education sciences

MDPI

Article

An Internet-Based Medicine Education Intervention: Fourth Graders' Perspectives

Sirpa Kärkkäinen [1,*], Tuula Keinonen [1], Anu Hartikainen-Ahia [1], Kirsti Vainio [2] and Katri Hämeen-Anttila [3]

[1] School of Applied Educational Science and Teacher Education, University of Eastern Finland, Yliopistokatu 2, 80100 Joensuu, Finland; tuula.keinonen@uef.fi (T.K.); anu.hartikainen@uef.fi (A.H.-A.)
[2] Faculty of Health Sciences, School of Farmacy, University of Eastern Finland, Yliopistokatu 2, 80100 Joensuu, Finland; kirsti.vainio@uef.fi
[3] Finnish Medicines Agency Fimea, Microkatu 1, 70210 Kuopio, Finland; katri.hameen-anttila@fimea.fi
* Correspondence: sirpa.a.karkkainen@uef.fi; Tel.: +358-40-745-1301

Academic Editor: Eila Jeronen
Received: 28 September 2016; Accepted: 6 April 2017; Published: 11 April 2017

Abstract: Health education, which also includes medicine education, promotes social sustainability in society. Through the context of Internet-based intervention, this study reports on fourth graders' (N = 51, aged 10–11 years) perspectives on medicines, their use with common diseases and medicine-related information sources. The study was qualitative by nature. Data was collected in spring 2010, by audio recording students' group discussions during the study process and group interviews. After intervention, students were well aware of the proper use of medicines and how to find information both on medicines and health issues. The main challenge was finding websites that provide reliable and confidential information. The results of this study raise awareness of a concrete pedagogical approach to health education. The pedagogical approach conducted in the intervention could, to some extent, be transferred to any school setting. This study underlies the promotion of Internet-based health literacy and criteria, for evaluating online health information in the primary school context.

Keywords: medicine education; health education; internet-based education

1. Introduction

The Finnish education system, which incorporates the entire population, is a pillar of social and economic development. Education promotes responsibility, a sense of community, and respect for the rights and freedoms of the individual [1]. Thus, schools are also excellent places in which to promote the health and well-being of children and adolescents. Health education in schools should be developed in accordance with the requirements of three sustainable development aspects: environmental, socio-cultural and economical [2]. In order for social and cultural justice to be taken seriously, health and sustainability must mean equity and understanding between people and cultures, as well as peaceful, unprejudiced co-existence [2]. Health education that includes health knowledge, skills and values, is necessary to meet the challenges of schools both in the present and the future. This study focuses on medicine education which is a less-studied area of health education. The study, in the context of intervention, presents an Internet-based teaching method to promote medicine-related health literacy; it also examines fourth graders' perspectives on medicine use as well as promoting the search for information on diseases.

One of the central objectives of public health and the promotion of health is the worldwide development of health literacy. Health literacy is linked to health habits, health, the quality of life and differences in health [3]. Over the past decade, the interest and academic discourse dedicated to the

concept of health literacy, has escalated enormously [4]. Without doubt, health literacy is an important and expanding topic in contemporary health care, health promotion, health education research and policy development. The probable reasons for health literacy becoming such a hot topic for researchers, health practitioners and educators alike, are essentially two-fold: first, the function of health literacy as an identified public health goal, added to the widely reported relationship of health literacy with behavior and measurable health parameters [5–8]; and second, the portrayal of health literacy as a direct outcome, the aim of health education as a school subject, as well as the outcome of health promotion practices exemplified through the whole school approach [9–12]. Generally, the increasing focus is not only on adult but also on adolescent health literacy [13].

Health literacy is defined as consisting of five core components: theoretical knowledge, practical knowledge, critical thinking, self-awareness, and citizenship. It is emphasized that the two last additional components are called for when the aim is to develop students' internal capacity to construct their own meanings regarding health topics. One of the main aims of health education in schools should be to foster students' ability to define their own beliefs, identity and social relations. Moreover, if it is desired that students should become responsible citizens acting in an ethically responsible way, competencies such as ethical reflection skills should be developed in schools. The development of certain health literacy components may demand specific kinds of learning conditions [12].

As health literacy is linked to health habits, health, quality of life and differences in health [14], poor health literacy is connected with an individual's inability to interpret health-related knowledge, such as the number of visits to the hospital and the incorrect use of medicines [15]. People with poor health literacy have difficulties in understanding diagnoses, are unable to follow instructions on how to take care of themselves as well as poorly benefitting from health care services [14–16].

Adolescents in Finland, as well as in Norway, Poland and Scotland, reported a high level of health-related symptoms; headache, backache, sleeping difficulties, with the intensity of most symptoms increasing with age [17]. Finnish parents reported that their children have a good health status, although approximately one-tenth had experienced some psychosomatic symptoms or long-term diseases [18]. Furthermore, Finland has a high rate of medicine use-related problems [19].

Limited attention has been given to the topic of adolescent health literacy, although (1) future health problems can be prevented by providing health knowledge and skills at an early age; (2) young people, especially those with chronic illnesses, at a younger age take an increasingly greater role in managing their health [20,21]; and (3) many important physical, behavioral, and sexual health issues arise prior to adulthood [22]. Educating children through school health programs is one of the means to develop the critical health literacy recommended in the goals of the EU.

Health literacy includes the skills needed to search for information on health issues, medicine use and diseases. Rational medicine use, the goal of medicine education, is defined as the right medicine taken in the right way at the right time for the right problem. The use of medicines is common to almost all adults and children [23–30], thus children are familiar with the most commonly used medicines and their use [31–37]. Children consider parents to be the most common source of information about medicines [23,34,35,38], other sources being the insert in the medicine package itself [23,39], physicians and nurses [23,35,38,39], and an increased use of the Internet [40].

Most individuals seek health information from the Internet [41]. Use of the Internet for this purpose by 50% of Europeans, has increased significantly in recent years [42]. Despite its advantages, the Internet is also a rich source of potentially alarming information about health and illness [43], especially disturbing for people who are already anxious about their health [44].

In the United Kingdom (UK) and the United States (USA), the Internet is the primary source of general information that adolescents use (11–19 years) and health information is generally regarded as being salient. Its saliency was increased through active searching and personalization. The perceived credibility of the Internet varies because expertise and reliability are sometimes difficult to determine; empathy can be facilitated through online communities but the individual can control disclosure. Internet sources combine positive traditional features of amateur and professional, personal and

impersonal. Although it is unlikely to supplant the role of trusted peers and adults, the Internet has found an important place among adolescents' repertoire of health information sources. Adolescents are interested in finding information about a range of health topics, such as exercise, diet, sexual health, alcohol and drug misuse. Recognizing that Internet information may not be credible, some adolescents have developed strategies to test its reliability. Many also advocate the use of quality marks from well-known institutions. Here arises a hint of contradiction between adolescents' general perceptions of the Internet as a medium, and its specific use for health information [45].

The availability of reliable Internet material that provides high-quality information on mental health may assist young people in need of help to overcome barriers, and to improve awareness of the common symptoms related to mental problems [46]. Although there is significant variation in quality, at best, websites can also provide basic, evidence-based, self-help, and direct young people to sources of professional care [47]. The readability of online educational materials made available to patients also needs to be improved [48].

This research provides new information about Internet-based medicine education in the primary school context. Previous research has mainly focused both on the general aspects of how and why people use the Internet for health information purposes [49] as well as on the perceived credibility of online health information [43,45]. In this study, we are interested in students' perspectives on medicine education intervention, the focus being mainly on the theoretical knowledge about medicines, practical knowledge about the use of medicines, and critical thinking in searching for information on the Internet. The study is guided by the following research questions:

- What students perceive they have learned about medicines and their use?
- What students perceive they have learned about different diseases?
- How students perceive medicine-related Internet information sources?

2. Materials and Methods

2.1. Participants

This study involved a rural primary school in the eastern part of Finland. Three fourth grade classes participated in the study, totaling 51 students (ages 10 to 11 years). The medicine issues included in the research belong to the curriculum and the yearly schedule of the school, thus following their normal daily routines. Each class had their own teacher who was responsible for teaching during the intervention, modifying the case studies to suit the needs of their pupils. Three teachers and five researchers planned the intervention together.

2.2. Intervention

During the Internet-based intervention, students worked in small groups: seven groups in each class (three classes in all). Each group comprised of two or three students. Intervention embodied three phases; (a) the scenario; (b) the Internet-based inquiry; and (c) the compilation. In the scenario phase, each student group became familiarized with one case story; a fictitious person described his/her health problems or injuries and considered issues concerning the use of medicines (Table 1). The stories were aimed to promote the students' interest and motivation by connecting themes on disease and medical use, to a real-life context. The case stories concerned stomach ache, flu, accidents, migraine, snake bite, diabetes and asthma (Table 1). In the Internet-based inquiry phase, the students carried out structured inquiry tasks. From websites given to them in advance (Medicine education websites, the alternative medicine website, Terveyskirjasto website), they searched for information about the case person's symptoms and a possible cure. The aim was to develop students' theoretical and practical knowledge about medicines and diseases, as well as to develop students' critical thinking skills in relation to the use of Internet sources. In the last phase, the students presented to each other their own particular case, and the results and conclusions of their inquiry tasks. There was general

discussion amongst the whole class about how to use medicines properly and the appropriate use of Internet sources.

The medicine education website is targeted at schoolteachers and it is designed to help them educate children about the proper use of medicines. As well as offering a lot of background information about the proper use of medicines and common childhood illnesses, it also includes assignments for different age groups of children, such as role-play about a visit to the pharmacy or a quiz about the proper use of medicines. The medicine education website is available in Finnish and in Swedish at www.laakekasvatus.fi. The idea of an alternative medicine website is offered as a general source of medical information and treatment, which also includes advertisements. The website 'Terveyskirjasto' (http://www.terveyskirjasto.fi/terveyskirjasto/tk.koti) comprises of 10,000 scientific articles about medicines, giving actual information about health and illnesses.

Table 1. Intervention case stories.

Case Story	Health Problems and Issues Concerning the Use of Medicine
Ville's stomach ache	Stomach ache (symptoms, disease and cure)
Veijo's case: How to get reliable information about flu?	Flu (symptoms, disease and cure)
Eetu's case: Once bitten, twice shy	Accidents: Hand wound and sprained ankle (symptoms and cure)
What is wrong with Sonja?	Headache: Migraine (symptoms, disease and cure)
A snake causes a woman serious symptoms	Snake bite (symptoms and cure)
What is wrong with Mikko?	Diabetes (symptoms, disease and cure)
Minna's story	Asthma (symptoms, disease and cure)

2.3. Data Collection

The main data was students' group interviews after the intervention and it was supplemented by audio recordings of students' group work during the study process. Semi-structured group interviews focused on the following themes: (1) medicines and medicine use; (2) disease under consideration; (3) medicine information sources; and (4) working within the intervention. One of the authors held audio-recorded group interviews with students in spring 2010, in a quiet, private room, during regular school hours; the interviews ranged in length from 20 to 35 min. The atmosphere established during the group interview was positive and relaxed and the interviewer tried to encourage students to admit any lack of understanding or anything else that might be unclear. The group interview began by students being asked in general about the medicine education intervention. Students were then asked to define medicine, explain what they had learnt about medicines and diseases, and how medicine information can be found. The interviewer also asked students to expand on particular points of issue. The order of the questions and topics was undefined and depended on the flow of discussion.

2.4. Data Analysis

Students' group discussions and group interviews were transcribed and checked for accuracy with the audio recording, and content analysis [50] was chosen for the analysis of students' descriptions throughout all the data. The answers were received to the following questions: What have the students learned about medicines and their use; what have the students learned about different diseases; and what are the students' perceptions of Internet-based intervention. Two researchers independently analyzed the data in order to create categories and sub-categories. Discussion followed as to whether or not the categories found were consistent. The analysis was quite convergent. An example of such categories and sub-categories can be found in Table 2, concerning what students learned about medicines and their use. A count was made of how many times each category was mentioned during the group interview. Data was analysed in the context of a particular setting and does not represent any absolute "truths" about students' perceptions of medicines, medicine use, diseases or searching for information [51–53].

Table 2. Students' descriptions of what they had learned about medicines.

Category	Number of Descriptions	Descriptions
		Use of Medicines
Adult permission	15	Medicines prescribed by a doctor may not be taken without adult approval (Boy 1) Children may take medicine with the permission of a physician or parents, or even children, of course take some Burana (ibuprofen) (Girl 4)
Medicine dosage	8	The prescription states a safe dosage, and if … (Boy 3) If you take more than the recommended dosage, then you get too much medicine; if you take too little, then you may not be cured (Boy 9)
Label/package instructions	9	In a way that is shown on the label (Girl 12) This means, if it reads e.g., one tablet per day for a specific age-group, then you should take only one; if you take more, then you may have a reaction (Boy 8) So, act according to the instructions on the packages (Boy 13)
Right time to take medicines	3	Take medicine at a certain time (Boy 2) You can take the medicine after a meal (Girl 1)
		Reason
For pain/feeling poorly	16	If you feel that you have headache or stomach ache, then you may take some 'off the shelf' medicine, or … (Girl 8) So if you are sick or allergic or you have a seizure or e.g., flu, then you may take (Girl 13)
Prescribed	6	I have a prescribed medicine, Burana (ibuprofen) (Boy 4)
When necessary	4	You should only take medicines when necessary (Girl 9)
For a health problem	3	If you have a very high fever, then you may take some kind of painkiller or something that lowers the fever, however, not just for only a slight headache (Girl 14)
		Storage
Medicine cabinet	3	In the medicine cabinet. And then there are some that need to be stored at a low temperature. Yes (Girl 7) And some must be locked in the medicine cabinet (Girl 11)
Out of access to children	2	So that small children cannot reach the medicine. (Girl 5)
		At What Age Can You Take Medicines without Parents' Consent
Fourth graders	4	Depends on the medicines. Some medicine for a fever or a cough, yes those can be taken, but if you have... (Boy 9) More serious symptoms (Girl 5) For example you are asthmatic and you get an asthma attack, then, if you don't know which medicines to take, you had better follow the advice of an adult (Boy 10) If your parents have shown you what medicines to take then you may use them, but if you're not sure, then it is not worth taking the risk (Girl 3)
4 year old age-limit	4	I think it was something up to 4 years old (Boy 14)
Ages from 8–12 years	3	You can take medicine I think that 8–12 is a suitable age and adults have their own medicines (Girl 14).
Total	80	

2.5. Ethical Issues

This study is part of a larger research project concerning medicine education, permission for which was granted by the Committee on Research Ethics, at the University of Eastern Finland. Students' views and participation was respected, therefore they had the right to drop out of the project at any stage of data collection. The interviewer highlighted the fact that participation was totally voluntary and during the interview the students could refuse to answer any question. Emphasis was placed on there being no right or wrong answers. The questions presented did not refer to personal illnesses or use of medicines.

3. Results

3.1. What Students Learned about Medicines and Their Use?

The students' group discussions about medicines were quite generalized. Almost everyone had used medicines such as painkillers and education on the careful use of medicine was highlighted. In the interview, students later described what they had learned during the medicine education

intervention. Issues mostly mentioned were related to the use of medicines, the reason for using medicines, how to store them and who should use them. The descriptions could be classified into four categories: use, reason, storage and the suitable age for children to use medicines alone (Table 2). There were 80 descriptions in all.

Students explained that they had learned about different kinds of medicines. They described that if a cough continues, if one has a high fever, or if medicines do not help, then you should contact a physician. Students perceived that you should not take medicines prescribed for others and that it is important to know about the side effects. They spoke about *home care* in the following ways: domestic treatments do not require the presence of a physician, even though, if you visit a physician and ask what treatment can be done at home, he/she may be able to give certain instructions as to what to do.

Students knew the difference between over-the-counter medicines (OTC) and prescribed medicines:

It (OTC) is the kind of medicine you can take yourself. (Boy 21)

Prescribed medicines are those you can't buy without a prescription given by a physician. (Girl 19)

3.2. Students' Descriptions Regarding What They Had Learned about Different Diseases

Stomach-ache was perceived to be due to constipation, the runs, or appendicitis, and medicines should not then be used. Particularly highlighted was the importance of washing hands in order to avoid and prevent droplet infection. Students had acquired a lot of general information about flu, discussing the symptoms and home care for it. They were also able to name some commercial medicines. Flu was considered in a more detailed way after intervention. The difference between flu and influenza was also explained; students mentioned how best to avoid flu. They suggested keeping a distance from people who are sick, washing hands and taking care of your own health. There was very little discussion about First Aid during group discussions and the interview, but students recognized the need for First aid knowledge and highlighted the fact that accidents can be prevented in a number of ways. Students wanted to learn more about First Aid skills either at school or during their free time.

3.2.1. Migraine

At the beginning of the first lesson, students knew that migraine may cause a seizure, nausea, razor-like light formations, and that bright lights should be avoided. Later, they understood that video games and special movie effects might also worsen the situation. They had the impression that taking paracetamol is acceptable but ibuprofen should be avoided, even though both medicines may be used for migraine. Environmental aspects were mentioned in association with treating migraine; they suggested a dark, quiet place, with no bright lights, also mentioning such health aspects as sleeping and eating regularly. It was interesting to note that one of the students had searched for information on migraines at home, and had gathered a lot of facts on the subject.

3.2.2. Snakebite

Initially, students knew asnakebite to be dangerous but were not able to offer any form of treatment in such a situation. Furthermore, they thought that a typical reaction to a snake bite is increased sweating and nausea. The group discussed what should have been done to avoid getting bitten, suggesting that a First Aid kit and the use of rubber boots would have been a good preventative measure. During the group interview, the students were able to explain the symptoms and the First Aid required, in more detail. When a snake bites a person on the leg, the leg swells, the person is nauseous, the location of the bite is tender, bright red, and exhibits two small holes. You should then administer the tablet contained in the First Aid package for snakebites, the leg must be propped up and the patient should not be lifted. Finally, students suggested calling an ambulance, adding that snakebites can be avoided by stomping on the ground, watching where you walk and by wearing rubber boots.

3.2.3. Diabetes

At the beginning of the first lesson, students did not express any perceptions about the cause of diabetes. They described symptoms of weight loss, increased thirstiness, and a more frequent need to go to the bathroom. Later, they stated that you have to visit a doctor regularly, that the person needs insulin, which is injected either into the hand, stomach, or some other part of the body. Symptoms can be avoided by ensuring a sufficient amount of exercise and eating healthily.

3.2.4. Asthma

At the beginning of the first lesson, students had a very narrow comprehension of issues related to asthma, mentioning only that cold air is harmful and that it is worsened by the use of tobacco. A symptom of asthma is coughing and during an asthma attack, you need to breathe the medicine through an inhaler. After intervention, they were able to discuss more widely the different issues related to asthma and highlighted that asthma is a common, long-term disease among children. Environmental pollutants (dust, smoke) as well as the quality of outdoor air, were mentioned as being factors that may affect the severity of asthma. The students also knew that ibuprofen may worsen an asthma attack. Later, they broadened their perceptions of the symptoms, mentioning a prolonged cough and difficulty in breathing during an attack. They knew that prescription medicines such as Ventoline (salbutamol) are needed to combat asthma, but also spoke about OTC-medicines, First Aid and home care. According to students, 'you should remain calm' in order to control the symptoms.

3.3. Students' Perceptions about Searching for Information on Diseases

At the beginning of the first lesson, students considered that sources of reliable information could be acquired from a doctor, hospital, pharmacy and the Internet. However, the students also mentioned their doubts as to whether the Internet is completely reliable. After intervention, the information sources for diseases mentioned were Iltalehti (a Finnish afternoon tabloid), Google, the Internet, doctors, books, TV, pharmacy, parents, mothers, nurses, packages and labels.

Students perceived the medicine education site as being safe, contrary to Wikipedia, which can be modified by anyone. The same doubt applied to the alternative medicine website. Two students described the reliable website in the following way:

There was...the first site (Medicine education website) from which it was easy to find all the information. When you went to the website, there was a title and subtitles that you could use to read the symptoms. These were clearly written and there were no difficult words. (Boy 1)

The writer's name always appeared at the bottom of the paper, it was the name of the doctor at the end (website Terveysirjasto). (Boy 21)

The Terveyskirjasto website gave names of the experts, but the text included many concepts which were not easy to understand. Conversely, students considered that the texts on the Medicine Education website were fluent, logical and clear. They found that the information was easy to find and the links were good. Students would have wished for more subtitles.

3.4. Students' Perceptions of Internet-Based Intervention

Students were asked, during the interview, about their perceptions of the medicine education intervention. They acknowledged its role in learning, its significance, and how they felt about it. Students described learning about medicines, medicine use e.g., future knowledge of what medicines to take. Students perceived that medicine education is useful and necessary:

It is rather good that school provides opportunities for medicine education and there could be more of these lessons; they are quite useful. (Girl 2)

Everybody needs medicine education, learning to use medicines in the correct way. (Girl 14)

Students perceived medicine education studies as enjoyable, very nice or quite nice. They also perceived the topic as interesting. In conclusion, students perceived Internet-based medicine education as being important; it was a different, nice way to study a previously unfamiliar issue.

This was much nicer than working in normal lessons, because in this way you learned more important issues. (Girl 20)

It was interesting; this information is of use in your free time too, and then in the higher grades these issues will probably be easier to understand when they are revised. (Boy 3)

Some of the students perceived that it would be better to study medicines in the sixth grade. They considered medicine education to be difficult.

Some issues were difficult to understand, it was difficult to search for information and ponder on it yourself. (Girl 7)

The theoretical framework and main results are shown in Figure 1. Medicine education as a part of health education promotes social sustainability and health in society. Health literacy in the context of Internet-based medicine education intervention entails rational medicine use and awareness of reliable information.

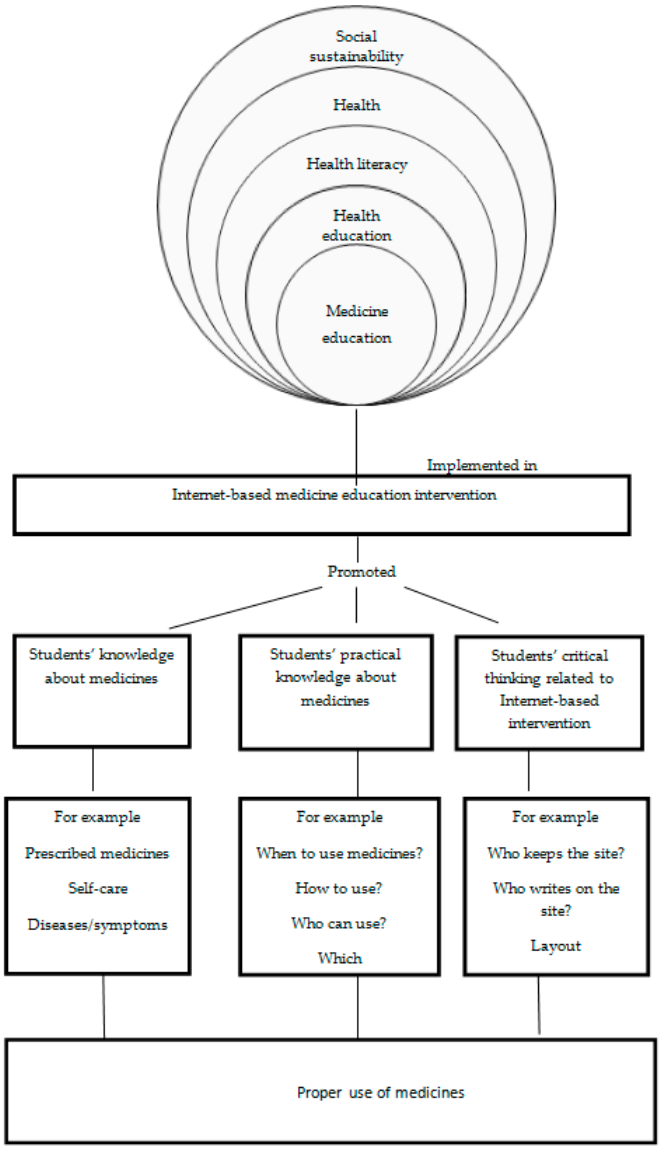

Figure 1. The theoretical framework and main results about the Internet-based medicine education intervention.

4. Discussion

This study examined fourth graders' perspectives on medicine issues in the context of the education intervention that was aimed at developing student health literacy and the further promotion of their health habits, health and quality of life, thus contributing towards solving the challenges of national and international health [1–11]. Self-awareness and citizenship were not considered, even though they are also essential components of health literacy [12].

Students' theoretical and practical knowledge about medicines and diseases was seen in their descriptions, which are in line with main processes in healthcare [14,15]: keeping healthy, detecting health problems, diagnosing diseases and treating diseases. Fourth graders were able to understand the causes of diseases, symptoms, treatment and prevention. Students especially described common illnesses; in moderation, they highlighted chronic illness, its symptoms and treatment, mentioning their own experiences, symptoms and treatments, as well as that of their friends or schoolmates. It seemed that the desire to take a greater role in managing their health was developing [20–22].

Students' perspectives on medicines and their use, was similar to that seen in previous studies in Finland [26,27,30]. Fourth graders' perspectives included the view that as well as the benefits, medication always includes risks such as the side effects. They knew that, generally, adult permission is needed; that the amount of medicine given must be accurate; that medicines should be used according to the instructions on the label/package and administered at the right time for pain or sickness. Fourth graders considered that in some cases, at least children of their own age could use medicines without the permission of adults, which is in line with international results of medicine use among adolescents [23–25,31,34,36,37]. As previous studies have also shown [29,30], students pointed out that medicines should be stored in a medicine cabinet, out of the reach of young children. The rational use of medicines and safe medicine storage decrease health risks and healthcare costs, thus being an important aspect of sustainability.

Searching for Internet-based information about diseases and their care was practiced according to the structured tasks. In the initial discussions, students pondered that reliable information could be acquired from doctors, from a hospital and from a pharmacy, as has been found in previous studies [23,34,35,38,39]. Unlike previous studies [23,26,34,35,38] fourth graders did not point out the role of parents, teachers or patient inserts as being an information source. During the group discussions after intervention, they mentioned packages and labels, showing an understanding of the rational use of medicines. Still, students did not consider schoolteachers to be a source of medicine information.

The students appropriately evaluated different websites; they were able to identify reliable sites and argue their perceptions. The students learned to evaluate the reliability of health information sources, even though this could be sometimes difficult to determine, and they recognized that Internet information might not be credible. Strategies were developed to test reliability. There were signs that fourth graders' general perceptions differed about the Internet as a medium and its specific use for health information. We would hope that high-quality health information from reliable websites, would aid in overcoming barriers for young people seeking help, and would improve awareness of common symptoms related to health problems. Students were able to find evidence-based self-help on the Internet, and they identified that there is significant variation in the quality of sources, as previous studies have shown [41,46]. Fourth graders expressed the need for improvement in the readability of online health educational material and considered that already at their age, medicine education is needed.

However, generalization of our findings is clearly limited, because conclusions based on our findings, are directional and transferable mainly in the Finnish settings. Due to its sample size, this study is limited, but the group interviews provided students with the opportunity to talk about the rational use of medicines. The objective was to understand fourth graders' perceptions rather than make generalizations. The Internet-based medicine education intervention was conducted in accordance with the age and developmental level of the students, and thus supports the healthy growth of children.

5. Conclusions

Research findings support previous national and international studies and show that this kind of Internet-based medicine education intervention and its research is important in the school context. The medicine education website, was found to develop students' conceptual awareness of diseases and awaken student values related to sustainable development, such as the prevention of diseases.

The results of this study show the importance of developing the content of Internet-based medicine education and education for sustainable development. This should focus especially on taking responsibility and seeking out critical information. The Internet-based medicine education intervention motivated and activated students. They discussed and complemented each other's thoughts and words and encouraged them to examine Internet-based health material. However, we acknowledge that Internet-based information replaces neither professional help nor the role of parents and teachers.

The prevalence of chronic diseases such as asthma and diabetes is obviously part of a student's everyday life. The need for knowledge concerning First Aid is also apparent. Students' prior knowledge of symptoms, what causes them and the treatment for diseases was quite relevant, but during the intervention this knowledge was deepened further. It is possible to say that this Internet-based medicine education intervention helped students understand health as a physical and social capability. Important skills were also developed relating to the acquisition and application of information, implying that the achievement of a level of knowledge and skills actually improves personal health.

This study suggests that fourth graders need well-structured tasks when searching for information on the Internet, addressing the possibility of them becoming distracted and straying too far from the actual task. Educational material on the Internet needs to be structured in the same way in order to support student inquiries. Furthermore, in health education, media literacy and health literacy should be developed side by side, improving students' skills and enabling them to use the Internet in their learning. Health literacy supports the understanding that prevention and health promotion are essential for improving sustainable development at the local, regional and national level.

Author Contributions: Sirpa Kärkkäinen is responsible author. She has participated in writing the article, planning the research and interventions, data collection and analysis; Tuula Keinonen has participated in writing the article, planning the research, data collection and analysis; Anu Hartikainen-Ahia has participated in planning the research and interventions as well as in writing the article; Kirsti Vainio has participated in planning the research and writing the article; Katri Hämeen-Anttila has participated in planning the research and writing the article.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. The Finnish National Board of Education. National Core Curriculum for Basic Education (NFBE). 2004. Available online: www.oph.fi/english (accessed on 29 October 2016).
2. Jeronen, E.; Kaikkonen, M.; Lindh, A. Health education in the perspective of sustainable development in teacher education. In *Forum on Global Responsibility in Research and Education—Practices in Partnerships and Daily Activities*; Tapola, H., Suntioinen, S., Karjalainen, K., Eds.; University of Eastern Finland: Joensuu, Finland, 2010; pp. 13–21.
3. World Health Organization. *Health Promotion Glossary*; WHO: Geneva, Switzerland, 1998. Available online: http://www.who.int/healthpromotion/about/HPR%20Glossary%201998.pdf (accessed on 13 March 2017).
4. Paasche-Orlow, M.K.; Wolf, M.S. The causal pathways linking health literacy to health outcomes. *Am. J. Health Behav.* **2007**, *1*, 19–26. [CrossRef]
5. De Walt, D.A.; Berkman, N.D.; Sheridan, S.S.; Lohr, K.N.; Pignone, M.P. Literacy and Health Outcomes. A systematic Review of the Literature. *J. Gen. Intern. Med.* **2004**, *19*, 1228–1239. [CrossRef] [PubMed]
6. Institute of Medicine (IOM). Available online: http://www.nationalacademies.org/hmd/Reports/2004/Health-Literacy-A-Prescription-to-End-Confusion.aspx (accessed on 29 October 2016).

7. Sanders, L.M.; Shaw, J.S.; Guez, G.; Baur, C.; Rudd, R. Health literacy and child health promotion: Implications for research, clinical care and public policy. *Pediatrics* **2009**, *4*, 306–314. [CrossRef] [PubMed]
8. Nutbeam, D. Defining and measuring health literacy: What can we learn from literacy studies? *IJPHS* **2009**, *54*, 303–305. [CrossRef] [PubMed]
9. Nutbeam, D. Health outcomes and health promotion: Defining success in health promotion. *Health Promot. J. Aust.* **1996**, *6*, 58–60.
10. Nutbeam, D. Health literacy as a public health goal: A challenge for contemporary health education and communication strategies into the 21st century. *Health Promot. Int.* **2000**, *15*, 259–267. [CrossRef]
11. St Leger, L. Schools health literacy and public health: Possibilities and challenges. *Health Promot. Int.* **2011**, *16*, 197–205. [CrossRef]
12. Paakkari, L.; Paakkari, O. Health literacy as a learning outcome in schools. *Health Educ.* **2012**, *112*, 133–152. [CrossRef]
13. Diamond, C.; Saintonge, S.; August, P.; Azrack, A. The development of Building Wellness, a youth health literacy program. *J. Health Commun.* **2011**, *16*, 103–118. [CrossRef] [PubMed]
14. Sun, X.; Shi, Y.; Zeng, Q.; Wang, Y.; Du, W.; Wei, N.; Xie, R.; Chang, C. Determinants of health literacy and health behaviour regarding infectious respiratory diseases: A pathway model. *BMC Publ. Health* **2013**, *22*, 261. [CrossRef]
15. Bergman, B.; Neuhauser, D.; Provost, L. Five main processes in healthcare: A citizen perspective. *BMJ Qual. Saf.* **2011**, *20*, 41–42. [CrossRef] [PubMed]
16. Cho, Y.L.; Lee, S.Y.; Arozullah, A.M.; Cittenden, K.S. Effects of health literacy on health status and health service utilization amongst the elderly. *Soc. Sci. Med.* **2008**, *66*, 1809–1816. [CrossRef] [PubMed]
17. Haugland, S.; Wold, B.; Stevenson, J.; Aaroe, L.E.; Woynarowska, B. Subjective health complaints in adolescence: A cross-national comparison of prevalence and dimensionality. *Eur. J. Publ. Health* **2001**, *11*, 4–10. [CrossRef]
18. Siponen, S.M.; Ahonen, R.S.; Savolainen, P.H.; Hämeen-Anttila, K. Children's health and parental socioeconomic factors: A population-based survey in Finland. *BMC Publ. Health* **2011**, *9*, 457. [CrossRef] [PubMed]
19. Lindell-Osuaqwu, L.; Sepponen, K.; Farooqui, S.; Kokki, H.; Hämeen-Anttila, K.; Vainio, K. Parental reporting of adverse drug events and other drug-related problems in children in Finland. *Eur. J. Clin. Pharmacol.* **2013**, *69*, 985–994. [CrossRef] [PubMed]
20. Hoffman, S.; Marsiglia, F.F.; Nevarez, L.; Porta, M. Health literacy among youth in Guatemala City. *Soc. Work Publ. Health* **2016**, *32*, 30–37. [CrossRef] [PubMed]
21. Manganello, J.A. Health literacy and adolescents: A framework and agenda for future research. *Health Educ. Res.* **2008**, *23*, 840–847. [CrossRef] [PubMed]
22. Greenberg, M.T.; Lippold, M.A. Promoting healthy outcomes among youth with multiple risks: Innovative approaches. *Annu. Rev. Publ. Health* **2013**, *34*, 253–270. [CrossRef] [PubMed]
23. Chambers, C.T.; Reid, G.J.; McGrath, P.J.; Finley, G.A. Self-administration of over-the-counter medication for pain among adolescents. *Arch. Pediatr. Adolesc. Med.* **1997**, *151*, 449–455. [CrossRef] [PubMed]
24. Dengler, R.; Roberts, H. Adolescents' use of prescribed drugs and over-the-counter preparations. *J. Public Health Med.* **2003**, *18*, 437–442. [CrossRef]
25. Hansen, E.H.; Holstein, B.E.; Due, P. International survey of self-reported medicine use among adolescents. *Ann. Pharmacother.* **2003**, *37*, 361–366. [CrossRef] [PubMed]
26. Ylinen, S.; Hämeen-Anttila, K.; Sepponen, K.; Lindblad, A.K.; Ahonen, R. The use of prescription medicines and self-medication among children—A population-based study in Finland. *Pharmacoepidemiol. Drug Saf.* **2010**, *19*, 1000–1008. [CrossRef] [PubMed]
27. Hämeen-Anttila, K.; Lindell-Osuagwu, L.; Sepponen, K.; Vainio, K.; Halonen, P.; Ahonen, R. Factors associated with medicine use among Finnish children under 12 years. *Pharmacoepidemiol. Drug Saf.* **2010**, *19*, 400–407. [PubMed]
28. Siponen, S.; Ahonen, R.; Kettis, A.; Hämeen-Anttila, K. Complementary or alternative? Patterns of complementary and alternative medicine (CAM) use among Finnish children. *Eur. J. Clin. Pharmacol.* **2012**, *68*, 1639–1645. [CrossRef] [PubMed]

29. Sanz, E.; Bush, P.; Garcia, M. Medicines at home: The contents of medicine cabinets in eight countries. In *Children, Medicines and Culture*; Bush, P.J., Trakas, D.J., Sanz, E.J., Wirsing, R.L., Vaskilampi, T., Prout, A., Eds.; Pharmaceutical Products Press: New York, NY, USA, 1997; pp. 77–105.
30. Hokkanen, J.; Elorinne, A.L.; Vainio, K.; Keinonen, T. Medicine case study highlights the problems of Finnish households in medicine consumption practices. *Probl. Educ. Century* **2016**, *71*, 31–43.
31. Sanz, E.J. Concordance and children's use of medicines. *BMJ* **2003**, *327*, 858–860. [CrossRef] [PubMed]
32. Gagliardi, A.; Jadad, A.R. Examination of instruments used to rate quality of health information on the Internet: Chronicle of a voyage with an unclear destination. *BMJ* **2002**, *324*, 569–573. [CrossRef] [PubMed]
33. Vaskilampi, T.; Kalpio, O.; Ahonen, R.; Hallia, O. Finnish study on medicine use, health behaviour and perceptions of medicines and health care. In *Childhood and Medicine Use in a Cross-Cultural Perspective: A European Concerted Action*; Trakas, D.J., Sanz, E., Eds.; European Commission: Luxembourg, 1996; pp. 191–219.
34. Menacker, F.; Aramburuzabala, P.; Minian, N.; Bush, P.; Bibace, R. Children and medicines: What do they want to know and how do they want to learn. *J. Small Anim. Prac.* **1999**, *16*, 38–52.
35. Hämeen-Anttila, K.; Juvonen, M.; Ahonen, R.; Bush, P.; Airaksinen, M. How well can children understand medicine related topics? *Probl. Educ. Century* **2006**, *60*, 171–178. [CrossRef] [PubMed]
36. Bush, P.; Joshi, M. Towards a universal curriculum for teaching children about medicines. In Proceedings of the Federation Internationale Pharmaceutique World Congress, Nice, France, 31 August–5 September 2002.
37. Almarsdóttir, A.; Hartzema, A.; Bush, P.; Simpson, K.; Zimmer, C. Children's Attitudes and Beliefs about Illness and Medicines: A Triangulation of Open-ended and Semi-structured Interviews. *J. Small Anim. Prac.* **1997**, *14*, 26–41.
38. Bozoni, K.; Kalmanti, M.; Koukouli, S. Perception and knowledge of medicines of primary schoolchildren: The influence of age and socioeconomic status. *Eur. J. Pediatr.* **2006**, *165*, 42–49. [CrossRef] [PubMed]
39. Stoelben, S.; Krappweis, J.; Rossler, G.; Kirch, W. Adolescents' drug use and drug knowledge. *Eur. J. Pediatr.* **2000**, *159*, 608–614. [CrossRef] [PubMed]
40. Westerlund, M.; Bråstad, J.-O.; Westerlund, T. Medicine-taking behavior and drug-related problems in adolescents of a Swedish high school. *Pharm. World Sci.* **2008**, *30*, 243–250. [CrossRef] [PubMed]
41. Huby, K.; Swallow, V.; Smith, T.; Carolan, I. Children and young people's views on access to a web-based applications to support personal management of long-term conditions: A qualitative study. *Child Care Health Dev.* **2016**, *43*, 126–132. [CrossRef] [PubMed]
42. European Commission. Managing Health Data (2016). Available online: https://ec.europa.eu/digital-single-market/en/managing-health-data (accessed on 29 October 2016).
43. Faith, J.; Thorburn, S.; Sinky, T. Exploring healthcare experiences among online interactive weight loss forum users. *Comput. Hum. Behav.* **2016**, *57*, 326–333. [CrossRef]
44. Singh, K.; Brown, R. Health-related Internet habits and health anxiety in university students. *Anxiety Stress Coping* **2014**, *5*, 542–554. [CrossRef] [PubMed]
45. Gray, N.J.; Klien, J.; Noyce, P.; Sesselberg, T.; Cantrill, J. Health information-seeking behaviour in adolescence: The place of the Internet. *Soc. Sci. Med.* **2005**, *60*, 1467–1478. [CrossRef] [PubMed]
46. Richards, C.; Hughes, J. 2016 The use of technology to support young people with mental health issues in schools. In *Mental Health and Wellbeing through Schools: The Way Forward*; Shute, R.H., Ed.; Routledge: London, UK, 2016; p. 230.
47. Reavley, N.J.; Jorm, A.F. The quality of mental disorder information websites. A review. *Patient Educ. Couns.* **2011**, *85*, 16–25. [CrossRef] [PubMed]
48. Hutchinson, N.; Baird, GL.; Garg, M. Examining the reading level of internet medical information for common internal medical diagnoses. *Am. J. Med.* **2016**, *129*, 637–639. [CrossRef] [PubMed]
49. Eysenbach, G.; Kohler, C. How do consumers search for and appraise health information on the world wide web? Qualitative study using focus groups, usability tests, and in-depth interviews. *BMJ* **2002**, *324*, 573–577. [CrossRef] [PubMed]
50. Roth, W.-M. *Doing Qualitative Research. Praxis of Methods*; Sense Publishers: Rotterdam, The Netherlands, 2005; pp. 78–98.
51. Gomm, R.; Hammersley, M.; Foster, P. *Case Study Method*; Sage Publishers: London, UK, 2000; pp. 111–113.

52. Lincoln, Y.S.; Guba, E.G. *Naturalistic Inquiry*; Sage Publications: Newbury Park, CA, USA, 1985; pp. 125–130.
53. Stake, R.E. Case studies. In *Handbook of Qualitative Research*, 2nd ed.; Denzin, N.K., Lincoln, Y.S., Eds.; Sage Publications: Thousand Oaks, CA, USA, 2000; pp. 435–455.