

# Safety at School Context: Making Injuries and Non-events Visible with a Digital Application

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**Abstract.** Safety and security have for decades remained basic values in the Finnish society. Extreme violence and unintentional injuries at schools have raised the need of more developed measures to analyze the potential risks. The Green Cross application is seen as an example of how to prevent accidents and how to make the non-events visible for the individuals who work at school. The study explores the usability and usefulness of Green Cross injury reporting application. The data is qualitative, based on 10 (n = 10) end-user interviews representing school and day-care staff.

Based on this study the school risks were unpredictable, connected to human factor issues or persons acting against regulations. It looks clear that Green Cross software works quite well for solving physical or structural risks at the school context. However, the software was not very useful when reporting repeatedly happening cases, like aggressive behavior.

**Keywords:** Non-event · Learning environment · Pedagogics · Injury · Usability · Usefulness

## 1 Background

In Finland students' right to safety, security and welfare is mandated in the Basic Education Act "A pupil participating in education shall be entitled to a safe learning environment" [1] A pupil's wellbeing concerns everyone working in the school community as well as the authorities responsible for pupil's welfare services. Extreme violence and unintentional injuries at schools have raised the need of more developed measures to analyze the potential risks. At the same time the society is getting rapidly digitalized. This has happened extremely fast in the learning environment at schools and concepts like *smart learning*, *E-learning* and *virtual classrooms* have been established [2] it has to be noted, that the learning environment is also a work environment for adults such as teachers, school administration as well as cleaning, kitchen or maintenance staff [3], yet an essential part of these activities in school, for instance cleaning, maintenance and food delivery, are outsourced for economic reasons.

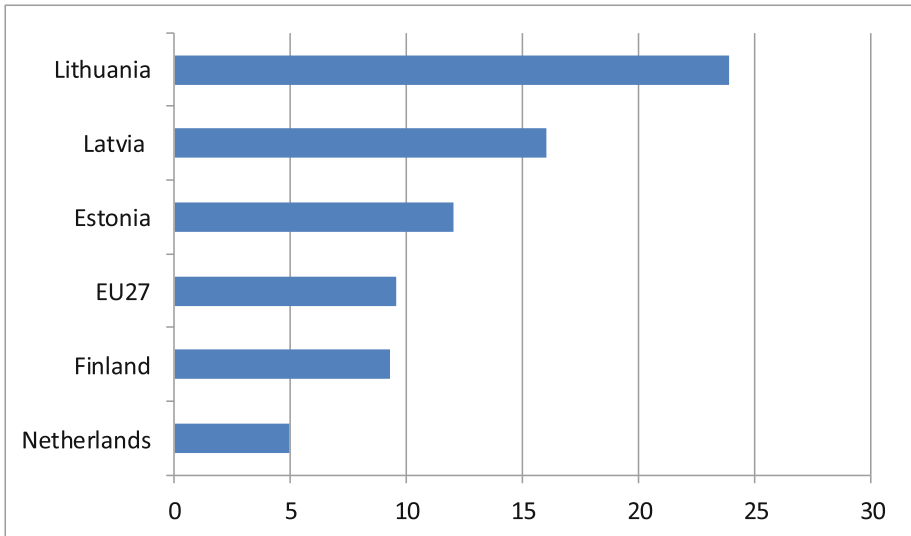
Safety and security have remained as basic values for decades in the Finnish society [4] and therefore safety culture should be visible also during the school day. This paper describes a qualitative that aims to investigate the end-users' perceptions and

experiences of the Green Cross application. In this study school safety and security are seen from pedagogic point of view. This point of view includes the structured learning environment, people and practical solutions made at the school as well as the curriculum all of which create a functional context for teachers' actions. In this study the emphasis is put on the structured learning environment, social issues and practical safety solutions. Accident is an event in which a person dies, is severely injured or sustains a less serious injury. The concept contains two components: the event and the injury [5].

In general, school is a safe place for children and adolescents. Despite the injury reductions and safety improvements over the last 20 to 30 years, injury remains a leading cause of death for children and adolescents in Europe. The child and adolescent injury death rates have decreased also in Finland during the last decades, but the figures still remain almost twice as high as rates in the Netherlands, one of the safest countries in Europe (Fig. 1).

Injury is a leading cause of death among children and adolescents aged 0–19 years in and annually about 2800 Finns die accidentally [7], however the most of the children's injuries happen during the leisure time. The most common types of accidents leading to death among children aged less than 15 years are traffic accidents, drownings and other suffocations [8].

To enhance injury prevention, the process that leads to an injury needs to be studied. We need to know exactly where, when and to whom these injuries happen. [9] The recent studies show that neither incidents nor near-miss cases are systematically recorded or monitored at schools. This can be one reason why preventive actions are not carried out precisely. Yet there are various multi-sectoral target programs and



**Fig. 1.** Injury deaths for children and adolescents, Europe adjusted rate per 100 000 population 0–19 years [6].

action plans for safety and injury prevention in Finland, the most essential of these has been The Internal Security programme that will be replaced with *The Internal Security Strategy* during this year [10]. These strategic documents describe a strong leadership to support the existing infrastructure on children and adolescent safety. More emphasis should be put on implementation of the plans and programs. In these programs, it is recommended to monitor injuries and develop reporting systems for the local needs [11, 12].

On the other hand, accident prevention consists of working towards being accident-free. It is challenging to promote safety, when nothing has happened. Freedom from accident, a non-event, can always be deemed to be a successful end result. Accidents can be prevented, from the top, for instance from an administrative level, or from the bottom, for instance local or individual level. [13] The application presented in this study works both ways, from the school administration to school when analyzing the risks and from the the bottom, school level, when reporting them. However, the focus in this study is at the the school level. For each serious accidental injury there is a number of milder injuries. Only the part of accidents that results in serious physical or material injuries are recorded in the statistics [8]. At the moment there are no nation-wide statistical system that would cover the school injuries and near-miss cases. The Green Cross application that is explored in this study, is seen as an example how to prevent accidents and how to make the non-events visible for the individuals who work at the school for the parents as well as pupils.

The study questions in this study are: How is the Green Cross software used in the pilot schools? What kind of injuries are reported? Is the Green Cross suitable for reporting and analyzing the injuries and near-miss cases in the school context?

## 2 Conceptual Remarks on Usability

Usability is introduced in the ISO 9241-11 standard as follows: “Extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” [14]. Nielsen [15, 16] describes the concept of usability with term usefulness. He states that usability of the software consists of how efficient the software is to use, how it recovers from errors, enjoyability, visually pleasant dimensions, memorability and satisfaction [15, 16]. Sharples [17] suggest that usability should be studied by three dimensions: usability (will it work); effectiveness (does it enhance the activity) and satisfaction (is it liked). Also there is often a strong link between usability and acceptance [18]. Since this study is focused on social rather than technical factors, the study design here contains user interviews with a concept of usefulness. The concept means hear also user experience; possibilities and weaknesses. Therefore the traditional usability content with technical specification like mentioned in ISO 9241-11 or Nielsen’s definitions are partly faded.

This study is focused in the usefulness and usability questions of the Green Cross application that is web-based work-flow software designed for developing safety culture in educational organization. The project started by designing a tool for safety promotion, problem solving, practical actions and risk management in such way that the safety and risk information could be visually shared at the unit. The software was

designed in co-operation with school authorities as a part of regional quality assurance work in five communities. Principal and school administration is in essential role when bringing the safety culture in practice. Safety culture and safety measures at school lie deeply on principal's shoulders. In the schools involved in this study the decision of using Green Cross software was done at municipality level and the end-user teachers could not make any choice whether to use the application or not.

### 3 Description of Green Cross Risk Reporting Application

Green Cross visualizes the incidents of one calendar month in an easily interpretable format. The screen indicates one calendar month at a time divided into 30/31 units (days). This view is made available to all users so that the whole community can easily see the safety situation in one view. If no incidents have happened, the units in Green Cross remain green. When an incident has occurred and is reported, the units change color according to the classification of the incident. The colour will turn red if the reported case is an actualized event such as an injury or accident, or alternatively yellow in a near miss case. This color-symbolized visual form provides a picture of the safety situation in one glimpse (Fig. 2).

During the cause and risk analysis phase the working methods, people, machines and other physical environment, material and knowledge matters are discussed and

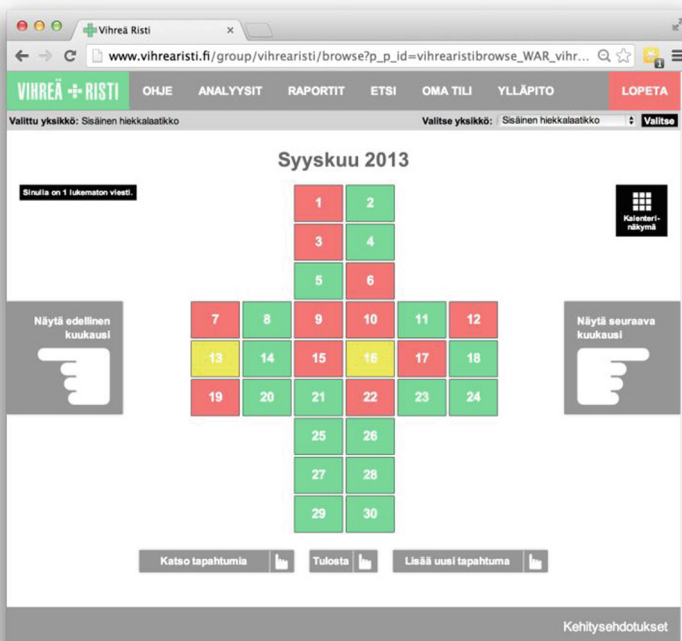


Fig. 2. Screenshot of the basic Green Cross screen



Fig. 3. Screenshot for cause and risk analysis of the Green Cross tool

analyzed in order to understand how the event happened (Fig. 3). Once the reported incident has been analyzed and the agreed safety improvement measures implemented, the analysis is marked complete. The software also provides injury reporting capabilities of all the school units in one municipality.

There are three basic phases in Green Cross safety improvement process: incident reporting; cause analyses and problem solving. The quick incident reporting phase takes approximately 2–3 min, in which a basic description of the case is noted. This paper discusses the usefulness and usability of Green Cross application with the aid of qualitative data. Firstly, it explores what kinds of injuries are reported with the help of the application, secondly the practical actions carried out after the reporting in the monitoring process and thirdly how the product works. The reported risks are dangers, injuries, accidents, violence, bullying or problems at work processes.

## 4 Methods, Sample and Study Questions

The aim of this study was to examine user experiences, views and definitions of Green Cross software end-users. Since the main approach was qualitative, a structured open-response, semi-structured thematic telephone interviews were carried out during the spring 2015. The content of the interview was based on the idea of usability, effectiveness and satisfaction and the interview questions were based on these concepts. Examples of the interview questions: How do you use the Green Cross software? What is a typical case reported with this software? (usability); Do you think this program can be used to eliminate the risks at your school? How well the program is working for your purposes? (effectiveness); How would you develop the software further? Do you

think you could use another method to report and analyze the risks in your school? (satisfaction).

The data were transcribed and analyzed with qualitative content analysis. The study used grounded theory to describe the end-users' perceptions on data usefulness and usability. Two specific actions were completed to get the preliminary conception of the software Green Cross. Firstly, to formulate the semi-structured interviews, a preliminary interview was carried out. The key informant, preliminary interviewed, was a person who is specialized for the design of the Green Cross software. This interview was done to get the preliminary conception of the software in this study. Secondly, the researcher, who was involved with the interviews, learned how to use the software Green Cross.

The sample consisted of 10 ( $n = 10$ ) software end-users who had been using the Green Cross software two to three years for reporting risks at school. Persons interviewed included teachers, principals, as well as preschool and school administration who worked at the comprehensive school in Pirkanmaa district, which had piloted the use of Green Cross software. The persons that had been involved with the use of Green Cross were chosen as key informants in this study. The average age of the responders was 51.8 years, average working years within education being 22. The average amount of people at the school where responders were working was 337. Of the schools involved in this study 2 were elementary, 6 upper secondary, 1 kindergarten. One of the responders represented school authority.

## 5 Results

Firstly the study discussed about the usability as a process. All the responders had participated in an education event for 60–120 min for using the software in the beginning of the school year. Some of them were offered additional lessons on a yearly basis. The basic idea of the process was quite similar in all the communities participating in this study.

The reported risks were processed in weekly teacher meetings or additional risk group meetings where the aim was to find out why the risk situation happened and how it could be prevented. A typical case was an injury, accident or an act of violence with/involving a human factor (Table 1).

Totally 38 risk cases ( $n = 38$ ) were mentioned at the interview of 10 respondents. 21 % (8) of them were near-miss cases. The most typical case that was reported was a failure or malfunctioning of the school property or product.

Examples of the cases reported with Green Cross tool are here classified in five groups (Table 2). The classification is based on a modification of the injury reporting system of the Finnish Rescue Services (PRONTO) [19].

The responders reported that the most common case was a violence based event caused by students, such as aggressive pushing, fight or carrying a knife at school. In the injuries class, the winter time injuries are typical, and also the unpredictable happenings with a human factor. It seems that most of the cases reported are physical or visible.

**Table 1.** Injuries, accident of near-miss cases at the responder interview

Injury, accident or near-miss	f	%
Trips, falls, risky behaviour	4	11
Slips	4	11
Violence, aggressive behaviour	5	13
Unsuitable object	1	3
Structure, property	10	29
Illness	6	16
Traffic	3	8
Other	4	11

*Interview number 1 (II): “A typical case is when two students start to hit each other. Also during the sports lessons injuries are typical. - -Since there is very limited space at the corridors, in the analyzing session we started to find solutions for how we could have less students going outside at the same time.”*

Also the practical actions were discussed during the interview. According to the responders it was important to continue the analyzing process after the reporting phase. Basically, the analysis consists of the question; “Why did this happen and how could we avoid this next time?” One of the strengths of the program was the visibility and clearness – the overall safety situation could be seen in one glance. The responders reported about the practical solutions done after Green Cross analyze discussion (Table 3). Also it was stated that Green Cross was the first program where near miss cases were systematically collected.

*II: “When the risk situations are collected and reported, everybody gets to know about what happened. It is important to continue the process to the analyzing phase, if that doesn’t happen, it is just another program.”*

*16: “Prior to this program we were using paper forms to report the risk cases and near misses. It is not as easy to get the whole picture of the situation by reading through the papers. Also it is possible to add pictures to the reports and that is very useful.”*

**Table 2.** The reported Green Cross injuries, accidents and near miss cases

<b>Violence:</b> violent behavior, a knife found in student’s clothing, bullying, student throwing objects, other aggressive behavior, a student escapes from the school,
<b>Injuries:</b> icy or slippery surface, a head hit to a stone wall, student fell down at a playground, finger injured by door, teacher was hit by hard baseball, student ran through window glass, student jumped down from storage building roof, allergic reaction, student’s head got stuck between the wall and the staircase
<b>Structural or technical failures:</b> bad acoustics, broken handrail, school door was open, cleaner’s school keys were stolen, electrical appliance was broken, loose object in the door, indoor air pollution issues
<b>Accidents:</b> car accident, student’s work jacket caught fire during crafts lesson
<b>Near miss:</b> student was about to get injured in the angle grind machinery, allergic child got wrong food, vehicle was speeding at the school yard

**Table 3.** Cases and solutions in a Green Cross analyze phase

Case or near miss	Solutions after Green Cross analyze
Fights in crowded corridors when going to recess	Flexible time table, re-scheduling rush times
Student climbed and jumped off the roof during the recess – severe injury	Supervision changes during recesses, CPR training for the supervisors, modifications to roof access
Near miss: an allergic person got wrong food	Additional education material for substitute workers, better process description for the food delivery staff
Student was stuck at the staircase	Technical department was contacted, additional installations to the staircase
Student’s unpredictable aggressive behaviour	Code word for announcing the staff to respond
Work jacket got on fire during craft, design and technology lesson	New and fire-proof working jackets for students
Child ran through the window	More durable window with markings installed
Near miss: a student was about to hurt his hand when using a lathe (turning machine)	New method of working with machinery introduced

The responders reported a few challenges using Green Cross reporting program. Remembering the password when starting to use the program seemed challenging. This was difficult, because the responders were not using the program on a daily basis. It was not clear for the responders who would need the reports and whether the information was needed outside the school or not. Some considered the software as double reporting; it was suggested that there would be a possibility to print forms in the precise format required by the insurance company.

*12: “A grey panther – as an old worker it is difficult to remember all the passwords when you don’t use the software more than a couple of times a year.”*

*17: “- - We can learn from each other and look at the reasons without blaming anyone. Still some of the workers here think that this process is not necessary and we also have workers who are not so used to use computers this way. But I think by reporting the cases we have a possibility to prevent the accidents and injuries.”*

For some schools and some users, on-line reporting felt difficult. They hoped that Green Cross solution would also classify the risks. This was reported to make the process easier. Also when talking about children with special needs there are continuous risk situations during the day and the users hoped there would be a possibility to combine the cases in a way or another. Despite of these weaknesses all the users believed that the software was helping them to raise and enhance the safety culture at the school.

*17: This program wakes you up, otherwise my table would be filled with little notes and part of them are forgotten forever. This program keeps me in the map, what’s going on in the school.*



One of the issues taken up by the responders was compatibility. The program seemed to work well when reporting the near-miss cases. However, the compatibility was considered poor. After an injury, teacher would first write a report for Green Cross, in addition for school administration program Wilma and thirdly write a report for the insurance company. Responders suggested possibilities for developing the application further. Some of them also wished Green Cross could be used with a mobile phone.

*15: It would be best if this application could be connected to the school administration Wilma program to avoid double or triple reporting. It is also difficult to add any pictures to Wilma. Green Cross gives a holistic picture of the safety situation and the information can be disseminated to everybody who works at the school.*

*16: Pretty often it is the same student or situation that causes all the events. I really hope it would be possible to connect these cases. Otherwise, when reporting, we have to start from the beginning every time.*

## 6 Discussion

This study examined a novel application of web-based technology to enhance schools in promoting safety and reporting injuries, accidents and near-miss cases; the actions carried out after the risk monitoring process and how the product itself works in reporting injuries, violence and near-miss cases.

Findings presented here indicate that the usability and the effectiveness of the software is fairly good. According to the responders of the study, Green Cross is a well-designed program that has the potential to monitor and analyze the risks that would not be analyzed otherwise. The most typical injury during the school day was around structural issues, for instance broken or malfunctioning property. In addition, many school risks were unpredictable, connected to human factor issues, persons acting against norms and regulations or using structures or products in a way they are not supposed to be used. This makes predicting the risks challenging. Green Cross solution provided equally and efficiently a documentation of the whole safety situation in the learning environment. About one fifth of the reported injuries were near-miss cases. Especially these risks could be reported with the help of Green Cross application. These cases would not be reported with any other process at the school context. If a systematic process for school bullying needs to be established with the Green Cross tool, the issue should be better supervised and mentored.

## 7 Conclusions

The end-user perceptions on the Green Cross software with three main concepts, usability, satisfaction and effectiveness, were explored. Green Cross provided a road-map and an analyzing method for monitoring and preventing risks. The responders reported cases after which practical actions were carried out. These actions were, for instance, changes in supervision or technical issues. Practical measures can be seen essential for enhancing the safety culture [20–22].

When developing risk analysis solutions for learning environments, a special attention should be paid to satisfaction and acceptance dimensions. The quick incident reporting system was considered very useful, whereas very basic abilities such as memorizing the password were considered challenging due to the nature of teachers' practical tasks during the day [see also 23]. Also, part of the staff such as cleaning or kitchen personnel are not familiar with computers. Some users hoped that the software would become more accessible, for instance applications for phone or other device and also some responders hoped they could have insurance forms in printable form as a part of reporting Green Cross. Based on this study it looks clear that Green Cross software works quite well for solving physical or structural risks at the school context. Yet the software was not very useful when reporting repeatedly happening cases, like aggressive behavior where no new measures could be taken any more. Making the Green Cross application more visible would probably encourage teachers and other staff to report more often. It is important that the administration gives support to data usability to gain sustainability at the program use. This would make the data more comparable within the community.

The results indicate that there are structural and unpredictable incidents and every-day accidents at school, caused mostly by unpredictable human behaviour. In the school context it is vital to consider also other risks than injuries, such as violence and other mental health issues. By monitoring and analyzing the near miss cases it could be possible to prevent accidents to escalate. However, there is still need for more supervision and encouragement to use the software more actively on an every-day basis. It seems, that the user activity goes down, if the personnel is not encouraged to use the application in a sustainable way. As the personnel gets the image that reporting can make the change in safety culture, it would encourage more people to use the software. When designing such software for a learning environment use, usability should be considered as easily accessible tools would probably be more efficient at schools. As a core conclusion it was found that structural risks, unpredictability and the human factor dominate the risks at school. This sets challenges when monitoring the risks. With the help of the Green Cross tool it is possible to make safety culture more visible. This also enables learning from risks and not by shocks.

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