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# An Agile Framework Towards Inclusion

## Supporting teachers working in an inclusive learning environment

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**Abstract.** This paper reviews a user-centered agile systems design process, in the context of facilitating an educational environment. It focuses on the design of an ICT tool to support teachers in building an inclusive learning environment for children with Special Educational Needs (SEN), applying the “Index of Inclusion” (IoI) as a framework that directs the development process. The IoI is a set of guidelines that offers schools a supportive process of self-review and development when it comes to SEN; it draws on the views of staff in the educational sector. Extracting a requirements specification from a theoretical framework can be challenging. This study investigates how end-users, clients and stakeholders’ involvement in the development process can be used with the aim of establishing design implications. The outcomes suggest that integration of user experience in the development processes, design ideas, and/or framework can be useful for software developers, specifically when working with diverging needs and perspectives.

**Keywords:** Information and Communication Technologies, User-centered design, HCI design and evaluation methods, Special Educational Needs, Index of Inclusion, User-Centered Agile Design

## 1 Introduction

Working towards providing an inclusive, high quality education for all pupils contributes towards the Sustainable Development Goals of the United Nations in 2018 [1]. Not only this, but high-quality learning environments, “can be particularly beneficial for children with disabilities” [2] and particularly, children with Special Educational Needs (SEN). There are different aspects when it comes to measuring quality of education. One of these measures is equal access to educational opportunity, such as mutual learning and sharing of best practices, with the aim to enable learning for everyone, including

children with SEN. SEN is an umbrella term used to cover many kinds of difficulties in learning, and can be interpreted differently depending on the country [3]. For example, the Network of Experts in Social Sciences of Education and Training distinguishes between normative and non-normative difficulties. Whereas normative difficulties refer to physical and sensory difficulties, non-normative difficulties include social, emotional and behavioural difficulties, as well as learning difficulties, such as dyslexia [4]. Kaulina et al. [5] stress that children with SEN are children that require additional medical, educational or social support due to “disorders caused by illness, trauma or hereditary disease, regardless of whether the child has been defined as disabled in accordance with the procedure defined by the law” [5]. According to the Salamanca Statement and Framework for Action on Special Needs Education [6], inclusive education is based on the principles of social justice and provides everyone with equal access to education, suggesting that all children have equal rights to be included in the general education system to learn. This perspective can be considered as the core in defining an inclusive education. In most cases to achieve an inclusive education for children with SEN, additional information is required. This information is documented in an individual ‘Action Plan’. An Action Plan is thus a tool that documents individual requirements and is a part of the assessment processes for children with SEN. It is therefore central to the process of creating an inclusive education. Teachers play a significant role and rely heavily on each student’s action plan, and is essential to derive in consultation with the pupils themselves, their parents and specialist support teachers [7]. This action plan is continuously updated, evaluated, monitored for progress and can be altered if necessary. Within Sweden, action plans can contain: a) goals and learning objectives for the child, b) resources to be used, c) time-plans and methods of evaluation. Further to its core value of equal access, inclusive education planning is often guided by an Index of Inclusion (IoI) framework. This ICT tool is designed to fit into the existing processes and to aid teachers working to establish and maintain equal access in the education of children with SEN. As far back as the early 1990s, HCI characterized itself as a field concerned a human-needs driven process that developed alongside technological innovation[8]. As such, it can include various design approaches as well as cognitive or empirical approaches [9]. The version used in this study was a user-centred agile design approach that focused on the practices, organizational mechanisms, and relationships between each stakeholder group. During this study it was important to gain in-depth knowledge regarding different stakeholders' opinions on inclusion and how ICT tools could support their needs. The design process was motivated by the goal to develop supportive communication approaches between teachers in the educational sector in keeping with the IoI philosophy of collaboration [10]. It was also designed specifically for teachers that focus on supporting children with SEN. With the aim to examine the viewpoints and experiences of teachers in how ICT can support the process of creating an inclusive environment for children with SEN. The study aim is to examine and answer the following questions using an agile user centred development method:

1. What are the viewpoints held by teachers in regards to the link between the index of inclusion and SEN?

2. What are the viewpoints held by teachers in regards to ICT as a supportive tool in regards to inclusion?

## **2 Background**

The purpose of this study was to utilize a User-Centered Agile development method and reflect on the important role of the teacher in identifying what forms of information can support the inclusion process of children with SEN. Applying the IoI in a number of different countries helped identify a common framework which can support creating an inclusive learning environment. In addition, to create optimized action plans that can lead towards sustainable processes. Hence, create a better understanding of how to create an inclusive school for all children. According to UNESCO policy guidelines on inclusion in education, it has been established that people's participation in so-called knowledge and information societies is contingent on the availability and affordability of ICTs, the relevance of ICT-based content and services, but also on their accessibility [11]. "Users must be able to perceive, understand and act upon ICT interfaces" [11]. Research often focuses on technical solutions designed to compensate for specific special educational needs in the form of a pedagogical tool. With an emphasis on "building collaborative relationships"[12] in educational settings, the IoI focuses on three factors, which are: 1) the child, 2) the environment, and 3) associated activities, with the aim of creating a guide that can support educators towards an inclusive way of thinking. Given the IoI frameworks focus on the importance of collaboration and communication in establishing an inclusive educational environment, this study focuses on the teachers' informational and communication needs and take into consideration their perspective on inclusive education for children with SEN.

### **2.1 The Index of Inclusion (IoI)**

The index of inclusion is a set of guidelines that offers schools a supportive process of self-review and development when it comes to SEN. It draws on the views of staff in the educational sector. The emphasis is on factors affecting the development of thought and practice within schools, as well as broader contextual influences that limit these changes, an exploration of overlooked possibilities for moving practice forward. [13-15]. The IoI support educators reflect and review the current structures, and create an inclusive development structure with the recognition and sharing of good practices, while at the same time drawing attention to ways of working which may pose obstacles to certain students' involvement and learning. The IoI creates a unified guide for educators to effectively support children with SEN [14]. The IoI is a set of guidelines, good practices and activities that can be adapted by schools to develop inclusive learning environments, including creating inclusive values, developing a school for all, and organizing support for diversity [14]. Originally deployed in 22 UK schools, the framework has since been tested in a number of schools in Australia [12]-[16], New Zealand [17] and some developing countries [18]. Studies have shown that the IoI framework can be applied to diverse educational settings ranging from schools to higher education

in a number of different countries [19]. Together with existing mechanisms like Action Plans, the IoI guides teachers in their efforts to create an inclusive learning environment for children with SEN.

## **2.2 The Dimensions Of Inclusion**

Inclusion is context-bound and can therefore be interpreted in different ways. Previous research has identified ‘inclusion’ as a process of addressing and responding to the diversity of needs for all children, youth and adults through increasing participation in learning, cultures and communities aiming to eliminate exclusion within the educational system [20]. Qvortrup argues that the definition of an inclusive education must be according to the following three dimensions: 1) different levels of inclusion, identifying if the child is “recognized member of the community”. 2) different arenas of inclusion, identifying “different types of social communities, in or from which a child may be included or excluded,” and finally and 3) different degrees of inclusion, identifying “different degrees of being included in and/or excluded from social communities” [20]. Qvortrup concludes that to achieve an inclusive educational environment one must create a balance between the described dimensions and this is achieved by acknowledging these dimensions [20]. Skoglund identifies three factors: 1) Equivalence: the capability to see, recognize and understand the Childs’ preconditions and needs; 2) Accessibility: the capability to adapt teaching, localities and social community from a diversity of needs, and 3) Participation: the capability to stimulate children to ‘take part’; learning to be led, to lead oneself and learning to lead others [21]. These perspectives by Skoglund were considered as main requirements in this study.

## **2.3 Information and Communication Technologies and SEN**

The impact of using ICTs has been investigated and studied over the years with different perspectives, including how ICT has offered new possibilities for improving different aspects of the educational sector, i.e. educational delivery and management processes, changing processes of teaching and learning environments, such as virtual environments. Designing ICT tools can be considered as a user’ needs driven process used in complementing suitable technological innovation. Recent studies have shown some of the benefits of using information communication technologies (ICTs) in a SEN context, including a significant number of studies that examine how ICTs are being used in practice and what impact they have on the life of children with SEN [22, 23]. The results of these studies highlight such benefits as alternative communication, assistive and enabling technologies, virtual environments, technology integration, as well as saving time and labour [23]. Moreover, during the last decade, the design and development of software that provides children with SEN equal access to education has progressed significantly [24]. This paper draws on these instances of implementation of the IoI framework and its role in creating an inclusive educational environment and presents a case study that demonstrates how the IoI can also be applied in the development of an ICT tool.

### 3 Method

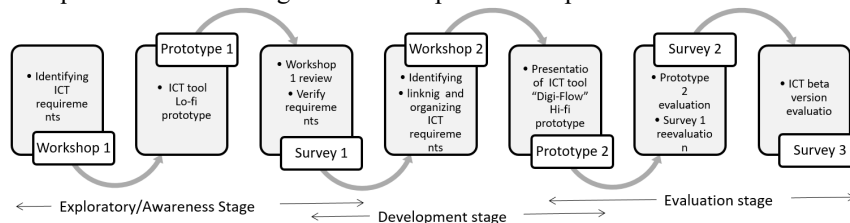
This study was built from a collaborative research project with three municipalities in Sweden, Iceland and Germany, in a project called the “iDea” (inclusion, Diversity and equity for all children) project. With the idea of inclusion taken to primarily mean recognizing the Childs’ right to equal access to high-quality education and to be part of the social environment of a school. Behind this was an understanding of the need to strengthen an organizations’ ability to work with and share all necessary information. Achieving this meant including both teachers and school administration i.e. headmasters in this part of the study. The project included participants such as teachers, pedagogical specialists, educational and administrators; and was conducted over a two-year period. The project’s focus was to work with teachers on formalizing and identifying features and guidelines included in the IoI that they considered useful when supporting children with SEN. These features and guidelines were then used as requirements in the development of an ICT tool named “Digi-flow”. To achieve this, the project consisted of three main milestones, each milestone focused on different aspects such as formalizing requirements, reviewing prototypes, etc. The participants participated in workshops, discussions, field visits and took part in a tailored education. The aim of these activities was for all members to gain better insights and understanding regarding different aspects associated with inclusion practices, i.e. the dimensions of inclusion, school systems and methods used by schools to support inclusion. Thus, gaining a better understanding of the educational environment of children and how they can develop skills to meet diversity.

#### 3.1 User-Centered Agile Method (UCA)

A common challenge when developing a product involves understanding and identifying requirements that fit into context with the user’s needs. User-Centered Agile (UCA) incorporates the user by bringing them into the various stages of an agile design approach. UCA is an iterative design process in which designers focus on the users and their needs in each phase of the design process. During this study the UCA process included the following stages: 1) understanding context of use; 2) specifying user requirements; 3) design solutions, and 4) evaluating against requirements [25]. In UCA, design teams involve users throughout the design process via a variety of research and design techniques, including user interviews, persona definition and prototype creation. [26],[27]. Hence, using an UCA method was key in gaining a better understanding of teachers’ opinions and needs, adding an advantage in defining and confirming user needs and usability requirements. In addition to collecting data to gain a better understanding of the ICT tool requirements and system structure, with the objective to provide better insight into the potential benefits and limitations of the users’ needs. This was achieved during different stages that are referred to as the 1) exploratory phase, 2) the development phase and the 3) evaluation phase. Each stage helped in determining if the design requirements accumulated were to be modified, eliminated and/or merged with others.

1. **Exploratory/Awareness stage**; the first stage included an exploratory study to verify the problem scope and evaluate the research problem. Starting with a general problem statement and initial awareness, which helped in collecting information about the problem domain, constraints, and environment. Investigating existing solutions via unstructured interviews with teachers. All the information gathered during this stage were combined to generate initial designs, which were then prototyped focusing on generating an overview of the main ICT tool. During the exploratory stage information was also gained via conducting workshops and discussion sessions, with the focus on process analysis and design. Identifying the status and challenges related to children in need of special assistance and how teachers could identify and meet these needs.
2. **Development stage**; since user involvement can be critical in domains where user reflections are used to capture design feedback and can be more beneficial for specialized tools aimed for a particular context of use than for tools with a broader target user group [28]. In addition, since ICT tools can include various understandings, which influence the requirements, therefore during this study it was important to capture the different participants' views, the second stage consisted of several increments, which consisted of suggestions using prototypes, with the aim to capture user requirements in regards to the ICT design process. Which led to gaining a better understanding of the ICT tool being developed.
3. Finally, an **Evaluation stage**, which included evaluating various prototypes via surveys. The evaluation of technologies, i.e. ICT tools are often performed to learn how a new tool is being used, accepted and perceived. Another purpose of conducting evaluations is to gain knowledge about the effects of introducing new technologies into an organization. To achieve this, various approaches can be used including i.e. workshops and surveys.

**Fig. 1** represents a general overview of the design method used during this study, as illustrated; the study used a mix method approach, including workshops, surveys and prototyping that acted as development increments. Gathering requirements, over different stages in an incremental approach. Prototyping was used during this research study to obtain user feedback, confirming and/or generate requirements, which were then analyzed, prioritized and implemented into upcoming stages. Which were further refined during the development and evaluation phases, with the objective to answer questions and investigate unclear aspects of the problem.



**Fig. 1.** Design method milestones including main activities driven by stakeholders

As **Fig. 1** illustrates, since the user is the centre of the design process a number of workshops were conducted including the majority of project members to get feedback and drive the design process. Building design specifications in sets, each set of requirements collected was reviewed and confirmed by the study group using surveys and/or prototypes.

## **4 Results and Discussion**

Several outcomes have been achieved during this study, which included benchmarking the concept of “dimensions of inclusion” between all European partners, and thus creating a unified framework that can be adapted to all countries. The development of the ICT tool “Digi-Flow” was influenced by gathering different reflections and information over three main milestones, giving a clearer objective for the tool and the information from the IoI needed to be included.

### **4.1 Exploratory/Awareness Stage**

#### **4.1.1 Workshop 1: Identifying ICT requirements**

The aim of the digital tool was to help users i.e. teachers in schools to structure their work when meeting with children with special needs. The first workshop was part of the exploratory methods and was conducted over a period of two days. The aim of the workshop was to identify and create a unified understanding between participants regarding the term the “Index of Inclusion”. The goal of the workshop was to create a logical structure of questions generated from the specified index. To achieve this, a workshop including 18 participants from Sweden and Iceland, creating three teams each representing a country partner in the project. Each team consisted of six members, including teachers, educational administrators and special needs educators. The objective of the workshop was for each group to discuss and summarize their opinions and reflect on the concept of inclusion, leading further on to group discussions and finalizing a unified perspective that all project members could agree upon. The following is a list of general questions used for the workshop:

1. What is the status and challenges related to children in need of special assistance?
2. How can an ICT tool help the teachers in the school to structure the work in the meeting with children with SEN?

The participants reflected on the dimensions of inclusion and adapted them into three factors that could be explored and used as requirements to achieve inclusion for children with SEN. Which are: a) see and recognize; b) understand the need; and finally, c) adapt and support. The data collected from each of these questions is key to building inclusion in educational settings for children with SEN. As a result, the following list of associated factors and relevant information needed based on the requirements:

1. The first requirement was to include the viewpoint “See and recognize the problem and how it reveals itself”. This means that the ICT tool should support the user in



identifying issues in association to inclusion and frame these problems. To achieve this the participant's questions focused on the child, identifying the Childs' school history, social relations and communication and information regarding diagnoses and formal evaluations of the child, and other observations.

2. A second requirement was that the ICT tool should support the user in reflecting on current state by "Understand the need"; in other words that after recognizing the problem an evaluation, the tool should support by mapping the problem and gathering information. To support the requirements, the participants agreed that the following questions are necessary to answer; including reflections regarding the Childs' experience of its school environment. What challenges does the child experience? What barriers does the child experience? How does the child describe its own lifestyle? Finally, what does the Childs' parents, teachers and others say about the Childs' lifestyle.
3. The third requirement was to include the viewpoint "Adapt and support", the participants noted that to support a child with SEN, user of the tool need to understand what the Childs' needs are, to be able to adapt the learning environment. Therefore, this requirement included questions, such as a) Are there leisure activities the child can participate in? b) What possibilities of change are in the environment? c) What opportunities are in the teacher's abilities? d) What specialized professional assistance can we use? e) And what opportunities do we see in the resources of the municipality?

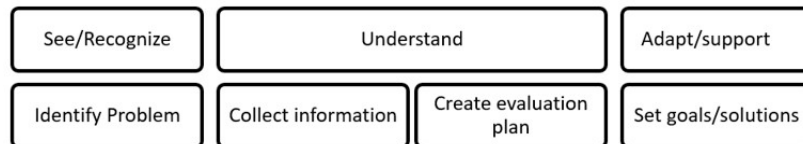
This list of questions was driven and provided by the participants based on the IoI and were identified by the participants as important factors in creating an inclusive education for children with SEN, which they considered had a direct influence on further stages of the project. **Fig. 2.** illustrates the first sketches produced representing the participants conception of the concepts introduced in the workshop.



**Fig. 2.** Workshop 1, Participants early sketches of the mind map of inclusion

To give more depth to these concepts the study also needed to gather information relating to the Childs' education and care, such as, information on their school history, diagnoses and formal evaluations, and their experience of schooling.

The outcomes of this workshop were used to create a framework, which comprised a combined overview of the dimensions of inclusion in relation to the IoI. This translated into a unified process map for the design flow of the ICT tool that was to be developed (See Fig. 3).



**Fig. 3.** Workshop 1, Participants first unified process map for the design flow of the ICT tool that was to be developed.

#### 4.1.2 Survey 1: Verifying ICT requirements

As part of the first milestone (the explorative phase) and after the first workshop, an initial questionnaire including 16 participants was conducted with the aim of gathering more detailed requirements and to verify the initial requirements previously identified and gathered. A survey was used to help; 1) verify potential users and their communication needs and perspectives; 2) what details are considered necessary as “basic information” and finally 3) identify if the developed tool should store all data or not. The question include in the survey were:

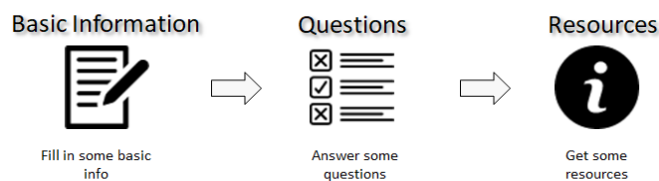
1. “Who do you see is the potential user?” – This question was framed to identify who will be the main user of the tool, to help identify in later stages what specific user’s requirements could be needed. Three different users were presented; teacher, special education teacher and/or head of the school
2. “What background information should be included?” – This question was framed to help identify what information should be gathered, categorized and prioritized. Including information regarding the child, for example what are the Childs’ interests such as music, painting, etc. In addition, contact information that the teacher could need, including other caregivers that support the child in other sectors, i.e. healthcare sector, including for example the Childs’ name, caregivers name and role. In addition to noting the Childs’ strong points/weak points, the Childs’ perspective, and related social background and finally, background information such as telephone number, name of person/company, helpful websites.
3. “Is not saving data acceptable?” – This question was framed to verify if further design requirements regarding general data protection regulations were needed. In addition to considering the safety and wellbeing of the individual and others who may be affected.

Most of the questions in the survey included simple “yes,” “no” feedback, with the aim to create a focus viewpoint from the different participants. The survey confirmed with

75% identifying the teacher as the target user group and 50% claiming the Special education teacher while only 25% identified the Head of the school as the main user. What was interesting during this survey was that all participants agreed that there was a lack of helpful information regarding both information regarding previous action plans and programs, with 100% defining the need for previous plans. In addition, 60% requested details regarding the Childs' strengths and weakness. In addition, 100% indicated the need for supportive information and guidance in the form of helpful websites and contact information of caregivers in other sectors. The feedback also indicates that the majority agreed that saving information was not acceptable, with 93% response to not saving information due the sensitivity of the data. Therefore, the ICT tool was designed to produce results that could not be stored. Even though this survey helped formalizing early design requirements, more in-depth details were required before development of the tool could begin. Therefore, a second iteration was conducted, and it included a second workshop and a second survey in addition to creating the first digital prototype.

#### 4.1.3 Prototype 1: ICT tool Lo-fi prototype

The results from the first workshop were used in creating a mind map as illustrated in **Fig. 3**. (Workshop 1, Participants first unified process map for the design flow of the ICT tool that was to be developed). This was used in planning a second workshop, and as a source for the main requirements for the ICT prototype. However, before setting up the second workshop, confirmation of the first set of requirements was needed. Therefore, based on the main requirements derived from the first workshop, a lo-fi prototype was produced (See Figure 4) and presented to the project participants. It illustrated a structured requirement overview for the ICT prototype in the form of a flowchart that became part of the ICT-tool, Digi-Flow.



**Fig. 4** Confirmation of requirements, illustrated in an overview of the first Digi-Flow Lo-fi prototype

The purpose of Digi-Flow is that when a teacher meets a child who is in need of support, they use the ICT tool Digi-Flow, starting with the first step in **Fig. 4**, "basic information" (details included in survey 1), then depending on how the child responds to the framing of the questions in step two. This stage consisted of a set of "questions" formulated by the participants (details included in workshop 2) that helps teachers reflect on the Iol and finally the tool will assess the information and the results of the questions generating an assessment. Moreover, reach the "resources" step, which offers teachers

advice on how they should proceed. Presenting this lo-fi prototype at the end of workshop 1 was to confirm our understanding of the intended tool that would be developed and to verify our understanding of the main project scope associated.

## 4.2 Development Stage

### 4.2.1 Workshop 2: Identifying ICT requirements

As part of milestone two (the development stage) workshop 2 was organized based on the results from the survey 1. Preparations for this workshop included that the participants provided a new version of the mind map sketch created in workshop 1. This resulted with the participants providing an in-depth design of the mind map. As illustrated in Fig. 5 the mind map now included a clearer perspective from the participants regarding the dimensions of inclusion, identifying three main factors that must be included in the assessment phase of the tool, which are 1) the environment, 2) the activities and 3) the child. This modified mind map helped all participants in preparations for workshop 2. The workshop was conducted with 25 participants, dividing all participants into five groups; each group included two children between the ages of 12 to 15 that had agreed to participate with the consent of their parents.

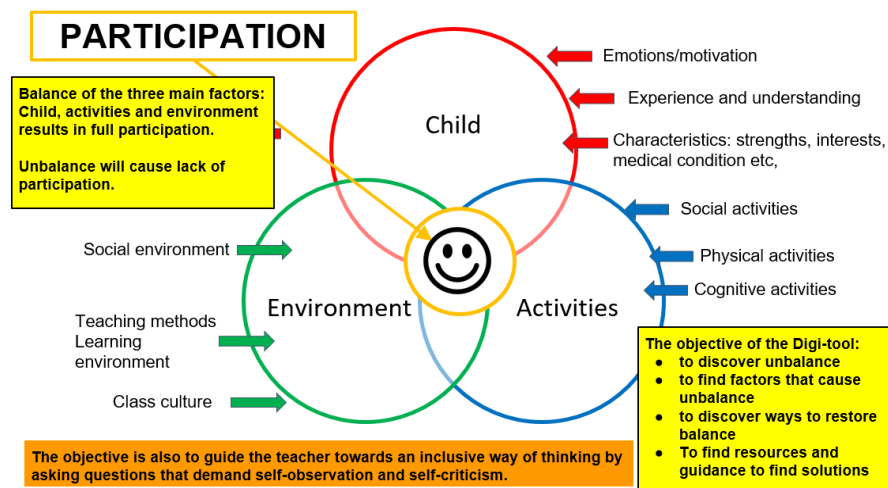


Fig. 5. Workshop 2, Participants presented a second sketch of the mind map of inclusion originally designed in workshop1 (see Fig. 2)

Based on the workshop layout the following information was produced by the participants and includes three main discussion categories in relation to the dimension of inclusion mind map created in workshop 1, which are a) barriers; b) child participation and c) learning opportunities. Participants reflected on associated factors that could affect participation: a) children's understanding, b) acceptance of children by peers and c) atmosphere in both the classroom and in school, as illustrated in Fig. 6.



Fig. 6. Workshop 2, participants organizing, linking and formalizing requirements.

This was done by providing colored notes to the participants, where participants would link these factors how they felt needed. Fig. 7 represent a unified matrix identifying the relation between the different aspects included in the inclusion mind map and the main categories participants considered to influence creating an inclusive educational environment.

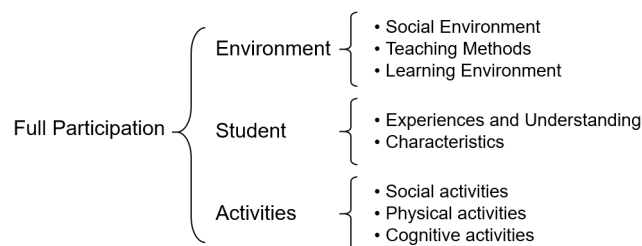
	Barriers	Participation	Opportunities
Physical environment	X	X	
Organizational environment		X	X
Social environment	X	X	X
Class/school culture	X	X	X
Teaching environment	X	X	X
Child	X	X	

Fig. 7. Workshop2, Participants perspectives identifying the relation between the different aspects included in the inclusion mind map

The outcomes of workshop2 resulted in an updated mind map of inclusion. This update included creating inclusion qualities (see Fig. 8). After reflections from the participants regarding the workshop, participants presented their views. This in terms led to the identification of what was termed, “full participation” [40] and was defined as the ‘actions and resources required in helping the teacher in creating an inclusive environment for children with SEN’. This included:

1. Environmental needs – details provided by the participants included: Childs’ social background; Childs’ social relations; Teaching and evaluation methods; Teacher’s and other staff’s perception of child and it’s family; Organization of classroom and other surroundings in school; Transportation; Technical support, use of support devices; School/classroom culture regarding diversity and inclusion.

2. Childs' needs – this category included information such as; Childs' experience of school; Childs' understanding of school demands; Child's self-efficacy; Childs' success and achievements; Childs' strengths; Childs' interests; Existing medical and cognitive conditions and diagnoses teachers need to know.
3. Associated activities – everything the child does in school and other surroundings that matter; Childs' participation; Childs' communication; Childs' skills regarding school related and social activities, i.e. reading, writing, communicating with others, physical activities, cognitive activities, etc.

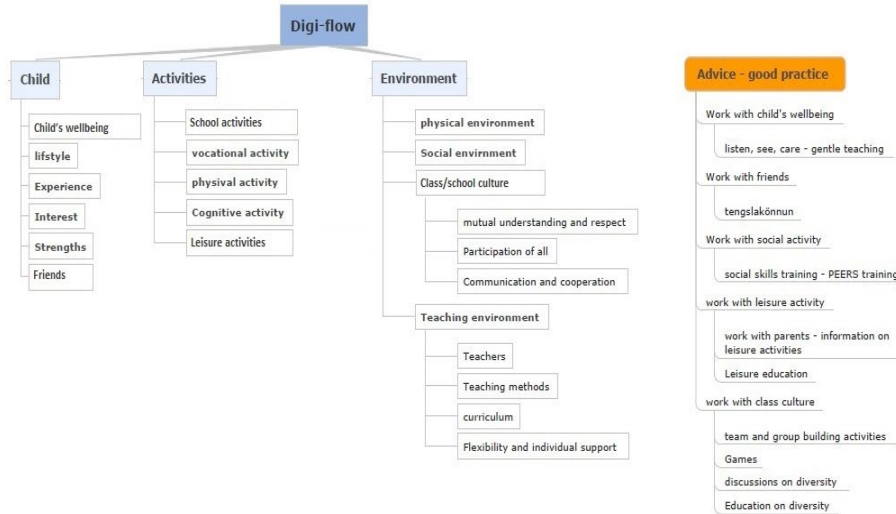


**Fig. 8.** A unified perspective created by the participants, identifying factors associated with creating a balanced learning environment

This unified perspective was an important result in this project, since it created a unified model of the IoI that all participants agreed to use and which was utilized in the development of Prototype 2. Digitalizing the concept “full participation” as a core system requirement (details in prototype 2) [29]. As a result, the ICT tool “Digi flow” needed to support the users in investigating and determining the factors associated with creating a balanced learning environment by assessing the level of ‘full participation’.

#### 4.2.2 Prototype: 2: Teachers ICT tool “Digi-Flow”

As part of milestone three (the evaluation stage) the following model illustrated in **Fig. 9** was provided by participants including their thoughts on the main design requirements to be included in the ICT tool “Digi-flow”. Based on this model, the ICT tool was designed in two segments; the first segment consisted of general background information form, this decision was based on the requirements gathered and confirmed in survey 1 (Identifying ICT requirements) and prototype 1 (ICT tool lo-fi prototype). The second segment of questions totally depended on the answers received from stage one; in this stage the user, i.e. teacher, goes through a series of logical questions that help in the filtering process. This was based on survey 1 and included details from the updated mind map in workshop 2 (Identifying ICT requirements).



**Fig. 9.** Prototype sketch provided by the participants including main ICT tool features

In addition to including base question; which were generated from the inclusion mind map, details were required in order to digitalize the concept of “full participation”. Therefore, a subset of participants were asked to fill in a customized datasheet provided by the developers, which included the following columns:

1. Column one included each question and a sub list of answer options. Participants were required to provide each question with a set of related answers in the form of multiple choices.
2. Column two included a numeric scale, a ‘weight values’ associated with each answer that was used and represented by a numerical scale from 1 to 5. Participants were asked to determine ‘weight values’ where 1 represented less critical/low priority and 5 representing highly critical, thus giving the associated answer a high priority.
3. Column three included the main categories based on the inclusion mind map, which are: a) child; b) activities and c) environment, where the participants needed to link each question in the list to one or more of these categories.
4. Column four included additional subcategories, which were based on the inclusion mind map, i.e. for the main category environment, subcategories could be social environment, learning environment or other subcategories. This association between main and sub categories was determined by the participants.
5. Finally, column five included follow-up questions; the objective was to crosslink and associate questions to others that could be related.

Identifying these ‘weights’ helped create additional attributes to the questions being asked, and helped determine the data navigation process. Thus, using the base question to represent the main distribution of the weight scheme in the designed prototype was to create an interactive questionnaire system that can respond according to the answers

provided by the users of the tool. As the ICT platform fetches a question, examining and depending on the answer provided, the tool will identify any sub-questions linked to it. The ‘weights’ in this platform are used to determine the importance of the questions. Weights are stored for every answer and affect the questions in a ‘positive’ or ‘negative’ way. Linking every question and resources to a category. Each question answered by the user will determine the next set of questions, creating a customized map/path for each child, the final result of the ICT tool would help illustrate to the user i.e. teacher what can be prioritized and/or what to take into consideration as a first step towards inclusion for the child in hand. Based on the weight analysis (accumulated values). The main categories were organized with the aim of creating a ranking dependency based on the associated values. Results of the ICT tool are illustrated in a graphical representation for the user (See figure 14) in a simple layout. This included that users could only print the full details since storing information was not an option to be used based on the feedback from survey 1 (Identifying ICT requirements).

### 4.3 Evaluation Stage

#### 4.3.1 Survey 2: Prototype 2 evaluation

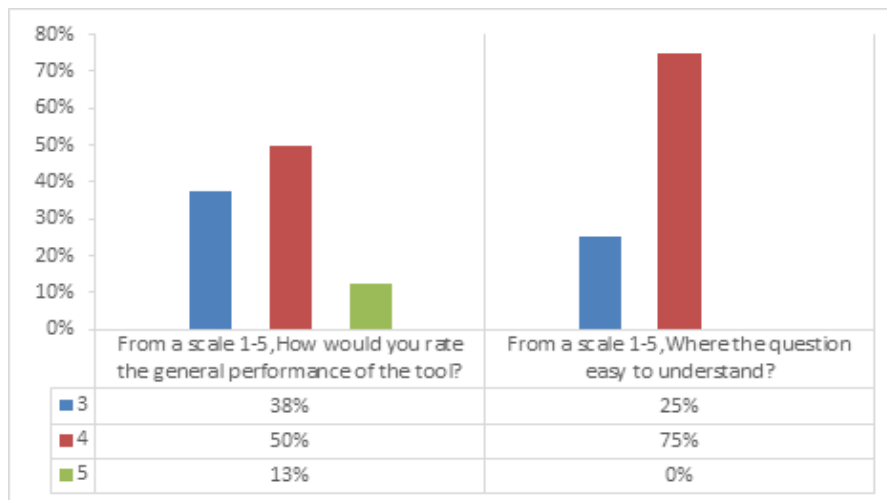
As part of milestone three (the evaluation stage) and after collecting in-depth details from the participants in both workshop 2 and hands-on involvement from participants in designing the second prototype, the development team was able to produce a second digitalized hi-fi prototype. To receive feedback from the participants regarding the presented prototype, an online survey was distributed. The aim of the survey was as follows:

1. **Verify requirements** – the following questions were asked to understand what type of platforms and internet browsers teachers’ use on a daily basis. With the aim of creating a tool that could support teachers with everyday technology and not impose new needs. Therefore, the survey included questions such as, what type of device are you using? In addition, which browser are you using?
2. **Validate and evaluate the prototype** – the following questions aimed on understanding the teacher’s general acceptance of the tool’s layout and information navigation. Collecting information regarding how the teachers used the tool and if they thought that the tool included and conveyed all the information from earlier stages. In addition to verifying that there were no unnecessary stages or details in the tool, with the aim of creating an easy to use tool that was not time consuming but useful for teachers to use. Since it was important to create a tool that would not require additional efforts and time, which could lead to the teacher not using the tool, i.e. did you have any problems when filling in the Childs’ basic information. Did you have any problems showing the result page? Did you find any problems downloading the PDF? Were there too many questions? etc.

The survey included questions with a rating scale from 1 to 5 (where 1 represents the lowest value and 5 the highest). **Fig. 10** and **Fig. 11** illustrates a general acceptance

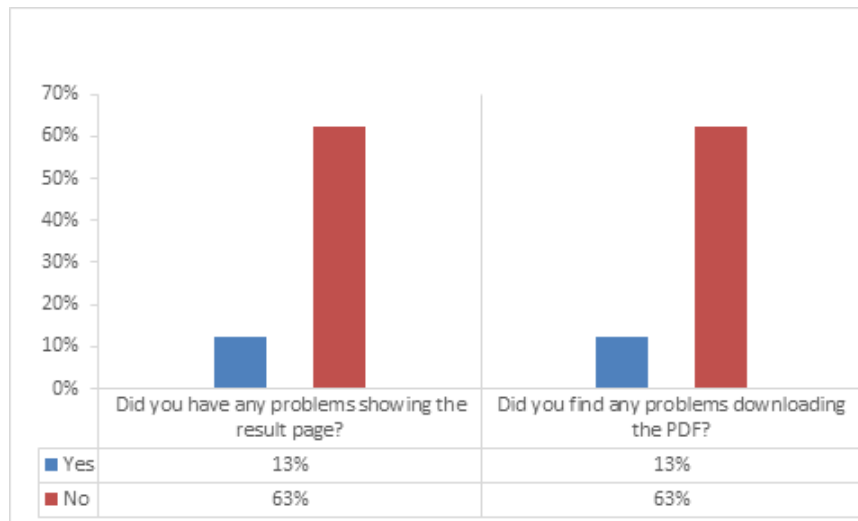


from participants regarding the use of the ICT tool “Digi-flow”, in addition to giving feedback on what could be improved for the upcoming sprints [29]. During 16 participants responded out of the original 30 participants.



**Fig. 10.** Survey 2 feedback

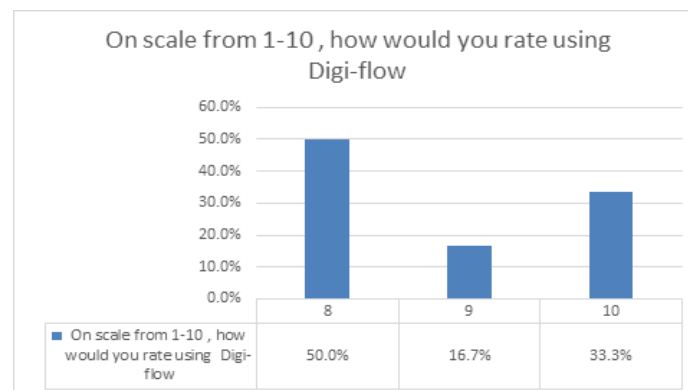
As illustrated 80% gave feedback which indicated a general satisfaction with the presented tool, with a percentage of 63% in total expressing a higher level of content with the general performance of the tool and 75% finding the tool easy to understand. Feedback from the survey identified that 65.5% of the teachers use Internet Explorer, while 25% use Safari and the remaining 12.5% used Edge. In addition, 100% of all participants use either desktops or laptop, therefore the development team did not need to consider touch screens features in their development requirements. In addition, 50% thought that some questions could be removed and that there was 35% similarity between some questions, which lead to 75% indicating that they would prefer to skip some question. Based on the feedback revisions were made to the tool [29]. As a result, developers were able to produce the first ICT BETA tool. This version of the tool was shared with the participants, and were provided with a third evaluation survey.



**Fig. 11.** Survey 2 feedback

#### 4.3.2 Survey 3: ICT beta version evaluation

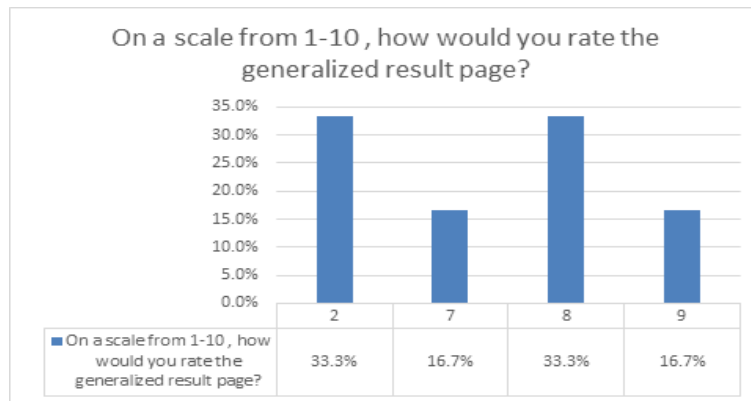
Since the project was conducted in an UCA approach and based on the feedback in the previous survey 2 (Prototype evaluation), modifications were made to the prototype leading to an ICT beta version. After the release of the ICT beta version a new survey was conducted; the objective was to validate the prototype that was built according to the specified requirements.



**Fig. 12.** Survey 3, ICT beta version evaluation feedback

Participants were asked to use the tool and reflect on their experience (See figure 12, 13). The results would then be taken into consideration before the final deployment of the ICT tool. By utilizing the tool, the teacher initiates the first step in the flowchart then depending on how the child responds to the framing of a question/ issues they will

continue in the flowchart and will ultimately get a form of advice on how they should proceed. **Fig. 12** is an example based on the questionnaire results and illustrates that the main issue that the teacher needs to focus on, which is associated with the activities as a main focus point, since it received the higher priority and the learning environment with a lower priority.



**Fig. 13.** Survey 3, ICT beta version evaluation feedback

By answering questions divided into different categories, the tool can determine which resources that are applicable. Depending on what category and subcategory gets the most weight (i.e. Environment - social environment) the user will be provided with a collection of information material and tips on where to seek for more information.

The tool was design with simple design elements to create a common and easy to use everyday tool, as illustrated in **Fig. 14** and **Fig. 15**. The user also will get information on good practice examples. including a draft Action plan containing; 1) Goals and objectives for working with the child; 2) Resources, ways to reach goals and cooperation partners in other sectors, i.e. healthcare sectors for working with the child; 3) Methods to be used, including the Childs' strengths and interests, adaptation of environment, working on inclusive attitude, etc. On an overall level, this represents the initial dimensions of inclusion stages presented in **Fig. 4** and **Fig. 7**. By using a user-centered agile design approach that incorporates workshops, surveys and iterative prototyping, the Digi-Flow design process offered an example of how to involve teachers in the design process and how to use their expertise and ideas about inclusive education to identify key requirements. Digi-Flow provided teachers with essential information in the form of a digital map that responded to the teachers' categorizations of information according to the three dimensions of inclusion (barriers, opportunities and atmosphere).

DigiFlow

Here you answer questions about the student divided into the existing categories. Use the plus-button (+) to expand the containers. Below each question you can see which category it belongs to. If a question have a sub-question it will be shown when an answer is selected. When you have answered all the questions in all containers you will be able to press the submit button. If nothing happens when clicking submit, make sure that you really have answered all questions and try again.

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Child category +

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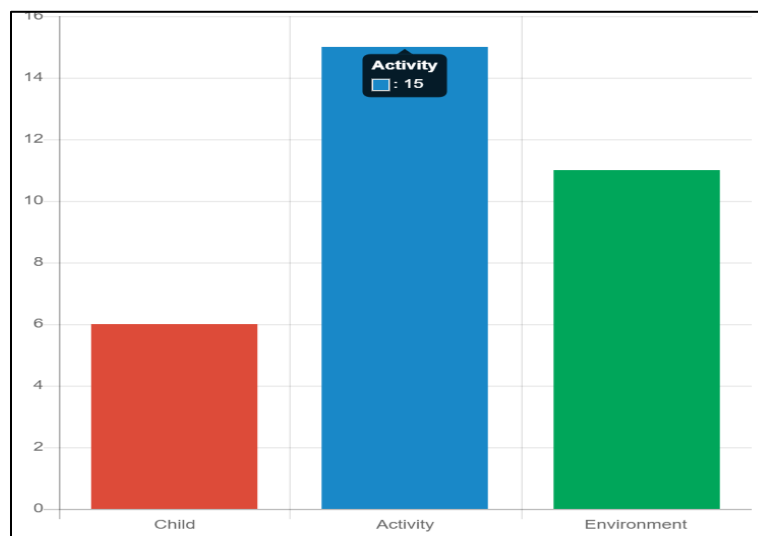
Activity category +

---

Environment category +

Submit

**Fig. 14.** Digi-Flow first page



**Fig. 15.** The Digi-Flow result page

In addition, the focus on teachers in class, who are responsible for providing an inclusive environment for children with SEN. The study's findings have a number of implications concerning creating an inclusive environment for children with SEN from the teachers' perspective. One issue is the teacher's role in identifying the SEN required for each child as a process that requires detailed information from a number of sources that is presented in a structured way that aligns with their views on inclusion. The IoI proved

to be a logical framework that mapped neatly onto the teachers' perspectives and acted, as a communicative device that made it possible for both teachers' and developers to identify the correct resources required, supporting a child with SEN in the Swedish educational context. When it comes to UCD activities, there is no size fits all. The specific context will often include certain unique aspects that require some form of tailored UCD activities. Therefore, during this study the use of UCA activities shows that some questions in the survey were design driven, identifying from a user's point of view what information is needed and if the presented solution was easy to use and thus support users working with SEN on a daily basis.

## 5 Conclusion and Contribution

During a two years research and development period, we realized how using an UCA method supported both developers and stakeholders in formalizing ideas, forming and organization information, which lead to creating requirements that stakeholders could recognize and relate to. This helped stakeholders reflect on previous requirements gathered and provide them with the knowledge needed to formulate ideas, which supported modifying any requirements in further stages. We realized that to support user participation working in an agile framework, it was important to include them in creating objectives and prioritize requirements based on a joint perspective. Thus, the participants helped derive the development process, which also led to a clearer understanding of the users' needs. In conclusion, this study offers an example of how the various aspects of how utilizing a UCA method and including various stakeholders throughout the design process, for example, by obtaining domain specific knowledge from users that can support and categorize requirements. In other words, how potential users', i.e. teacher's, perspective plays a key role. Using the IoI as a means to collect input from various teachers representing the educational sector was a critical design decision. In addition, this framework helped teachers and designers alike in gaining a better understanding of user requirements as well as the teachers' own needs, and lead to the identification of some of the major challenges associated with the process of establishing an inclusive educational environment. The findings that emerged alongside the development of the ICT tool are key insights into how a design project can be part of a larger effort toward inclusion. Moreover, it offers valuable support for teachers involved in the design process, through creating focus points that help them identify their own core values and informational requirements in order for them to provide children with SEN with an inclusive and sustainable balanced learning environment.

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