Designing web-based learning opportunities for children related to health care

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Abstract

Background
Hospitalisation is a significant and stressful experience for children and parents which may cause both short-term and long-term negative consequences. Web-based preparation programmes to reduce these stressful experiences that encompass children's learning processes should help information exchange and understanding. The Anaesthesia-Web was created to meet the needs of children and parents when preparing for anaesthesia and surgery.

Objective
The objective of this study was to elucidate key educational principles when designing web-sites for children and parents in the health care context.

Methods
A directed qualitative content analysis was applied to illuminate and explain prerequisites for learning on the Anaesthesia-Web. The educational concepts of pre-understanding, motivation, learning processes and the outcome of learning were used to analyse the learning possibilities of the Anaesthesia-Web for children prior to contact with health care.

Results
Four themes characterising children's learning opportunities on the Anaesthesia-Web were found in the analysis: "In charge of my own learning"; “Discover and play”; “Recognise and identify” and “Getting feedback”. The analysis showed that the Anaesthesia-Web offers children control and enables use of the web-site based on interest and ability. This is important in terms of motivation and each child's individual pre-understanding. Through discovery and play children can receive, process, and apply the information on the Anaesthesia-Web cognitively, emotionally and by active participation. Play stimulates motivation and is very important in the child's learning process. When facing hospitalisation, children need to develop trust, and feel safe so that they can focus on learning. On the Anaesthesia-Web children can recognise situations and feelings and can find someone with whom to identify. Several features on the web-site promote feedback which is necessary to judge the learning achievements, confirm understanding and the need for repetition.

Conclusion
Web-based preparation programs are important health care learning resources for children and parents. Content and design need to change from simply providing information to embracing the importance of the child’s need to process information to learn and fully understand. By developing web-based preparation programs that include educational principles, web-based technology can be used to its fullest advantage as a health care learning resource for children and parents. The four educational themes described in this study should help future similar website developments.
Introduction

Hospitalisation is a significant and stressful experience for children and parents, which may cause psychological and behavioral consequences, complicate cooperation and treatment as well as future dealings with medical services [1-4]. Hospitalisation includes new experiences and routines and often results in separation from home, familiar objects and family members. The child may also undergo painful examinations and treatments and may fear body injury and physical restrictions [5-7]. Anaesthesia and surgery are some of the most stressful events for children and parents while in hospital [8-10]. In terms of impact, children with preoperative anxiety and stress are at higher risk of developing postoperative excitement, distress, nausea, increased levels of pain and analgesic exposure and delayed hospital discharge during the early postoperative period. Many children also show late reactions in the form of nightmares, separation anxiety, eating disorders and temper tantrums within the weeks following anaesthesia and surgery [2, 4, 10-12]. When a child is hospitalised, the entire family is involved. Parents experience significant anxiety and stress from their child’s condition and a child’s level of anxiety and stress is related to that of the parents [10, 13]. Children have many questions about a forthcoming hospitalisation. They want to get information to understand their illness and be involved in their own care to prepare themselves for procedures [5, 7, 14-18]. Preparation for a forthcoming hospitalisation is important to decrease children's and parent's distress and anxiety for medical procedures [8, 19-22]. Adequate preparation is also of importance in developing an adaptive coping response, to generate accurate expectations and for reducing uncertainties and inconsistencies between fantasy and reality [3, 19-21]. The digital age is upon us and fully integrated into everyday life. In Sweden, 92% of the population has a computer, 93% have access to the internet, 56% own a tablet and 77% a smartphone. Most families with children (87%) have multiple computers, tablets and smartphones. The age at which children start using the internet is notably earlier nowadays (67% of two year olds) and the proportion who use it daily increases with age (32% at age 2 years, 50% at age six years, 75% at age 10 years and 96% of teenagers) [23]. The internet is a rapidly emerging source of health service and health care information [24]. Web-based technology has been shown to efficiently convey information in a number of health areas [21, 25-29]. Tailored multimedia combining text, animation and video has been shown to be an effective support to the information provided by the anaesthesiologist to adult patients [30]. Children who received a preoperative educational multimedia intervention combining film, modelling and interactive game activities, reported lower levels of worries about hospitalisation, medical procedures, illness and negative consequences compared to a control group [31]. A web-based tailored preoperative preparation programme has been reported to be well received by children and parents as an effective intervention for reducing preoperative anxiety [32]. Preparation programs for children and parents involve more than delivery of information because receiving information does not mean one has learned and understood. Learning is a process about constructing one’s own understanding [33, 34]. Children need to process information about their illness and health to learn and fully understand [35, 36]. Preparation programs for children therefore have to change focus away from simply the giving of information to encompass learning processes. To meet child and parental needs for preparation before surgery and by taking advantage of the learning opportunities provided by web-based technology, the
Anaesthesia-Web [37] was created. In this article, the content and design of the Anaesthesia-Web are analysed from an educational perspective to inform children’s web-based learning in a health care setting.

The Anaesthesia-Web

The Anaesthesia-Web (Figure 1) represents a comprehensive, interactive, age-appropriate, multimedia web-based portal to prepare and educate children and families prior to contact with health care. On the Anaesthesia-Web children can learn about the body and how it works, what it is like to be hospitalised and what happens before, during and after anaesthesia and surgery.

Figure 1. The Anaesthesia-Web

The content and design of the Anaesthesia-Web

The content of the information provided on the Anaesthesia-Web is based on evidence and clinical experience from different contexts including medicine, children’s cognitive developmental science and web-based technology. Common concerns from children and parents before hospitalisation include separation, loss of control, needle sticks, pain and risks associated with anaesthesia and surgery [5, 7, 14, 15, 38]. The web-site aims to provide learning possibilities as preparation for these scenarios with information for toddlers, school children, adolescents and parents. The Anaesthesia-Web is in two different parts which intentionally are not traditionally termed “For Children” and “For Adults” but instead to “Read” and “Experience”. The Anaesthesia-Web contains a wide range of communication modalities such as films, cartoons, web-books, games, blogs, videos and interviews with children of different ages. Two characters, Doctor Safeweb (Figure 2) and Hilding Vilding (Figure 3) are key features of the Anaesthesia-Web. Doctor Safeweb is available all over the web-site to guide visitors and to answer frequently asked questions. He conveys all information in both writing and with recorded narration. Hilding Vilding works as a curious spy scout in the hospital. He is as tiny as the palm of the hand which means he can be present everywhere and investigate everything without being discovered. Two notice boards are available on the Anaesthesia-Web, one for younger children and one for adolescents. On the notice boards children can ask each other questions and share experiences in text, drawings, paintings and photos (Figure 4).
The information on the Anaesthesia-Web is generally applicable which means the web-site can be used regardless of the health care setting to which the family presents. The Anaesthesia-Web is available in Swedish and three major world languages (English, Arabic, and Spanish) and contains written information in 27 languages. The Anaesthesia-Web has open access via three different URL addresses: www.anaesthesiaweb.org, www.webanestesia.org, and www.narkoswebben.se.

The development of the Anaesthesia-Web

The Anaesthesia-Web was developed and produced by a multidisciplinary team including health care professionals, computer programmers, web-designers and web-design students, journalists, authors, TV-producers, advertising agencies and photographers recruited from children’s magazines and TV shows. The adolescent parts of the web-site were created together with a popular Swedish author for this age-group and were enriched with their own design. The team also included parents and children of different ages, with different experiences of health care and hospitalisation. The content and design of the web-site were approved before publishing by the Anaesthesia-Web panel which included members from all these groups. The multilingual work had a central role during the development of the Anaesthesia-Web and translations of all manuscripts were performed by authorised translators with experience of medical work. The recordings involved around 25 native speaking actors per language.
in appropriate ages for all the characters. A native speaking person for each language was responsible for proofreading the translated texts and providing translations for the programmers during the implementation phase.

**Previous evaluations of the Anaesthesia-Web**

In order to understand the functionality of the web-site, data on total numbers and geographical distribution of the visitors, most visited parts of the web-site and visitor’s interactions on notice boards were registered continuously and analysed descriptively over a period of five years (2009-2013). Visitors were registered by means of their IP-addresses and search engines and web-sites with a ping back were also registered. All statistics were collated using the AW stats tool, a log analyser generating advanced web, streaming, ftp or mail server statistics graphically. The Anaesthesia-Web had an average of 120,000 visitors from approximately 100 different countries annually. The number of visitors were equally distributed over the years, months of the year and days of the week. Visitors from the “Top 10” countries are listed in Table 1.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>Sweden</td>
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<tr>
<td>2.</td>
<td>Norway</td>
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<tr>
<td>3.</td>
<td>Russia</td>
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<td>4.</td>
<td>USA</td>
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<td>5.</td>
<td>Ukraine</td>
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<td>Thailand</td>
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<td>Finland</td>
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<td>8.</td>
<td>Japan</td>
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<td>9.</td>
<td>Rumania</td>
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<td>10.</td>
<td>Turkey</td>
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</tbody>
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Table 1
Visitors from “Top 10” countries March 2016

Around 300 different web-sites link to the Anaesthesia-Web. Most visitors find the web-site via the web-address (51.7%) and search engines (42.3%) and the rest via other web-sites (6%).

The most common key word combinations for finding the Anaesthesia-Web on search engines are: *anaesthesia and children*, *anaesthesia and risks*, and *risks with anaesthesia*. Analysis of the “Top 5” most visited parts of the Anaesthesia-Web, during November each year between 2009 and 2013 showed that the most popular parts of the web-site have stayed quite stable during the years. The interactive parts of the Anaesthesia-Web were most visited in the “playful” part and general information about anaesthesia in the written part of the web-site.

In our previously published randomised controlled trial, including 125 children and parents undergoing out-patient surgery, the Anaesthesia-Web was compared with conventional printed brochure material. A set of six questions was assembled for children as well as for parents. A prerequisite was that a complete answer to the chosen questions should be available both in the web-based option and the brochure material. All questions should be relevant to anesthesia. The primary end-point was to
compare the total question score of correctly answered questions in children between the two options. Secondary end-points were the total question score for parents, and the influence of age, gender and time between the preoperative visit and day of surgery. The main conclusion was that web-based interactive preoperative preparation results in higher total question scores in both children aged 3-12 years and their parents, compared to conventional brochure material [39]. Since the Anaesthesia-Web has been well received we conducted the following educational analysis to help the design of future similar websites.
Methods

A directed qualitative content analysis [40] where the analysis starts with a theory or relevant research findings as guidance for initial codes, was applied to illuminate and explain prerequisites for learning on the Anaesthesia-Web. As a first phase of the analysis the learning concepts Pre-understanding, Motivation, Learning processes and Outcome of learning were chosen and described (see Supplementary Appendix). In a second phase the learning concepts were systematically applied on the Anaesthesia-Web to identify salient learning opportunities. In the third phase, the salient learning opportunities were scrutinised in relation to the learning concepts, children’s learning in the context of health care and web-based learning. An iterative analytic process identified the four themes: “In charge of my learning”, “Discover and play”, “Recognise and identify” and “Getting feedback”. The designation of the themes mirrors the child’s perspective of learning. The research group comprised experts with different perspectives on web-based learning, medical education, technology-enhanced learning and specialist nurses within paediatrics and anaesthesia. Two researchers (GL and CS) performed the initial analysis and the whole group negotiated and agreed on the results to increase trustworthiness using qualitative research methods [41].
Results

In the analysis of the Anaesthesia-Web related to the central learning concepts pre-understanding, motivation, learning processes and learning outcomes (see Supplementary Appendix) we found four themes related to children’s learning on the Anaesthesia-Web: “In charge of my learning”, “Discover and play”, “Recognise and identify” and “Getting feedback” (Table 2).

Table 2
Themes related to learning concepts on the Anaesthesia-Web

<table>
<thead>
<tr>
<th>In charge of my own learning</th>
<th>Discover and play</th>
<th>Recognise and identify</th>
<th>Getting feedback</th>
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</thead>
<tbody>
<tr>
<td>Pre-understanding</td>
<td>Motivation</td>
<td>Pre-understanding</td>
<td>Motivation</td>
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<td>Motivation</td>
<td>Learning process</td>
<td>Motivation</td>
<td>Learning outcome</td>
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<td></td>
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<td>Learning process</td>
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Theme 1: In charge of my own learning

This theme involves the central learning concepts pre-understanding and motivation. Based on their level of knowledge, interest and interpretation children themselves can decide where to start and how to use the Anaesthesia-Web. This allows them to be in charge of their own learning which is an important motivational factor. Instead of classifying children as one equal group, the Anaesthesia-Web acknowledges children as a diverse group in which the need and format for information differ. All information on the Anaesthesia-Web is adapted to children’s different cognitive and developmental stages, for example the vocabulary, length of stories and films, the configuration and design of characters and their expressions. However, there are no signs connected to age on the Anaesthesia-Web and so it is up to everyone to choose what and how to use the content provided.

Children’s past experiences of sickness and health care vary and the Anaesthesia-Web enables children to put their previous experience into a new frame of reference and make their thinking and learning profound. The Anaesthesia-Web contains a wide range of multimedia such as films, cartoons, web-books, games, blogs, videos and interviews with children in different ages. Here, children are able to take part in a hospital adventure together with the hospital's clowns, potter around and paint, creating their own operating theatre, watch a film and meet children with different experiences of hospitalisation. On the notice boards children can ask each other questions, express and share experiences in texts, drawings, paintings or photos. There is also information on different forms of anaesthesia, sedation, pain alleviation and answers to frequently asked questions from children and adults. Parents get suggestions on how to prepare both themselves and their children prior to the hospitalisation.
The Anaesthesia-Web can extend children’s ability to learn by enabling exposure to ideas and experiences that otherwise would be inaccessible. In “My own Operating Room” (Figure 5) children can construct their own reality by taking command and choosing what procedures they want to experience and what professions they want to play. Maybe they want to change roles being nurses or doctors. The Anaesthesia-Web provides children with tools to break the artificial isolation from real-world situations. They get the opportunity to experience roles in a real-life setting and at the same time learn about the setting itself.

Figure 5. My own operating room

Doctor Safeweb and Hilding Vilding, central characters on the Anaesthesia-Web, support the children to take charge of their own learning. By conveying all content in both writing and with recorded narration, children with special needs, hearing and visual impairments and reading difficulties, are given equal access to preparation and learning. For immigrant children all information on the Anaesthesia-Web is available in Swedish and three major world languages (English, Spanish and Arabic). Doctor Safeweb, Hilding Vilding, all characters and animated animals are fluent in these languages.

**Theme 2: Discover and play**

This theme involves the central learning concepts **motivation** and **learning process**. The content on the Anaesthesia-Web is mediated by playful interactive elements to stimulate children's natural curiosity, knowledge seeking and motivation, factors which all are crucial to initiate and maintain the learning process. Children can use play to seek new knowledge and make events possible to understand. The interactive parts of the Anaesthesia-Web enable children both to prepare for upcoming events but also to process what has happened. On the Anaesthesia-Web children can learn and experience how to give an injection, how to bandage a wound and plaster a broken leg. They can monitor the heartbeat and measure the blood pressure. In "My own Operating Room" children can decorate and furnish to their own taste. They might want the operating room to have flowered walls and grass on the floor, lying on a pink operating table with comfy pillows or one that looks like a space rocket. They can also try various technical functions such as use of different monitors or operate the suction, surgical lights and tables. The Anaesthesia-Web’s main characters Doctor Safeweb and Hilding Vilding have significant roles in stimulating children's motivation for learning. Hilding Vilding is filled with questions and does not stop asking until he has found the answers. With the answers on hand he is a master of
explaining difficult and complex things in an easy and understandable way. Children can follow Hilding Vilding through an exciting adventure inside the body and play and learn from his colouring and craft book (Figure 6).

Figure 6. Hilding Vilding’s colouring and craft book

At the Anaesthesia-Web children can design and create their own bandage, e-mail it to a friend or print and frame it. When playing the “X-ray” game or the “body memory game” they can learn about the body and how it works and in the “IV game” they can give injections and start IV infusions. In the “Pain-quiz” children can learn how to estimate the level of pain as well as strategies to cope with pain. Multimedia formatting offers choices of interfaces (text, images, sounds and animations) as the use of all senses for processing and interpreting information is known to be beneficial for children's learning.

**Theme 3: Recognise and identify**

This theme involves the central learning concepts pre-understanding, motivation and learning process. The learning process depends on a will to be engaged, interested and to experience the effort as meaningful. Children’s pre-understanding can stimulate their motivation to learn about what is going to happen to them in the hospital but the web-based information can also be a hindrance if the information is frightening or if they don't perceive that it is directed to them. To maintain the motivation to learn they need to experience the visit as meaningful. Recognition and identification are important factors in this process.

The diversity of characters available on the Anaesthesia-Web offer children with different backgrounds possibilities to find someone with similar experiences they can recognise and identify with. The content on the Anaesthesia-Web is non-time-sensitive and without time dependent factors such as hairstyles, clothing and accessories. Characters and their appearance are neutralised and de-identified. A number of characters consists of sick animals and teddy bears undergoing examinations and treatments (Figure 7). Toddlers can identify with cuddly toys and the information for school children is
adapted for this age group's curiosity. Adolescents can get information from others who have blogged about their experiences while hospitalised.

Figure 7. Neutral characters on the Anaesthesia-Web

![Neutral characters on the Anaesthesia-Web](image)

The Anaesthesia-Web doesn’t contain any hospital-specific or procedure-specific information and all interiors are created with generalisable features to help children identify with the information regardless of where and why the child presents for health care. Hilding Vilding has a key role in fostering this: he is afraid but at the same time curious to explore the hospital, has a lot of questions and wants to understand and learn. He gets answers to almost all questions, including the ones children probably would never dare to ask. Since Hilding Vilding always makes himself exhausted by asking even the dumbest questions he allows children to feel that they are always doing better than himself. Hilding Vilding confirms it is natural to be afraid and clarifies that being curious, asking questions and searching for answers is the only way to learn something new and when you have learned something new you often become a little less frightened. In the web-based magazine “Lucas’s adventure” (Figure 8) children are gradually introduced to steps associated with anaesthesia and surgery. By following someone who experiences the same procedures as they themselves will, children are given the opportunity to recognise situations, gain insight and understanding in advance.

Figure 8. Lucas's adventure

![Lucas’s adventure](image)

The notice boards on the Anaesthesia-Web help recognition and identification with others in the same situation. Children focus on their own fears and experiences associated with different medical conditions, hospitalisation, anaesthesia and surgery and those of their siblings and friends. They discuss symptoms, treatments and side effects especially fear of needles, injections and painful
procedures. Fasting routines before and after anaesthesia, and preoperative and discharge procedures are also commonly discussed. On the notice boards for adolescents, discussions are most often about fear of exposing themselves during examinations and treatments, and anxiety about losing consciousness and control.

**Theme 4: Feedback**

This theme involves the central learning concepts *motivation* and *learning outcome*. From an educational perspective, feedback is crucial in giving the visitor the opportunity to test their level of knowledge but also to reduce fear and generate trust and confidence. On the Anaesthesia-Web children get immediate feed-back on their performance and progress without any delay which increases motivation and concentration and retains attention. Doctor Safeweb has a central role in giving advice and feedback when children explore the Anaesthesia-Web. He is available all over the web-site to guide and to give confirmation, feedback and answers to frequently asked questions. By getting feedback on the failure of an idea immediately children have a chance to correct, learn from errors, improve performance and achieve goals. On the notice boards children can participate in discussions and get feed-back to questions from their peers facing similar experiences. On a web-site dealing with sickness and hospitalisation, feedback that promotes trust and confidence is vital. In this, Doctor Safeweb has a warm, secure and faithful personality which encourages the child and parent to maintain their motivation for learning when encountering new and sometimes frightening situations.
Discussion

Web-based information can be interactive and patient-centered but if it is not used with consideration of children’s learning processes it might work only as another source of information. In this article, the content and design of the Anaesthesia-Web was analysed from an educational perspective. The concepts of pre-understanding, motivation, learning processes and the outcome of learning were used to analyse the possibilities for children to learn on the Anaesthesia-Web prior to contact with health care. In the analysis of the Anaesthesia-Web related to central learning concepts four themes were found: “In charge of my own learning”; “Discover and play”; “Recognise and identify” and “Getting feedback”.

Research studies show that web-based activities can be effective for reasoning, problem-solving, recognition of words, concepts and situations at an earlier age than expected [42-45]. Therefore, the multimedia diversity in combination with the visitor’s freedom on the web-site is of importance to stimulate children’s learning based on their varied background, knowledge, abilities and what they find as meaningful. Children need opportunities to learn in ways that work for them [14, 17, 21, 44]. Pre-understanding will direct children’s attention, which might be helpful when navigating on the website but it can also become an obstacle to learning. This complexity is important when designing a web-site for children within the health care context. For many children, the information on the web-site is their first meeting with the health care system whereas others have a lot of experiences which unfortunately are not always positive. Children with previous experience of hospitalisation are not protected from fear. On the contrary their concerns and anxiety are often increased since they know what to expect and previous approaches to solve problems and answer questions may have failed [15, 21]. When designing the web-based learning opportunities it is therefore of crucial importance to consider this group of children. With increasing cultural diversity and global mobility, it is important to be aware that hospitalisation can be a very traumatic experience for migrant children. Language, cultural and religious beliefs and previous experiences of health care and hospitalisation make them in need of specific prerequisites for preparation and learning [46, 47]. By creating opportunities for migrant children to be in charge of their learning in their native language the risk of unnecessary anxiety as well as for misunderstandings will decrease.

Our analysis shows that the Anaesthesia-Web provides crucial prerequisites for any visitor to take charge of their learning. The content is adapted to children with different experiences, background, ages, knowledge, culture, developmental stages and abilities aiming to provide information suitable for everyone. This is in line with educational research which shows the importance of offering opportunities for meaningful learning [14, 17, 21, 44]. The content is presented and designed to provide different kinds of learning opportunities offering multimedia diversity and ease of access for the visitor to make individual choices. By designing multiple approaches to solve problems, answer questions and investigate information, meaningfulness and motivation to learn can be triggered [48]. Research into children’s learning with web-based technology in school shows that computer programmes offer children some control over the learning activities, and provides opportunities for
choices or imaginative expressions, facilitates children’s creative approaches to learning and increases interest and engagement [49]. Children will need guidance and support to get interested and make choices, since it is a great challenge for children to approach the frightening situation associated with preparation for a hospitalisation. On the Anaesthesia-Web this is managed by the two central characters “Doctor Safeweb” representing order and safety and “Hilding Vilding” introducing fun and curiosity, initiating challenges and confirming that it is possible to take different routes to learning and discovery.

The theme “Discover and play” represents the core of the content and layout on the web-site. Discovery and play are inter-related but the concept “discover” contains important additional features for learning. Exploration and play are well documented as important factors in children’s learning and the theme highlights significant educational factors connected to stimulation of motivation and processes involved in learning. The web-site helps the child explore the hospital environment and what is going to happen to them while in hospital. The content and design are developed to stimulate and motivate children’s curiosity, creativity, engagement, incidental learning and active participation and they can approach the situation playfully and by asking questions and finding answers. Play may reduce the pressure or tension associated with achievements or need to learn [50] providing a minimum of risks and penalties for mistakes associated with a hospitalisation. Children’s motivation has been shown to increase when they are involved with engaging and fun web-based technology [49] and computer learning activities can elicit high levels of interest in and focus on the learning task that does not tend to diminish over time [44, 51]. These studies relate to learning in school, but it seems likely that this knowledge is applicable in our target population. On the Anaesthesia-Web visitors are given possibilities to prepare for and process the hospitalisation by accessing information, by practicing skills, functions and procedures and by experimenting with different roles in a real-life hospital setting whilst learning about the setting itself. Children therefore receive, process and apply the information cognitively, emotionally and by active participation. By processing new information and analysing the old, new understanding and knowledge can be constructed [33, 44, 52]. As a tool in the learning process the computer gives the learner specific opportunities for information seeking, communication and processing of information [49, 50, 53]. The use of visualization, modeling and simulation have been proved to be powerful tools to increase children’s understanding of scientific concepts and underlying phenomena [44]. By providing children with tools to help them understand and manage procedures they may be able to transfer what they experience on the web-site to the real world context [50]. This is extremely important when designing a web-site to prepare for a real event. [44, 49, 53-55]. It has also been shown that it is beneficial to engage children in collaborative learning, reasoning and problem-solving activities that had been thought to be too sophisticated for them to understand and carry out at very young ages [45].

The third theme “Recognise and identify” is crucial when preparing for contact with health care. To find it meaningful to enter and use the web-site children firstly need to recognise and identify with the content and characters. Secondly, they need to recognise and identify themselves as a person
needing to learn and prepare prior to a hospitalisation. Building on children’s view of their own thoughts, concerns and experiences of sickness and hospitalisation has been shown to be essential in the development of web-based preparation programs in health care settings [56, 57]. When developing the Anaesthesia-Web a panel of children of different ages with different experiences of sickness and health care were involved. The development of the content together with the target group is important for children’s need for identification with others facing similar situations [14] but also to increase the acceptance and use of the information provided. On the Anaesthesia-Web children can interact with a diversity of characters and find someone to identify with. Accompanied by the safe and trustful character Doctor Safeweb the children are guided and supported to explore step by step the strange and maybe frightening situations at the hospital. The fantasy character Hilding Vilding, acknowledges feelings of fear and worry to help overcome barriers for learning. The presence of notice boards on the web-site helps identification with others facing the same situation. A child’s identity is enhanced by participating in a community or becoming a member of a group [58] and can be a powerful motivator for learning. Identification with others increases interest and engagement, enhances meaning and an increased motivation to learn.

The fourth theme “Getting feedback” highlights possibilities to verify and confirm that the learner has managed, understood, has made progress and gets acknowledgment for achievements and performances. Feedback is crucial for keeping up the motivation to learn and is necessary to be able to judge what you have learned. The best forms of feedback supporting learning involve interactive processes [59, 60]. This is a challenge to accomplish on a web-site concerning preparation for hospitalisation accessed in advance at home. Features promoting feedback on the Anaesthesia-Web include quiz games, answers to FAQs, and performance feedback for practical skills with guidance by Doctor Safweb. The notice board offers the possibility to discuss, share experiences, receive feedback and learn from others facing similar situations. Studies of children’s learning with web-based technology indicate that learning proceeds most rapidly when learners are provided with different levels of challenge, have frequent opportunities to apply the ideas they encounter and when feedback on the success and failure comes most immediately [44]. When designing games, it is important to ensure that the game structure suits the learning objectives. Children seem to like unpredictability, audio effects and games with scoring opportunities where the speed of an answer counts [50]. An improvement suggested by our analysis could be for children to have the possibility to chat and receive immediate feedback on questions and concerns from the hospital.

Implications for designing web-sites for children related to health care

By developing preparation programs based on knowledge and experience of children’s learning processes we believe that web-based technology can be used to its fullest advantage as a health care learning resource. The themes found in the analysis of the Anaesthesia-Web provide a basic structure that captures the key educational features needed to prepare children for contact with health care. Communication with health professionals is an area for further development but opportunities for children to communicate with others facing similar health challenges and experiences is an important
Learning with web-based technology is most effective when there is an active engagement, participation in groups, frequent interactions, feedback and connections to the real world. Identification with others creates interest and engagement which in turn will lead to meaningfulness and an increased motivation to learn about my own situation. Web-based technology can also be a solution for children with special needs for social interactions, communication and learning and to virtually participate in activities that would otherwise not be possible for them. According to social learning theories certain behaviors can be learned and reproduced, under similar conditions, by observing the actions performed by others.

Research, mentioned above, about improvements of children’s abilities of problem solving, abstract and reflective thinking, to analyse and evaluate by using web-based learning activities is well worth looking into to increase learning opportunities for children prior to a hospitalisation. The development of sophisticated computer games has resulted in new approaches to learning principles emphasising the role of elaboration, playing and engagement. Through interactive learning with games, pictures and sounds children receive several associations which help them to remember and assimilate new information.

For adolescents, the Internet has become an important, valued and frequently accessed information source on a range of sensitive health issues. When designing prerequisites for adolescent’s learning it is of highest importance to consider how to meet this group’s pre-understanding by providing the information at an appropriate level, balancing between childhood and the adult world. It is a challenge to develop and iteratively refine systems which both are attractive to catch children’s and young people’s interest, useful and keep the visitor on the web-site. We would argue that you only are given one chance to catch their attention and therefore carefully have to consider how to develop the content and design to be serious and trustworthy as well as secure an active updating. The phenomenon of attrition applies to a varying extent to most e-health interventions. Active updating is an important task which can be seen as the continued existence of a web-site in the sense of keeping visitors interested through continuous adjustments to maintain presence, interest and the web-site as a living tool. Another factor to be aware of is that children of all ages are extensive media consumers which may have resulted in a distorted picture of sickness and hospitalisation. Providing children with reality-based information is therefore important to help them regulate their expectations and allay their fears.

**Methodological limitations**

The outcome of the educational analysis depends on the choice of learning theories and the assumptions about learning they mirror and also how thoroughly they are used to interpret the content and layout on the web-site. To ensure credibility and make it possible to transfer the results, the theoretical perspectives on learning were described in detail (see supplementary appendix) and were applied systematically by an experienced multidisciplinary group.
Conflict of interest
The first author (GL) is the initiator of the Anaesthesia-Web and currently the owner of this non-profit web-site.

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