the consistent motivational deficits mentioned above, and because the use of reward systems reportedly are at work at the schools. Therefore, the persuasive concepts of praise and rewards are good candidates for concepts that can be traced through the development process. In similar studies we have focused on other concepts, such as *credibility*, and the notion of *difficult situations.* As persuasive technology is the core of the HANDS project, it should be emphasized that ASD is a complex neuro-cognitive condition, and not a mere matter of persuasion. Thus, technological solutions that are considered efficient for neuro-typical people might not automatically work when considering people with ASD [5]. That being said, the HANDS software is, to a large extent, developed in the tradition of participatory design. This means that the multidisciplinary development involves a high level of user participation, which ensures that expert knowledge on ASD is considered when choosing persuasive strategies. Thus, prior to the development of prototype 1 it was argued, that a strong motivational basis is a crucial element of interventions. This includes prevention and treatment of challenging behaviors as well as teaching new skills [8]. Reports from one of the schools in the project also suggest, that rewards related to this specific target group are context-sensitive and that both the reward character as well as its contingency should depend on the needs and desires of the individual [10].

For the purpose of persuasion, Fogg defines positive reinforcement as "*shaping complex behavior or transforming existing behaviors into habits*" and further divides these strategies into three types, each relating to different parts of the functional triad; *Conditioning, Virtual Rewards*, and *Praise* [12]. In the context of HANDS we find it fruitful to make a different distinction between *verbal, virtual* or *tangible* rewards, mainly to include rewards that are provided outside the computing technology itself. Some argue, that social incentives such as social facilitation and conforming behavior are equally or even more important in designing persuasive systems [13]. Knowledge on ASD, however, suggests that social incentives could be of less importance because of the target population's innate lack of interest in peer interaction. It could, of course, be argued that the very replacement of noticeable ASD-related tools with an assistive technology integrated in a mobile unit is, in fact, an instance of conforming behavior.

Even this brief exposition of the concept of rewards, shows many facets of theory and practice, that are not necessarily part of the semantics of the concepts in the user narratives. We will now engage in an even deeper analysis of the concept.

3. REVIEWING REWARDS

To trace the concept of rewards through the design process in the HANDS project, a preceding analysis of this concept as a theoretical construct is necessary. Although rewards are widely used and presumably an effective persuasive strategy in the contexts of teaching, parenting, managing etc., it is also very disputed and criticized. Thus, the concept of rewards has historically been defined by this dispute, in which critics argue that the use of rewards has a detrimental effect on intrinsic motivation, whereas advocates argue that the use of rewards has a powerful influence on human performance and interest and view it as a necessary part of teaching and learning.

3.1 The Dispute

Behavioral researchers underline the importance of the *law of reinforcement,* stating that behavior is selected by its consequences (i.e., punishment or reward) rather than driven by internal motives or thoughts [1]. Critics consider these operant conditioning principles a dehumanizing characterization of people as passive responders to events from the environment. Not all proponents, however, attribute effects of rewards to external circumstances. Social Learning Theory also view rewards as patterns of feedback used as information on how to produce or increase outcomes, but is distinguished from Behavior Theory by its attention to self-evaluative mechanisms [2]. Here, perceived competence mediates the effects of rewards on motivation, thus the critical issue is to cultivate interest and perceptions of personal efficacy through rewards based on *performance*.

Opposite, Attribution Theory predicts negative effects of rewards as a result of the *overjustification hypothesis* stating that individuals rewarded to do an activity they already enjoy are likely to attribute their behavior to the reward rather than to task enjoyment [3]. The Cognitive Evaluation Theory makes similar

predictions, but points to perceptions of control. This theory explains negative effects of rewards based on a distinction between *intrinsic* and *extrinsic* motivation; when rewards are interpreted as controlling, they interfere with innate needs for freedom and undermine competence by shifting perceptions of causality from *internal* to *external* sources, with a resulting loss of intrinsic motivation [4]. Proponents argue that major ambiguities exist within this framework. Particularly, the notion of intrinsic motivation is questioned since much behavior that appear to be intrinsically motivated prove to be, in fact, motivated by anticipated future benefits, previous environment-behavior interactions, and the physical and social context.

3.2 A Compromise?

As a response to the above criticism, the Self-Determination Theory has been developed [5]. Rather than *intrinsic* and *extrinsic* motivation, Self-Determination Theory focuses on the distinction between *autonomous* and *controlled* motivation, and while naturally advocating intrinsic and autonomous motivation, this theory also acknowledges the, at times, requirement of extrinsic motivation. Thus, rewards are divided into groups according to the nature of their regulation, resulting in a Self-Determination continuum ranging from *amotivation* to *intrinsic motivation* [5: 336]:

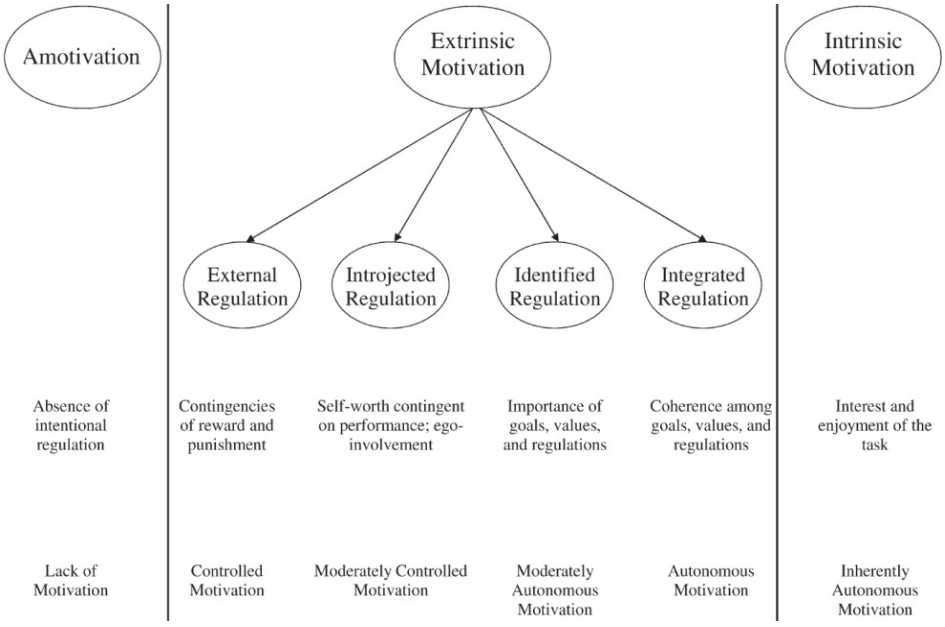

Fig. 1. The Self-Determination Continuum

This continuum allows the external regulation and the value associated with it to be internalized. When a behavior is *externally regulated*, it is initiated and maintained by external contingencies, but regulations is also accepted as either *introjected* (i.e., taken in but not accepted as one's own); *identified* (i.e., identified for own self-selected goals); or *integrated* (i.e., involving the sense that it emanates from one's sense of self) [5]. To exemplify, the continuum could illustrate a possible movement through the educational system, with primary school pupils often having little or no intrinsic motivation to do homework, thus depending on external or introjected regulations, moving through to secondary school, where regulations are mostly identified. Finally, entering university where students usually regard themselves as intrinsically motivated to study, thus view regulations primarily as integrated. Although it is not suggested that people must invariantly move through these stages with respect to particular behavior, this example shows that ideally, means of *control* should gradually be replaced by means of *choice*.

3.3 A Position in Context

In ASD-research, the debate on rewards has been equally evident, separating two major treatment models[1]; *TEACCH* and *ABA* [6]. However, the prevailing strategy in teaching life skills to youngsters with ASD is based on the idea of repeated intervention, and although teachers do have different views on the efficiency and purposefulness of reward systems, it seems that it is a common practice. The end goal of many of these interventions relate to freedom through self-management in various contexts. This corresponds directly to the question of innate needs for freedom as suggested by the Cognitive Evaluation Theory [4]. However, in the case of children with ASD, freedom often coincides with the presence of consistent support. And self-management thus depends on having access to updated support systems. This obviously incorporates an element of control, but that may well be a prerequisite for a successful intervention and therefore also for a successful persuasion.

It is sometimes argued that persuasive technologies should not be applied to people with diminished cognitive abilities, and there are certainly cases where such use would be unethical. But in the HANDS project, persuasive strategies are centered on existing pedagogical practice, and aimed at situations where a constructive alignment between persuader and persuadee has already been or is being established. Thus, though acknowledge-ing the risk of rewards being administered in coercive ways, we do agree that rewards generally enhance feelings of self-efficacy, and potentially encourage autonomy and independence in this specific target population.

[1] **A**pplied **B**ehavior **A**nalysis (ABA) focuses on reward and success (social and tangible incentives), whereas **T**reatment and **E**ducation of **A**utistic and related **C**ommunication-handicapped **Ch**ildren (TEACCH) instead emphasize the child's inherent resources as motivational.

4. DESIGN AND IMPLEMENTATION

We will now look at how the concept of rewards was implemented in the first prototype of the toolset.

The reward system incorporated in the HANDS toolset is based on gold stars, and while the specific reward contingencies are only visible on the web server, the total amount of rewards is always available to the pupil on the mobile device.

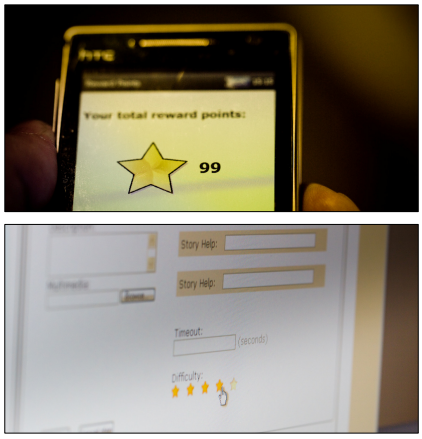

Fig. 2. The HANDS reward system as seen on the teacher's interface and on the mobile device.

Most of the preceding reflections on praise and rewards in general, and in Persuasive Design particularly, are evident in the project deliverables containing the initial requirements for the design of the HANDS software. One example is the emphasis on the role of the toolset as a self-evaluative mechanism contributing to feelings of competence and self-efficacy [8]. In addition, individualization is viewed as a crucial element in interventions, thus proposing that rewards have to be contextual and tailored to the individual. This is illustrated with a continuum similar to that of the Self-Determination Theory, showing that the persuasive function of the technology will range from a *coaching role* (providing guidelines, suggestions, and support of self-reflection) to an *instructor role* (providing instructions, rewards, and surveillance) depending on the individual [6]. Finally, the importance of goal-setting is considered, in particular ethical concerns related to the potential divergence between what the child perceives to be in his or her best interest and what parents, teachers, and other adults may consider a desirable outcome [7].

Reviewing the design and implementation of praise and rewards in the HANDS toolset as well as findings in related work has given rise to new aspects of the theoretical debate on praise and rewards in persuasion. One aspect continuously debated, is the coherence between rewards and intrinsic motivation, but methods of identifying the initial level of intrinsic motivation are not given. Another aspect debated specifically in the context of ASD is the contextual dependency of rewards. Although the Self-Determination Theory provides a continuum differentiating rewards based on their regulation, it does not seem to explain the effects of different types of reward or provide guidelines for employing these in practice.

5. EMPIRICAL FINDINGS

The first of two planned prototypes of the HANDS toolset were deployed at four partner test schools in the fall of 2009. In the period of from December 2009 to February 2010, we conducted interviews and observations at two of the partner schools in Denmark and Sweden, respectively. To the extent that it was possible, we conducted interviews with all children in the test group as well as with their respective teachers. Given the often fragile circumstances surrounding interviews with children, and specifically children with ASD, we decided early on to use a semi-structured and open-ended interview style. Since communicative deficits are part of the diagnosis shared by these children, standard ways of validating interview data cannot be applied and the teachers therefore play an important role in interpreting the interviews. In addition to videotaped interviews, we also made observations in and out of the classrooms and documented our observations with field notes and photos. Throughout our investigations we carefully sought to be as non-invasive in our demeanor as possible. All data are anonymized and stored according to the ethical protocols of the project. The findings reported here are results of work done at both the schools in question.

We found that rewards systems are at play at both schools, and as expected, that the use of such systems is highly individualized. The teachers argued that the existing reward systems could be adopted in the HANDS toolset but that pedagogical values such as emphasizing the child's inherent resources seemed external to the toolset. From the observations, however, we found, that the majority of the target population had great technical ability and seemed very familiar with different technological systems. Thus, we find reasons be believe that the toolset may promote competence and self-efficacy by making hidden resources more visible.

Having the reward system in a phone has the obvious advantage that you can carry it with you at all times and that it is constantly available. On the other hand, the mobile solution obscured the results for classmates and others. This is somewhat in contrast to current practice where information is frequently displayed in public. This point to the fact that the system has a number of effects on the information ecology, and that many of these effects are still not accounted for.

Furthermore, we also examined the hypothesis that social incentives are of less importance in ASD by asking whether the amount of gold stars were shared and compared, and found that the general non-competitive manner is also reflected in the use of the mobile device.

We documented that the reward system in some cases was used as a control mechanism, for instance to ensure that the phones were synchronized. Synchronization can be set to trigger an additional reward point, making it visible to both teacher and pupil that the phone has actively been synchronized. This is important because prompts and day plans has to be up to date. Here, the persuasion aims at integrating the technology in daily routines, and at the early stages, it is not surprising that most of the activity can be said to belong to zone 1 in the model above. In these cases we found little or no evidence that the pupils actually looked at the accumulated points. There are various possible explanations for this: navigation problems within the interface, the fact that some

pupils still use their own mobile phone and therefore have to cope with two phones, or it could be that the stars are construed mainly as a control mechanism. These are questions for further research.

In terms of changing the method intervention to include advanced ICT tools, the project is still at very early stages. We did, however, document cases where consensus appeared more evident, and where focus had shifted from external to shared motivation. In one case, a young man is prompted in the morning to go to school. As a result, he has gained some control over his urge to ditch school and has single-handedly taken on the responsibility of phoning in if he is delayed. This is an example of moving into zone 2, where the wanted life skill – desire for self-management – becomes the reward itself, and where the technology-mediated intervention supports decision making at critical times, as well as offers a solution to a present problem. This is consistent with the hypothesis, that a guided goal could be a way of facilitating motivation and by this moving gradually through to zone 2. In continuation of this, tangible rewards could possibly be a way of representing an agreed goal, supported by the virtual rewards, which provides a new ubiquitous self-monitoring tool.

Entering zone 3 would entail a larger degree of initiative on behalf of the child. We have not documented such behavior, nor did we expect to do so at this stage. Whether this kind of self-engaged persuasion can be sustained over longer periods of time remains to be explored, and will be a central issue in the planned test of the next version of the software.

5.1 Beyond the stars

In the initial design, the number of gathered rewards is displayed along with a generic star (fig. 2). Our interviews indicate an interest in the possibility of more individualized tokens. This could be closely related to special interest or hobbies, e.g., images from favorite computer games or other domains of interest. It is also considered to let a number of smaller tokens (e.g., 20 small yellow cars) be treated in for a bigger one (e.g., 1 decent sized red truck). This would be consistent with the current practice where smaller individual rewards (e.g., computer time) can be saved and exchanged into a collective reward (e.g., an outing). However, we found no indication that the children talked about the number of acquired reward points.

It is also a possibility that rewards obtained can be displayed as parts of a puzzle slowly revealing a picture of some interest to the individual. If the more generic token is to be replaced, the issue of fixation immediately becomes important. In some cases the intervention would aim precisely at avoiding a kind of behavior (say, obsessively talking about a specific computer game). In such cases, displaying images from the domain to be avoided may indeed be motivating, but counterproductive. Finally, the teachers also showed interest in compiling collections of support systems as they become obsolete for the purpose of displaying personal development.

6. ZONING PERSUASION

After having followed the process from idea to specification and implementation, and having reviewed the literature on the concept of rewards, we were compelled to reconsider the main model. Below, we propose a conceptualization of the ideal progress in a continued use of rewards based on the idea that an interdependent relationship exists between perceived *consensus* (i.e., the degree to which persuader and persuasee's intentions are interpreted as coherent) and perceived *control.*

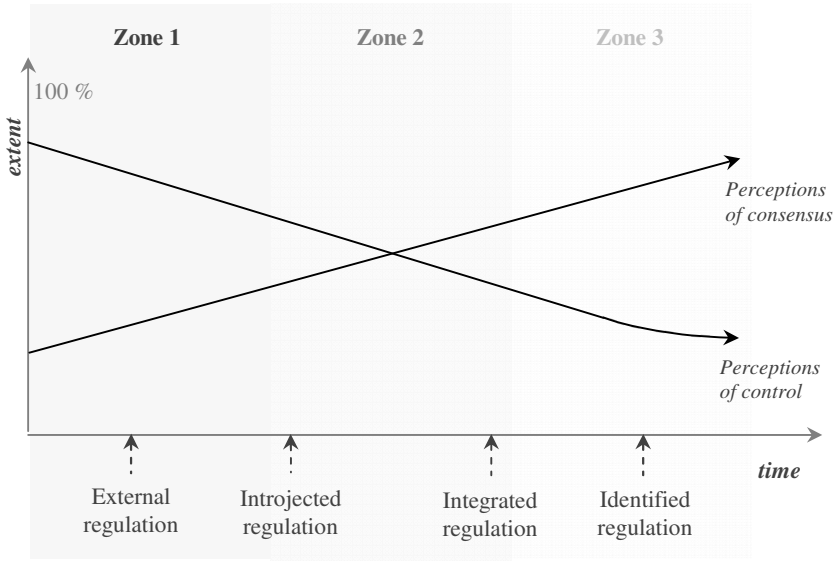

Fig. 3. Zoning Praise and Rewards in Persuasion

Similar to the Self-Determination continuum, this model is based on the view that motivation can be autonomous versus controlled. By dividing interventions into three *zones,* however, an attempt is made to further operationalize the framework proposed by the Self-Determination Theory by introducing a possible method for identifying the initial level of intrinsic motivation. The temporal dimension of the model entails a prescriptive perspective, based on the ethical principle that one should always try to enhance autonomy.

In the context of intervention strategies involving a teacher and child, it will often be the case that the initiative in the beginning lies with the teacher and that, correspondingly, the child to some extent may object to the intervention. This is caused by the asymmetrical relation between teacher and child (what Miller refers to as indirect coercion [18]), but also grounded in the very logic of intervention: that a certain behavior of the child is deemed undesirable. In the first zone, it is therefore expected that the intervention may be resisted and that, subsequently, the persuasion must aim at creating motivation for the intervention. If, for instance, the goal is for the child to be able to use public

transportation, the intervention may well be resisted at first, simply as a matter of convenience. Here, the resistance may be targeted and rewards given with little or no direct connection to the intervention in question.

In other cases, it could be that an intervention begins as an introjected or even integrated regulation, in which case focus of the intervention moves towards the actual outcome itself. Rewards given at this stage can be more directly connected to the successful outcome of the persuasive effort, regardless whether this effort begins in this second zone or carries with it a history from zone 1. As the child realizes the advantages of being able to move about in the city independently, constructive alignment between teacher and child begins to form, and the reward may then simply be for the child to do this on his or her own. From this example it is evident, that goal-setting, and in this particular case the *guided* goal, could be a way of establishing this alignment and by this facilitating intrinsic motivation.

Interventions beginning in zone 3, in turn, would require strong trust in the system used for interventions, as well as the ability to identify new needs and to initiate a course of action towards satisfying such needs. These requirements make zone 3 interventions unlikely to occur fast in this domain. However, most intervention schemes are made with the specific intention to render them obsolete at some point. As the desired ability is formed, the persuasive aim moves from creating or changing a behavior to maintaining an existing behavior. Rewards in this case could be a collection of tokens, representing successful incidents. In terms of goal-setting, this zone would be characterized by a growing number of achieved self-set goals.

7. CONCLUSIONS AND FURTHER DIRECTIONS

The concepts of praise have been traced from theory to implementation in an ICT based intervention system, and we have documented pertinent parts of the actual context in which the implementation takes place. We have found evidence of zone 1 and zone 2 persuasion as well as indications of movement from zone to zone. Findings suggest that the possible divergence between intentions of pupil and teacher in zone 1 may be alleviated by active goal-setting, as they move towards zone 2, and ideally to zone 3. The temporal difference between virtual and tangible rewards could be a way to incorporate this strategy. This will be taken into further consideration in future empirical studies, along with deliberations regarding individualization and accumulation of tokens. We also propose that the development in the use of rewards should ideally involve the process of moving from the toolset functioning as an instructor to functioning as a guide and by this gradually increasing autonomy. Thus we have demonstrated the usefulness in tracing concepts as part of the evaluation of a complex design task.

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