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COGNITIVELY EMPOWERING INTERNET-BASED PATIENT EDUCATION FOR AMBULATORY ORTHOPAEDIC SURGERY PATIENTS

by

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ABSTRACT

The aim of this study was to create and evaluate an Internet-based patient education programme aiming to cognitively empower ambulatory orthopaedic surgery patients. The research process was divided into two phases. In Phase I, the purpose was to create the content for cognitively empowering Internet-based patient education for ambulatory orthopaedic surgery patient care. In Phase II, the purposes were: to evaluate cognitively empowering Internet-based patient education (experiment group) user acceptance and the outcomes of this education, and to compare the outcomes of cognitively empowering Internet-based patient education to the outcomes of cognitively empowering face-to-face education (control group). The ultimate goal of this study was to create a new type of cognitively empowering patient education intervention which offers an individualized and engaging method that is free of time and place for patients having ambulatory orthopaedic surgery operations.

In Phase I, we used a descriptive comparative cross-sectional study (pre- and post-test) design and 120 consecutive ambulatory orthopaedic surgery patients evaluated their perceptions of their knowledge expectations and their received knowledge. On the basis of the results of this study, as well as earlier research knowledge on empowerment, we created a website to support the cognitive empowerment of an ambulatory orthopaedic patient. The content of the website is multidimensional. In Phase II we evaluated the programme using a randomized controlled trial. Elective ambulatory orthopaedic surgery patients were randomized to either an experiment group (n=72) receiving education through a website or to a control group (n=75) receiving face-to-face education with a nurse. We collected the data at the two phases of the research with structured instruments and analysed it using statistical methods.

This study showed that patients' possibilities to become cognitively empowered can be increased with the help of cognitively empowering Internet-based patient education. Users accepted the website that included multidimensional knowledge. Thus, the utility of cognitively empowering Internet-based patient education was partially lower than cognitively empowering face-to-face patient education; patients used the website without any problems and evaluated it as easy to use. There were no differences between the out-of-pocket costs of education. However, the nurses saved time when using the cognitively empowering Internet-based patient education. This study also showed that cognitively empowering Internet-based patient education increased patients' knowledge level and their sufficiency of knowledge more than did face-to-face education. Patients' experiences of their emotions and intensity of symptoms did not differ between the education groups.

In summary, cognitively empowering Internet-based patient education can be recommended as an alternative to the face-to-face education method for ambulatory orthopaedic surgery patients.

Key words: patient education, cognitively empowering patient education, Internet, ambulatory surgery patient

Katja Heikkinen

TIEDOLLISTA VOIMAVARAISTUMISTA TUKEVA INTERNET-PERUSTAINEN OHJAUS PÄIVÄKIRURGISILLE ORTOPEDISILLE POTILAILLE

Hoitotieteen laitos, Lääketieteellinen tiedekunta, Turun yliopisto, Suomi
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TIIVISTELMÄ

Tutkimuksen tarkoituksena oli kehittää tiedollista voimavaraistumista tukeva Internet-perustainen potilasohjausohjelma sekä arvioida sitä. Tutkimusprosessi jaettiin kahteen vaiheeseen. Ensimmäisessä vaiheessa luotiin sisältö tiedollista voimavaraistumista tukevalle Internet-perustaiselle ohjaukselle päiväkirurgisia ortopedisia potilaita varten. Toisessa vaiheessa arvioitiin Internet-perustaisen ohjauksen (koeryhmä) hyväksyttävyyttä käyttäjien arvioimana ja ohjauksen tuloksia sekä verrattiin Internet-perustaisen ohjauksen (koeryhmä) tuloksia tiedollisesti voimavaraistumista tukevan sairaanhoitajan välittämään ohjauksen (kontrolliryhmä) tuloksiin. Tutkimuksen tavoitteena oli luoda uusi potilasohjausmuoto joka tarjoaa yksilöllisen, osallistavan ja aikaan ja paikkaan sitomattoman ohjauksen päiväkirurgiseen ortopediseen leikkaukseen tulevalle potilaalle.

Tutkimuksen ensimmäisessä vaiheessa käytettiin kuvailevaa ja vertailevaa tutkimusmenetelmää (ennen ja jälkeen testaus). Tutkimukseen osallistui 120 päiväkirurgista ortopedista potilasta joiden tiedon odotuksia ja heille välitettyä tietoa tarkasteltiin. Tutkimuksen ensimmäisen vaiheen tuloksien ja aikaisemman voimavaraistumista käsittävän tiedon perusteella luotiin sisältö tiedollista voimavaraistumista tukevalle Internet-perustaiselle ohjaukselle. Sisältö rakentui voimavaraistavan tiedon kuudesta eri osa-alueesta. Tutkimuksen toisessa vaiheessa käytettiin randomoitua kokeellista tutkimusasetelmaa. Päiväkirurgiseen ortopediseen leikkaukseen tulevat potilaat randomoitiin koeryhmään (n=72) Internet-perustaiseen ohjaukseen ja kontrolliryhmään (n=75) sairaanhoitajan välittämään ohjaukseen. Aineisto kerättiin strukturoitujen mittareiden avulla ja tulokset analysoitiin tilastollisesti.

Tutkimuksen tulokset osoittavat, että kehitettyä tiedollisesti voimavaraistumista tukevaa Internet-perustaista potilasohjausmenetelmää voidaan suositella käytettäväksi ortopedisten päiväkirurgisten potilaiden ohjauksessa ja potilailla on hyvät mahdollisuudet voimavaraistua tiedollisesti sen avulla. Monipuolista tietoa sisältävä Internet-perustainen ohjaus osoittautui käyttäjien näkökulmasta hyväksyttäväksi. Vaikka Internet ohjauksen hyväksyttävyys koettiin osittain heikommaksi kuin sairaanhoitajan välittämän ohjauksen, potilaat käyttivät nettisivustoa ongelmitta ja arvioivat sen helppokäyttöiseksi. Ohjausmuodolla ei ollut vaikutusta hoidosta aiheutuneisiin kustannuksiin. Sen sijaan kustannuksista organisaatiolle voitiin puolittaa sairaanhoitajan ohjaukseen käyttämä aika Internet-perustaisen ohjauksen avulla. Internet-perustaiseen ohjaukseen osallistuneiden potilaiden tiedon taso ja kokemus tiedon riittävyydestä lisääntyivät ohjauksen jälkeen enemmän kuin sairaanhoitajan välittämään potilasohjaukseen osallistuneiden potilaiden tiedot. Ohjausmuodolla ei ollut vaikutusta potilaiden kokemien tunteiden ja oireiden voimakkuuteen.

Yhteenvetona voidaan todeta, että tiedollisesti voimavaraistava Internet-perustaista ohjausta voidaan suositella vaihtoehtoiseksi menetelmäksi sairaanhoitajan välittämälle ohjaukselle päiväkirurgiseen ortopediseen leikkaukseen tuleville potilaille.

Avainsanat: potilasohjaus, tiedollisesti voimavaraistava potilasohjaus, Internet, päiväkirurginen potilas

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LIST OF ABBREVIATIONS

AOSP	Ambulatory Orthopaedic Surgery Patient
CEF-FPE	Cognitive Empowering Face-to-Face Patient Education
CEI-BPE	Cognitively Empowering Internet-Based Patient Education
CEP	Cognitively Empowered Patient
CEPE	Cognitively Empowering Patient Education
Con	the Consultations -instrument
DUW	The Diary of the Use of the Website instrument
E	Emotions –instrument
F-FPE	Face-to-Face Patient Education
HPKE	Hospital Patient's Knowledge Expectations Scale
HPRK	Hospital Patient's Received Knowledge Scale
I-BPE	Internet-Based patient education
IPC	Intra- and Postoperative Costs instrument
KT	Knowledge Test
Nd	Nurses documentations
OPKQ	the Orthopaedic Patient Knowledge Questionnaire
PC	Preoperative Costs instrument
PE	Patient Education
PEE	The Patients' Evaluations of Education instrument
S	Symptoms instrument
S_{PRE}	Preoperative Symptoms instrument
S_{POST}	Postoperative Symptoms instrument
SosdemV	Socio-demographic Variables
SoK	Sufficiency of Knowledge instrument

LIST OF ORIGINAL PUBLICATIONS

This thesis is based on the following publications, which are referred to in the text by their Roman numerals I-VI:

I. Heikkinen K, Leino-Kilpi H, Hiltunen A, Johansson K, Kaljonen A, Rankinen S, Virtanen H, Salanterä S. 2008. Ambulatory orthopaedic surgery patients' knowledge expectations and perceptions of received knowledge. Journal of Advanced Nursing 60(3): 270–278.

II. Heikkinen K, Suomi R, Jääskeläinen M, Kaljonen A, Leino-Kilpi H, Salanterä S. 2010. The creation and evaluation of an ambulatory orthopaedic surgical patient education website to support empowerment. Computers, Informatics, Nursing 28(5): 282–290.

III. Heikkinen K, Salanterä S, Suomi R, Lindblom A, Leino-Kilpi H. 2011. Ambulatory orthopaedic surgery patient education and cost of care. Orthopaedic Nursing 30(1): 20–28.

IV. Heikkinen K, Leino-Kilpi H, Nummela T, Kaljonen A, Salanterä, S. 2009. A comparison of two educational interventions for the cognitive empowerment of ambulatory orthopaedic surgery patients. Patient Education and Counseling 73: 272–279.

V. Heikkinen K, Salanterä S, Leppänen T, Vahlberg T, Leino-Kilpi H. 2011. Ambulatory orthopaedic surgery patients' emotions with two different patient education methods. Resubmitted.

VI. Heikkinen K, Leino-Kilpi H, Vahlberg T, Salanterä S. 2011. Ambulatory orthopaedic surgery patients' symptoms with two different patient education methods. International Journal of Orthopaedic and Trauma Nursing. In press.

1. INTRODUCTION

Ambulatory surgery is a procedure that is an elective surgical treatment (Keskimäki 2003, OECD Health Data 2010). More than 1.5 million arthroscopic procedures are performed each year around the world (The Whitaker Foundation 2006). In Finland, the corresponding annual amount is approximately 21 000 (National Research and Development Centre for Welfare and Health 2006). An increasingly aging population will also add to the number of procedures in ambulatory surgery in the future.

The continuously increasing amount of ambulatory surgeries (Keskimäki 2003, Castoro et al. 2007, OECD Health Data 2010) strains new demands and resources for patient education, which is a common form of intervention preoperatively. Many different types of educational interventions have been designed for supporting the patient. Educational interventions are challenging since no single universal content or method has yet been defined. (Johansson et al. 2005, Suhonen & Leino-Kilpi 2006).

In Finland, a patient's right to receive knowledge is based upon the law (Act on the Status and Rights of Patients 785/1992). This law states that the patient has the right to receive information about his or her health and alternatives for promoting healthy behaviour. This legal requirement to provide information expects health care professionals to involve patients in their care and help them make decisions about it. This makes it possible for patients to take more responsibility and become more empowered in relation to their own care. Increasing patients' possibilities to become empowered may involve redefining and communicating the role of patients and enhancing their knowledge about their health and alternatives for promoting healthy behaviour. Increasing patient empowerment also requires policies that encourage patient independence. This includes identifying the needs of patients and the availability of easy access to valid information. (A Declaration on the Promotion of Patients' Rights in Europe 1994, Angelmar & Berman 2007.)

Patient empowerment is one of the central elements in Finnish national health strategies (Terveys 2015 –kansanterveysohjelma). The national strategies are centred on promoting an information society (National Knowledge Society Strategy 2007-2015) or patients' possibilities to become informed (Kaste 2008-2011, Attractive and Health Promoting Health Care 2009–2011). The Information Society Policy Programme focuses on utilizing the opportunities offered by information and communications technologies. The Information Society Policy Programme aims to maintain Finland's status as a leading producer and user of information and communications technology. (National Knowledge Society Strategy 2007-2015.) Currently, in Finland, approximately 86% of people aged 16-74 use the Internet and 68% of people use the Internet to search for knowledge about health or disease (Statistics Finland 2010). In Europe, approximately 58% of people are using the

Internet (Internet Word Stats 2010). Many orthopaedic patients search the Internet for knowledge about health or diseases (Beall et al. 2002, Gupte et al. 2002, Jariwala et al. 2004 and 2005). The Internet represents a very powerful tool for implementing the idea of patient empowerment (eHealth ERA 2007a and 2007b, Lemire et al. 2008) and it is assumed that web sites are the most representative tools for patient empowerment because of patients' abilities to control the information and have possibilities to make choices about the content and the amount of information they look at (Zhang & von Dran 2000, Clement et al. 2002, European Commission 2003, Hassling et al. 2003, Valaitis 2005, Ilic 2010). Also, National Health Authorities, EU Bodies, the European Council and WHO-Euro support the idea of patient empowerment (The World Health Organisation 2004, eHealth ERA 2007a and 2007b). The European experience with e-Health Patient Empowerment has focused on providing access to trusted information and advice and supporting patient education for health literacy (eHealth ERA 2007a).

The aim of this study was to create and evaluate an Internet-based patient education programme aiming to cognitively empower ambulatory orthopaedic surgery patients. In addition, we compared Internet-based patient education to cognitively empowering face-to-face patient education. The research process consisted of two phases. In Phase I (year 2004), the purpose was to define the content of the cognitively empowering Internet-based patient education for ambulatory orthopaedic surgery patient care. In Phase II (2005-2006), the purposes were as follows:

1) to evaluate cognitively empowering Internet-based patient education (experiment group) from the perspective of user acceptance and its outcomes, and

2) to compare the cognitively empowering Internet-based patient education to cognitively empowering face-to-face education (control group).

The ultimate goal of this study was to create a new type of cognitively empowering patient education intervention which offers an individualized and engaging method that is free of time and place for patients having ambulatory orthopaedic surgery operations.

2. BACKGROUND

The background consists of a definition of the main concepts of the study and an assessment of previous empirical studies concerning surgical patient education interventions, while paying special attention to Internet-based patient education or patient education methods that support patients' cognitive empowerment.

The database searches covered the time period from 1980 to 2011 and were limited to studies that included abstracts. The searches were based on the Cinahl and PubMed databases as well as manual searches. The manual search included articles found in the reference lists of the examined articles from the databases and related literature. Database searches focused on the main concepts of the study and issues concerning patient education interventions. We conducted the searches using the keywords, mesh terms and word-stems. The search terms were used alone and interchangeably. See Figure 1.

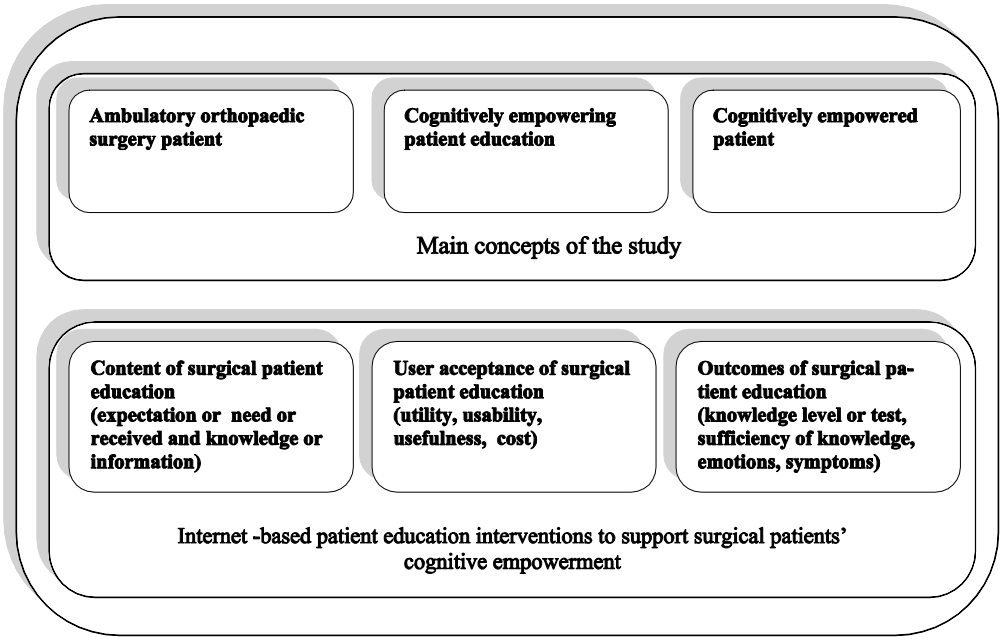


Figure 1. Search areas in database searches from Cinahl and PubMed, 1980-2011.

2.1 Main concepts of the study

The main concepts of this study are as follows:

1) ambulatory orthopaedic surgery patient (AOSP)
2) cognitively empowering patient education (CEPE)
3) cognitively empowered patient (CEP).

We define these main concepts by referring to dictionary definitions, existing literature and existing concept analyses. We also define the related concepts.

A**mbulatory orthopaedic surgery patient (AOSP)** is defined as a patient having a surgical operation, admitted to the hospital and discharged on the same day (The International Association for Ambulatory Surgery 2003, Castoro et al. 2007). Orthopaedic here means that the patient is having shoulder or knee arthroscopy. The AOSP is viewed as an active person, participating in her or his own care. In all phases of care, educational activities are usually needed to support patients' participation in their care and enable their recovery (Allvin et al. 2007). In this case, the educational activities are implemented by a nurse.

Cognitively empowering patient education (CEPE) (Figure 2) is divided into the categories of patient education, cognition and empowerment. ***Patient education*** is defined in the Finnish language as "koulutus", "opetus", "kasvatus" or "valistus". It includes the concepts of teaching, learning, counselling, guiding or informing. The teaching aims at helping patients to learn or to give instructions and learning is the act of gaining knowledge. Counselling refers to advice or guidance on behaviour, and the word guiding is used almost synonymously. Informing is defined as informing or giving information. (MOT Englanti 4.8 englanti-suomi, MOT Englanti 4.8 suomi-englanti, MOT Collins English Dictionary 2.0, MOT Collins Compact Thesaurus 1.0.) Patient education is important for purposes of helping patients to learn about health- and care-related issues and to become informed decision makers able to manage their own care. In ambulatory surgery, preoperative patient education is essential. Preoperative patient education is defined as providing the patient with health-related information, psycho-social support and the opportunity to learn selected skills in preparation for surgery (Devine & Cook 1986, The Joint Commission Guide to Patient and Family Education 2003, Piredda 2004, Fitzpatrick & Hyde 2006) and it is a common feature of the preoperative preparation for surgical procedures. Preoperative patient education might cover the entire perioperative surgical process from the time prior to admission until the point at which patients receive postoperative care at home (Bernier et al. 2003).

Cognition stems from the Latin word "cognoscere," which means to know, to conceptualize or to recognize. Cognition is defined in the Finnish language as "taju", "tietoisuus" or "tajunta". Cognition refers to the processing of information, applying knowledge and changing preferences. In addition, cognition refers to the mental act or process by which knowledge is acquired. (MOT Englanti 4.8 englanti-suomi, MOT Englanti 4.8 suomi-englanti, MOT Collins English Dictionary 2.0, MOT Collins Compact Thesaurus 1.0.)

Empowerment stems from the Latin word "potere", which refers to being able or having the ability to choose. Empowerment is also defined as enable, allow, authorize, commission, delegate, entitle, license, permit, qualify, sanction or warrant. It is also

defined as follows: the giving or delegation of power or authority; authorization, the giving of an ability; enablement or permission. Empower is defined in the following way: to give or delegate power or authority to; authorize, to give ability to; enable or permit, authorize. Empowerment refers to power itself, and empowerment as an outcome refers to the process of individual patients (Funnell et al. 1991, Hage & Lorensen 2005, Bradbury-Jones et al. 2008). Empowerment cannot be given to others and empowerment is not simply about the transferring of power from one individual to another (Gibson 1991, Kuokkanen & Leino-Kilpi 2000, Funnell 2004, Homan-Helenius 2005, Hage & Lorensen 2005). It is defined as a special inner sense of having control over one's own health (Anderson et al 1991, Funnell et al. 1991, Anderson 1996, Leino-Kilpi et al. 1998, Homan-Helenius 2005). Thus, a lack of control over events might cause a sense of disempowerment (Grieve 2002, Hage & Lorensen 2005, Bradbury-Jones et al 2008). In the Finnish language, empowerment is defined as "valtuutus" or "valtuuttaminen" and empower as "voimaantua", whereas empowered is defined as "voimaantunut". (MOT WSOY Enteka 4.0 englanti-suomi, MOT WSOY Enteka 4.0 suomi-englanti, MOT Collins English Dictionary 2.0, MOT Collins Compact Thesaurus 1.0, Leino-Kilpi et al. 1998, Kuokkanen & Leino-Kilpi 2000, Poskiparta et al. 2001, Kuokkanen 2003.)

Cognitively empowering patient education (CEPE) consists of three phases (Figure 2):

1) defining the orientation base of the education
2) implementing the educational activities
3) evaluating the outcomes of the education.

Defining the orientation base of the education involves evaluating the patients' existing knowledge (Gibson 1991, Feste & Anderson 1995, Ellis-Stoll & Popkess-Vawter 1998, Leino-Kilpi et al. 1999, Funnell 2004, Leino-Kilpi et al. 2005, Cagle & Kovacs 2009), knowledge expectations (Leino-Kilpi et al. 1998, 1999, Poskiparta et al. 2001, Rankinen et al. 2007), level of knowledge (Oxford Dictionary of Quotations 1999) and sufficiency of knowledge (Bandura 1977, Anderson et al. 1991, Funnell et al. 1991, Anderson et al. 1995, Funnell & Adersson 2003). An evaluation of knowledge is essential because knowledge itself is power (Oxford Dictionary of Quotations 1999) and knowledge is a prerequisite for action (Chambers Dictionary of Synonyms and Antonyms 1989, MOT Collins English Dictionary 2.0) and is needed in order to make decisions (Bandura 1977, Anderson et al. 1991, Funnell et al. 1991, Anderson et al. 1995, Funnell & Adersson 2003).

Implementing educational activities includes creating the content of the patient education and choosing the patient education method (second phase of CEPE; Figure 2). The content of knowledge that is defined as being important for implementing the cognitively empowering patient education contains bio-physiological (knowledge about illness, symptoms, treatment, complications), functional (individual needs, mobility, rest, nutrition, body hygiene), experiential (emotions, hospital experiences),

ethical (rights, duties, participation in decision-making, confidentiality), social (families, other patients, patient unions) and financial (costs, financial benefits) dimensions (Leino-Kilpi et al. 1998 and 1999). It is essential to relate this knowledge to the patient's own life and care and, thereby, to support them in taking a more active role in their care and control of it (Leino-Kilpi et al. 1993, Poskiparta et al. 2001).

There are several methods that support cognitive empowerment through patient education: individual, group, verbal, written and Internet-based methods. The interest of this study lies in Internet-based patient education (I-BPE) and face-to-face patient education (F-FPE). Internet-based patient education is rarely used with ambulatory orthopaedic surgery patients (Lewis 2003, Wofford et al. 2005, Nguyen et al. 2006, Beranova & Sykes 2007), whereas F-FPE is a commonly used patient education method (Rankin & Duffy 1983, Close 1988, Bastable 2003, Johansson et al. 2007). Internet-based patient education interventions take advantages of websites, e-mail and search-tools (Brooks 2001, Bastable 2003, Lewis 2003, Cussiare & Weingardt 2009). This study focuses on the use of websites. The Internet is a network of networks; it is a network that interconnects other computer networks, on which end-user services, such as World Wide Web sites or data archives, are located, enabling data and other information to be exchanged (MOT Collins English Dictionary 2.0). Another concept used for Internet-based patient education is, for example, web-based patient education. Internet-based patient education aims at a process of learning whereby computers can be used at different steps of the educational process. Learning takes place as a result of experiences and interaction within a computer-supported environment. It is not restricted to a certain time and can take place in a variety of locations, including home and community locations, libraries and cafes. Improved access to educational material is crucial. Technologies offer the patients control over the educational content and also allow patients to tailor their experiences to meet their knowledge expectations (Cline & Haynes 2001, Bastable 2003, Lewis 2003, Ruiz et al. 2006, Cussiare & Weingardt 2009.)

Face-to-face education refers to education where the individual patient meets with a nurse in a specific place (Close 1988, Wilson 2003), and they have an interactive relationship (Kettunen et al. 2002, Virtanen et al. 2007). Face-to-face education is based on verbal and nonverbal communication (Close 1988, Johansson et al. 2004). Verbal instructions can be tailored for the patient. They are formalized and offered at a prearranged time and place. Face-to-face patient education can be improved with supportive material such as written material. Researchers suggest that both verbal and written material should be used together. This can improve patients' understanding of the material (Close 1988, Arthur 1994, Kettunen 2001, Kruzik 2009.)

Evaluating the outcomes of the education is the third phase of cognitively empowering patient education. The outcomes that will be evaluated must first be defined. In this study, they are the fulfilment of knowledge expectations, level of knowledge and sufficiency of knowledge. The final goal is a ***cognitively empowered patient (CEP).*** (See Figure 2.)

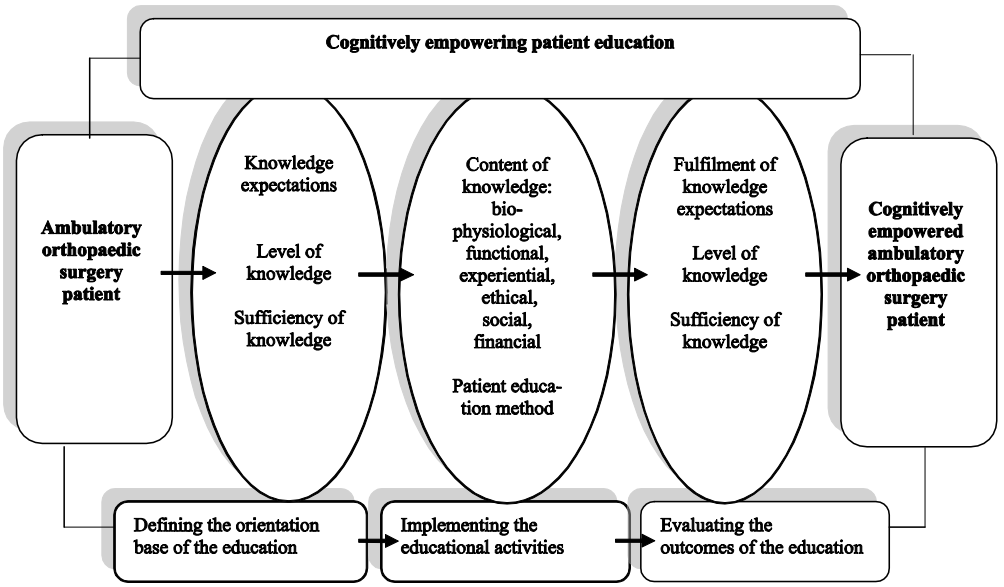


Figure 2. Main concepts of the study, presented as a process of cognitively empowering patient education.

2.2 Internet-based patient education interventions to support surgical patients' cognitive empowerment

This chapter consists of a description of studies concerning the content of Internet-based patient education interventions, studies concerning the user acceptance of patient education interventions and studies concerning the outcomes of patient education in terms of supporting cognitive empowerment.

During our search of the existing literature, we found some studies concerning empowering patient education (Pellino et al. 1998, Johansson et al. 2007), but none of these focused on cognitively empowering patient education and none were done with ambulatory surgery patients. Some studies could be identified that concerned Internet-based patient education, but none in the area of ambulatory orthopaedic surgery. These studies have mainly concerned patient education for long-term care patients, such as diabetes patients (Jackson et al. 2006, McAndrew et al. 2007), asthma patients (Bussey-Smith & Rossen 2007, Stinson et al. 2009), heart disease patients (Strömberg et al. 2006), and obesity patients (Tate et al. 2001, Harvey-Berino et al. 2002). In addition, several reviews have been done on the use of Internet-based or computer-based patient education with different patient groups (Lewis 1999, 2003, Wofford et al. 2005, Nguyen et al. 2006, Fox 2009). In these studies, computer -based patient education meant education conducted using CD-ROM or videos. Based on the literature search, there were four RCT studies concerning the use of the I-BPE method in surgery care. These studies were done with ambulatory surgery patients (Goldsmith & Safran 1999, Hering et al. 2005) or cardiac (Scherrer-Bannerman et al. 2000) or orthopaedic (Groves et al. 2010) surgery patients. (See Table 1.)

Table 1. Internet-based patient educational interventions for adult surgical patients (n=4).

Authors and year	Title	Sample	Intervention in experiment group	Intervention in control group	Time	Results
Goldsmith DM, Safran C. 1999	Using the Web to reduce postoperative pain following ambulatory surgery	Ambulatory surgery patients (n=195: 98 in intervention group and 97 in control group)	Ambulatory Surgery Nursing website and access to a pain management information section of the website and preoperative interview with a nurse	Ambulatory Surgery Nursing website and preoperative interview with a nurse	Pre-operatively	Patients in the intervention group reported significantly less postoperative pain on arrival to their home after surgery and into the night after surgery. They also reported significantly less postoperative pain for the day immediately following surgery
Scherrer-Bannerman A, Fofonoff D, Minshall D, Downie S, Brown M, Leslie F, McGowan P. 2000	Web-based education and support for patients on the cardiac surgery waiting list	Patients on the cardiac surgery waiting list (n=72)	Website; perioperative issues in cardiac surgery	Printed manual; perioperative issues in cardiac surgery	Pre-operatively	Patients in the experiment group evaluated their increase of social support more highly than patients in the control group. Experiment groups experience of anxiety decreased more.
Hering K, Harvan J, Dangelo M, Jasinski D. 2005	The use of a computer website prior to scheduled surgery (a pilot study): impact on patient information, acquisition, anxiety level, and overall satisfaction with anaesthesia care	Same day surgery patients (n=64: 25 in experiment group and 39 in control group)	Website; content standardized verbal instruction with digital photos about anaesthesia -related issues	Standardized verbal instruction about anaesthesia -related issues	Pre-operatively	Patients in the experiment group had a higher knowledge level than patients in the control group. Neither group had a significant change in post-test anxiety. The experiment group was more satisfied with teaching than the control group.
Groves ND, Humphreys HW, Williams AJ, Jones A. 2010.	Effect of informational Internet web pages on patients' decision-making: randomised controlled trial regarding choice of spinal or general anaesthesia for orthopaedic surgery.	Hip or knee arthroplasty patients (n=118: 59 in intervention group and 59 in control group)	Patients were given addresses of three relevant anaesthesia and health-related websites to access at home	No intervention	Pre-operatively	Experiment group altered their preference towards anaesthesia compared to the control group. The increase in patients' anaesthesia knowledge test score was greater in the intervention group than in the control group.

2.2.1 Creating the content for patient education interventions

The content of patient education can be created in different ways; for example, by developing new education materials, by revising existing materials, by using available and appropriate community education resources or by adapting materials from other similar organizations. Patient education can take many forms; it can be formal or informal, written or verbal, on paper or in electronic form. There are instructions that apply to all forms of material and then also more detailed and specific instructions, for example, for Internet-based patient education materials. When creating the content of the education material, it should be current, accurate and sufficient for the predetermined purpose of the education. (Rankin & Duffy 1983, Bastable 2003, The Joint Commission 2003, Anderson et al. 2007, Fox 2009, Kruzik 2009, Powell 2009.) Patients' knowledge expectations are the key elements shaping the content of empowering patient education (Leino-Kilpi et al. 1998, 1999, 2005).

Earlier studies have found patients' knowledge expectations to be diverse. Ambulatory orthopaedic surgery patients expect knowledge about bio-physiological (Linden and Bergbom Enberg 1995) and functional issues (Linden and Bergbom Enberg 1995, Thatcher 1996). Moreover, earlier studies have evaluated the amount and adequacy of the bio-physiological, functional, social, and experiential dimensions of knowledge received by ambulatory orthopaedic surgery patients. Earlier studies indicate that patients have reported receiving knowledge about the bio-physiological dimension of knowledge (Fitzpatrick et al.1998, Bernier et al. 2003, Leino-Kilpi et al. 2009), as well as the functional (Sigurdardottir 1996, Leino-Kilpi et al. 2009), social (Bernier et al. 2003, Leino-Kilpi et al. 2009), experiential, ethical and financial dimensions of knowledge (Leino-Kilpi et al. 2009). Previous studies have also reported a lack of received knowledge about the functional (Linden & Bergbom Enberg 1995, Bernier et al. 2003), bio-physiological (Sigurdardottir 1996, Fitzpatrick et al. 1998) and experiential dimensions of knowledge (Bernier et al. 2003).

In earlier RCT studies concerning the use of the I-BPE method in ambulatory orthopaedic surgery care, the content of the website has either included knowledge about the entire surgery process (Goldsmith & Safran 1999; Scherrer-Bannerman et al. 2000), or a specific area of the surgery process, such as anaesthesia -related issues (Hering et al. 2005, Groves et al. 2010, Edward et al. 2011). (See Table 1.)

Earlier studies concerning the use of empowering face-to-face education have either included multidimensional empowering knowledge about the entire surgery process (Johansson et al. 2007), or else the empowering knowledge has not been described in detail; instead, it has only been mentioned as being empowering (Pellino et al. 1998).

2.2.2 User acceptance of the patient education intervention

User acceptance of the patient education intervention is used in the evaluation of a website. User acceptance is determined by evaluating the utility and usability of the education as well as the costs of the education. (Davis 1989, Nielsen 1993, Dillon & Morris 1996, Venkatesh et al. 2002.)

Utility and usability are parts of the overall acceptance of a website. The concept of utility relates to patients' perceptions of the usefulness of the education. The usability of the education refers to how easy it is to use the website. Patients' evaluations about the utility and usability of the education are relevant when creating and evaluating a patient education website (Nielsen 2003, Kirkley & Rewick 2003, The Finnish Ministry of Finance Quality Criteria of Public Online Services 2004, Atack et al. 2008, Fleisher et al. 2008, Roberts 2010). Internet-based education must be easy to use and effective so that the patient can concentrate on the information content and learning instead of the interface (Nielsen 1993, Kirkley & Rewick 2003, Nielsen 2003, The Finnish Ministry of Finance Quality Criteria of Public Online Services 2004, Fox 2009).

Patient perception of the usefulness of the education is one aspect of the thorough utility evaluation of a patient education method. Usefulness can be evaluated by assessing the content, the achieved knowledge or satisfaction with the material. Previous studies have proved that patients are satisfied with Internet-based patient education (Scherrer-Bannerman et al. 2000, Lewis 2003, Wofford et al. 2005, McMullan 2006, Nguyen et al. 2006, Keulers et al. 2007, Atack et al. 2008, Fleisher et al. 2008, Edward et al. 2011), and with face-to-face education (Rankin & Duffy 1983, Harju 1991, Rudkin et al. 1996, Bain et al. 1999, Kanerva et al. 1999, Leino-Kilpi et al. 2000, Myles et al. 2000, Fung and Cohen 2001, Yellen & Davis 2001, Bastable 2003, Chanthong et al. 2009, Lemos et al. 2009, Goldstein & Hadidi 2010).

Website usability has been tested in several patient education studies (Beaudoin et al. 2005, Atack et al. 2008, Fleisher et al. 2008.), but not specifically in surgical patient education. In earlier studies, researchers have tested the usability, for example, in a test laboratory by following the user with a video camera and observation methods (Eysenbach & Köhler 2002). In addition, "Complete a Task" and "Talk Aloud" performance usability methods have been used (Ryan et al. 2009). These tests give direct input on how patients use the website. The usability of the website can also be tested with questionnaires for patients or by evaluating the user interface (Nielsen 2003).

Financial evaluation is a part of user acceptance. The cost of patient education is one part of the cost of care. The costs of care can be evaluated within different time frames (such as during hospitalisation, from home to home, or from falling ill to the final cure), and from different perspectives (such as that of the patient or an organisation).

Most guidelines suggest using a societal perspective; costs accrued outside of health care should also be included (Drummond & Jefferson 1996). Healthcare costs can be classified into categories: *costs for patients* (direct: child care, travelling expenses; indirect: travel and waiting time, sick leave) and *costs for the providing health care organization* (direct: prescribed drugs, working time; indirect: reduction of productivity) (Räsänen 2007, Sintonen 2007, Montin el al. 2009). Well-planned patient education seems to reduce the cost of care (Devine & Cook 1986, Devine 1992, Bartlett 1995, Loveman et al. 2003, Johansson et al. 2004 and 2005, Correll et al. 2006). However, it is not known if this is the case in Internet-based education (Knee & Jacobs n.d.). Several studies have been done in which the researchers assumed that the Internet reduces costs without being able to prove the assumption correct (Griffiths et al. 2006, Berger et al. 2009, Tate et al. 2009).

2.2.3 Outcomes of the patient education interventions

Commonly measured outcomes of patient education include patients needs (Suhonen & Leino-Kilpi 2006), knowledge level (Lee et al. 2003, Johansson et al. 2004, Fredericks et al. 2010), self-care behaviour, experiences of symptoms (Fredericks et al. 2010), attitudes (Johansson et al. 2004), satisfaction (Lee et al. 2003) or clinical outcomes, including, for example, blood pressure and weight (Lee et al. 2003, Fox 2009, Fredericks et al. 2010). This study focuses on the cognitive (including knowledge level and sufficiency of knowledge) and clinical outcomes (including symptoms and emotions) of patient education interventions.

Cognitive outcomes

Surgical patients' knowledge has been studied based on patients' own evaluations of their sufficiency of knowledge (e.g., Johansson et al. 2004). Whereas patients' knowledge level has also been studied, only a limited number of knowledge tests for measuring patients' knowledge exist. These tests have mainly been developed for a particular situation, or else they only cover a small part of the surgery process. (Strömberg et al. 2006, Keulers et al. 2007, Beamond et al. 2009, Groves et al. 2010, Edward et al. 2011.) Internet-based patient education has recently been studied from the perspective of cognitive outcomes. Both the patients' level of knowledge and their sufficiency of knowledge have been measured (Lewis 1999, Bessell et al. 2002, Lewis 2003, Kirsch & Lewis 2004, Wantland et al. 2004, Wofford et al. 2005, Griffiths et al. 2006, Beranova & Sykes 2007).

Hering et al. (2005) studied the knowledge level of ambulatory surgery patients using a website with a randomized controlled trial (n=164) with a control intervention of nurse based-education (standardized verbal instructions). Based on the results, the use of the website was more effective in improving patients' knowledge of anaesthesia. They used a Modified Standard Anaesthesia Learning Test (mSALT) as a tool to measure knowledge after patients had completed the education. Furthermore, Groves et al.

(2010) tested orthopaedic surgery patients' (n=59) knowledge level in an intervention where patients used three relevant anaesthesia and health-related websites which were not available for control group patients (n=59). Patients' knowledge was measured using a Standard Anaesthesia Learning Test before operations and postoperatively on the wards. This double-blind randomized controlled trial proved that websites improve the knowledge level of patients. Based on reviews of Internet-based patient education (Lewis 1999, Bessell et al. 2002, Lewis 2003, Kirsch & Lewis 2004, Wantland et al. 2004, Wofford et al. 2005, Griffiths et al. 2006, Beranova & Sykes 2007), improvements can be achieved in patients' knowledge level and their sufficiency of knowledge.

It is not well known which socio-demographic variables are related to the cognitive outcomes of Internet-based patient education. However, we do know that age, gender and previous education are associated with the cognitive outcomes of other types of patient education (Rankinen et al. 2007, Fredericks et al. 2010).

Clinical outcomes

Experiencing emotions during patient education

Experiencing emotions during an ambulatory surgery is common (Gillies & Parry-Jones 1997, Shuldham 1999, Gillies et al. 1999, Grieve 2002, Rhodes et al. 2006, Mitchell 2010). Emotions such as fear, anxiety, depression, nervousness, impatience, worry and uncertainty can be experienced. They are part of a normal surgery process for the patient (Spielberger et al. 1973). Sometimes, these emotions exceed a level that is tolerable (Mitchell 2010, Wong et al. 2010). With targeted patient education, it might be possible to help the patient deal with these emotions. Some studies, reviews and meta-analysis have been done on individual emotions in connection with patient education (Devine & Cook 1986, Hathaway 1986, Shuldham 1999, Hughes 2002, Lee et al. 2003, Johansson et al. 2004, 2005). These include anxiety (Cochran 1984, Gillies & Parry-Jones 1997, Shuldham 1999, Gillies et al. 1999, Grieve 2002, Dewar et al. 2004, Kiviniemi 2006, Rhodes et al. 2006, Mitchell 2010) and fear (Gillies & Parry-Jones 1997, Shuldham, 1999, Gillies et al. 1999, Grieve 2002, Rhodes et al. 2006, Mitchell 2010). Several emotions still remain understudied. Instruments measuring emotions vary considerably. The instrument that is most commonly used is the Spielberger State-Trait Anxiety Inventory. The Visual Analogue Scale has been used as well. (Shuldham 1999, Lee et al 2003, Coll et al. 2004a and 2004b.)

Internet-based patient education interventions have been found to be effective in reducing patients' anxiety after the education (Scherrer-Bannerman et al. 2000). However, there are also studies that did not show improvement in the anxiety level of patients (Hering et al. 2005). There are no studies concerning the effect of empowering patient education on orthopaedic surgery patients' emotions.

Intensity of symptoms as an outcome of patient education

Several studies have proved that AOSP experience a variety of symptoms postoperatively. However, the appearance of these symptoms has usually not been studied preoperatively. One of the most commonly studied symptom is pain (Cardosa et al. 1994, McHugh & Thoms 2002, Apfelbaum et al. 2003, Coll et al. 2004a, Susilahti et al. 2004, Suhonen et al. 2007, Idvall et al. 2008, Clabo & Mårtensson 2009, Mattila 2010, Rawal 2010, Wong et al. 2010). In addition, patients might experience bleeding (Chung 1995), vomiting (Oberle et al. 1994, Cardosa et al. 1994, Chung 1995, Susilahti 2004), nausea (Cardosa et al. 1994, Jenkins et al. 2001, Susilahti et al. 2004), headaches, sore throats, dizziness, drowsiness, hoarseness (Chung 1995, Beauregard et al. 1998), and fatigue (Oberle et al. 1994, Beauregard et al. 1998, Susilahti et al. 2004).

Researchers have studied the effect of Internet-based patient education in reducing ambulatory surgery patients' postoperative pain (Goldsmith and Safran 1999). Patients receiving extra information about pain from the website preoperatively evaluated their postoperative pain as being lower than patients receiving information about the surgery process in general. There are no studies concerning the effect of empowering patient education on orthopaedic surgery patients' symptoms. Few reviews and meta-analysis exist that have measured the severity of symptoms as clinical outcomes of orthopaedic surgery patients' education. Patient education has been improved to relieve postoperative symptoms such as pain (Devine & Cook 1986, Devine 1992, Shuldham 1999, Lewis 2003) nausea, vomiting, and fatigue (Johansson et al. 2004). There are also studies proving that patient education has had no effect in reducing, for example, pain (Johansson et al. 2004, 2005, Wofford et al. 2005) or that education might even have increased these symptoms (Johansson et al. 2004 and 2005). Usually, these studies have measured the symptoms postoperatively or before and shortly after the patient education.

2.3 Summary of the literature review

This literature review revealed a lack of studies about cognitively empowering and Internet-based patient education with ambulatory surgery patients. Some key elements for the content of CEI-BPE could be defined. Also, the literature supported the need to evaluate the user acceptance and outcomes of CEI-BPE. A summary of literature review concerning the creation and evaluation of CEI-BPE is provided in Figure 3.

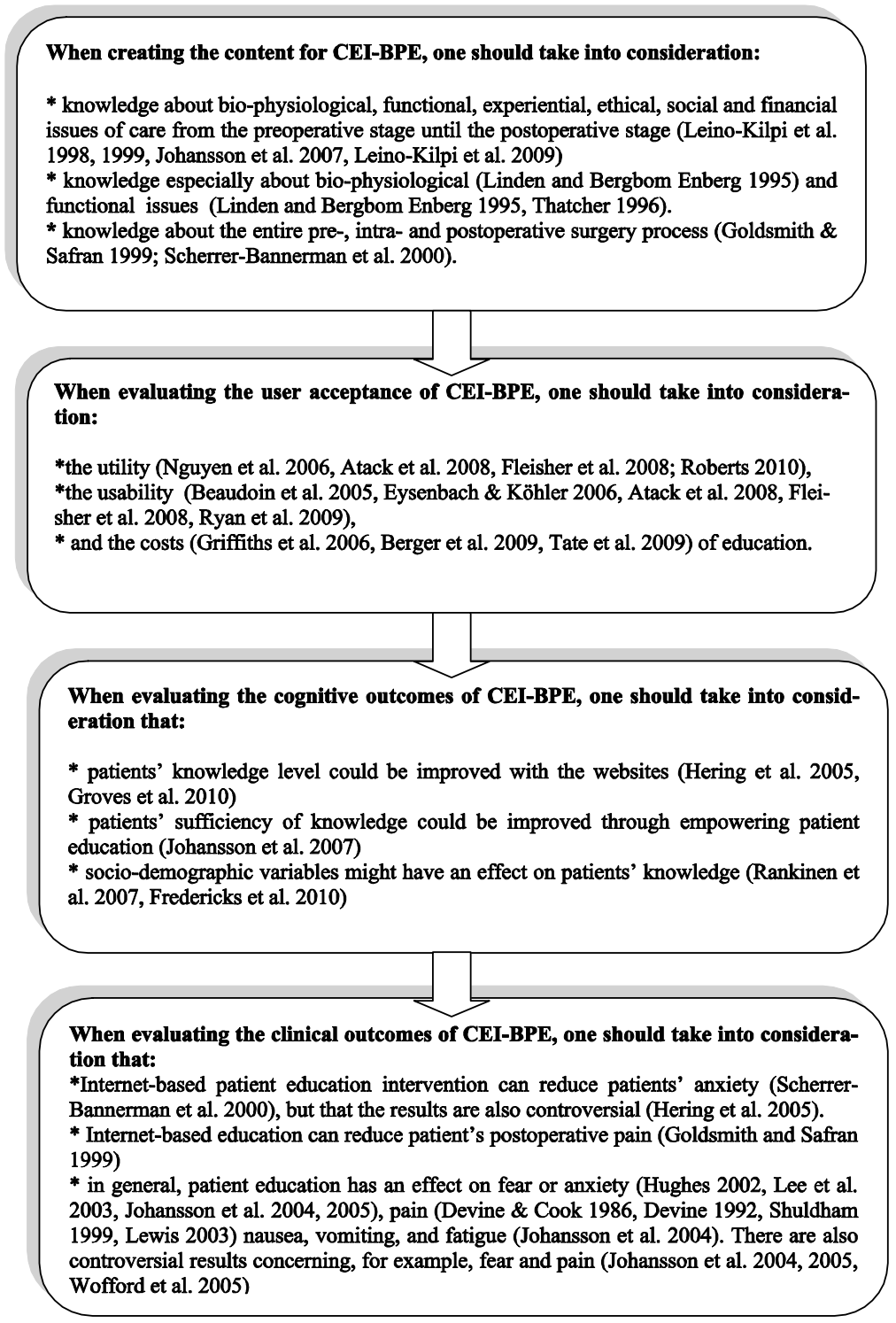


Figure 3. Summary of the literature concerning the creation and evaluation of cognitively empowering Internet-based patient education (CEI-BPE).

3. AIM OF THE STUDY, RESEARCH DESIGN AND PHASES OF THE STUDY

The aim of this study was to create and evaluate an Internet-based patient education programme that would cognitively empower ambulatory orthopaedic surgery patients.

The ultimate goal of this study was to create a new type of cognitively empowering patient education intervention which offers an individualized and engaging method that is free of time and place for patients having an ambulatory orthopaedic surgery operation.

The research questions were as follows:

1. What should be the content of cognitively empowering Internet-based patient education? (Paper I)
2. What is the user acceptance for cognitively empowering Internet-based patient education? (Papers II, III and summary)
3. What are the cognitive and clinical outcomes of cognitively empowering Internet-based patient education compared with cognitively empowering face-to-face patient education? (Papers IV, V, VI and summary)

The detailed research questions, in connection with the phases of the research project, are illustrated in Figure 4.

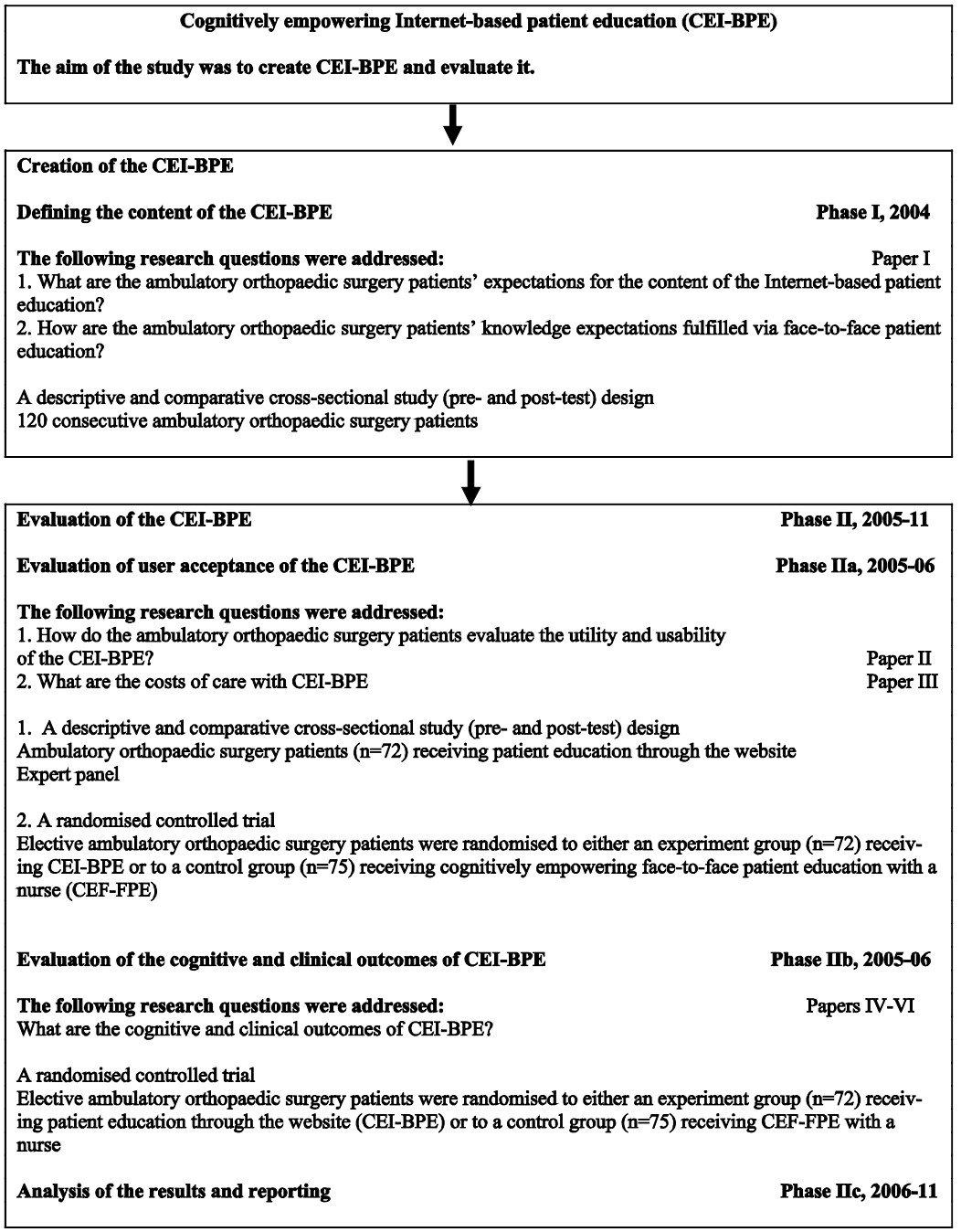


Figure 4. The study design.

4. METHODS

The aim of this study was to create and evaluate an Internet-based patient education programme that would cognitively empower ambulatory orthopaedic surgery patients. The study was conducted in two phases. In Phase I, we used a descriptive comparative cross-sectional study (pre- and post-test) design (2004). In Phase II, we conducted a clinical study using a randomised controlled trial (2005-2006). (See Figure 4.)

4.1 Sampling and setting

We collected the data in two phases using two different samples. In Phase I (2004), we collected the data from among surgery patients before admission and two weeks after their discharge in one university hospital in Finland during a six-month period in 2004. Altogether, 200 surgery patients were eligible, of which 50 declined to participate, and we discarded five questionnaires because of missing data. One hundred twenty of these patients were orthopaedic patients who we chose to include in this study. The response rate in was 73% (145/200). The inclusion criteria included being over the age of 18, being Finnish-speaking, having no cognitive disabilities and being capable of completing the questionnaire and giving informed consent. (Paper I.) Socio-demographic data on the patients are shown in Table 2.

In Phase II (2005-2006), we collected the data from among AOSPs. The inclusion criteria included being over the age of 18, being Finnish-speaking, having access to the Internet at home and being capable of using it, having no cognitive disabilities and being capable of completing the instruments and giving informed consent. The exclusion criteria were ASA-classification >II (ASA). All patients fulfilling the inclusion criteria received an invitation to participate in the study (N=173). Altogether, we excluded 127 patients from the study because they did not have an Internet connection at home and several other patients because they were not Finnish-speakers (n=3) or because their ASA-classification was > 2 (n=11). The response rate was 86% (n=149). Reasons for refusal included: the questions were too difficult (n=1), no time to participate (n=20) and do not participate in any studies in general (n=3). These patients participated in the usual patient education with a nurse. We randomly assigned patients who enrolled in the study (n=149) to two groups (n=72 in the experiment group and n=77 in the control group). We used a list of random numbers for the randomization. The randomizations were based on gender, age (18–34, 35–50, 51–65, >66), and the location of the operation (knee or shoulder arthroscopy). We chose gender and age as the variables for stratification since being female (Rankinen et al 2007) and older (Rankinen et al 2007) have previously correlated with having less knowledge about the operation. Neither the patients nor the study co-ordinators were aware of the educational assignment until after the randomization. Two patients that were randomised to the control group did not come to the patient education and were

excluded from the study. The intervention of the study is described in Figure 8 and in Papers II and III. There were no statistically significant differences between the characteristics for the two groups (p=0.189-0.976). (See Table 2.)

Table 2. Socio-demographic data on patients at Phases I and II of the study.

Variables	Phase I (Paper I)	Phase IIa & IIb (Papers II*, III, IV, V, VI)		
	n =120 %	Experiment group n =72 %	Control group n =75 %	p-value**
Gender				
• female	54	46	44	0.823
• male	46	54	56	
Age, years				
• mean	45.85	44.19	43.52	0.929
• range	19-83	18-69	18-67	
Basic education				
• six years of schooling	24	20	16	0.279
• nine years of schooling	46	41	55	
• twelve years of schooling	30	39	29	
Professional education				
• no education	15	16	18	0.816
• secondary level	43	29	36	
• upper secondary/college	27	32	29	
• polytechnic/university	15	22	17	
Employment status				
• employed	64	75	84	0.189
• retired	17	4	4	
• partially retired	-	3	1	
• homework	3	1	1	
• student	5	8	3	
• unemployed	9	4	7	
• other	2	4	-	
Work in health care				
• yes	22	19	24	0.503
• no	78	81	76	
Long-term illness				
• yes	57	21	21	0.976
• no	43	79	79	
Earlier ambulatory surgery				
• yes	53	58	57	0.847
• no	47	42	43	
Operation				
• arthroscopy of shoulder	19	62	57	
• arthroscopy of knee	20	38	43	
• other orthopaedic operations	61	-	-	0.523

*Paper II included only experiment group patients **Pearson chi-square

In Phase II, we evaluated the patients' use of a computer and their computer skills using "The PEE" in order to know if the groups were similar. Most of the ***patients*** (45%) ***in the CEI-BPE group used a computer*** several times a day. In the ***CEF-FPE group,*** 35% of ***patients used the computer*** several times a day. Computer use was almost similar two weeks postoperatively. There were no differences in these results between the two groups (p=0.198-0.352) (Mann-Whitney-U-test). (See Table 3.)

After the postoperative education, most of the ***patients' in the experiment group*** evaluated their ***computer skills*** as being good. Most of the patients in the ***CEF-FPE group*** evaluated their ***computer skills*** as being moderate. The evaluations were for the most part the same two weeks postoperatively. There were no differences in these evaluations between the groups (p=0.102-0.143) (M-W-U). (See Table 3.)

Table 3. How frequently patients used the computer and their evaluation of their skills at using the computer after their education.

Questions	Patients' evaluations after education preoperatively, as a percentage (%)	
	experiment (n=71)	control (n=73)
Use of computer		
* several times a day	45	35
* once a day	24	29
* 3-5 times a week	21	18
* 1-2 times a week	7	14
* 1-2 times a month	3	4
Skill at using a computer		
* extremely good	28	25
* good	35	25
* moderate	27	33
* rather poor	9	18
* really poor	1	-

4.2 Educational interventions

4.2.1 Face-to-face education (Phase I)

In Phase I, all patients participated in a preoperative face-to-face education session with a nurse. One nurse delivered this education session and it took place in a separate room in a day surgery unit. The content of the education consisted of six dimensions of empowering education. Patients were given a written leaflet about the content of the session. (Leino-Kilpi et al. 2005, Rankinen et al. 2007.) This intervention was the basis for the controlled intervention in Phase II. (See Paper I.)

4.2.2 Cognitively empowering Internet-based patient education (Phase IIa & IIb)

CEI-BPE requires careful design of content and structure. The content, structure and method have been designed so that patients enable the use of cognitively empowering material.

The content of the education

The content of this cognitively empowering Internet-based patient education program is based on previous studies on empowerment and empowering patient education and patients' knowledge expectations about the bio-physiological (e.g., their injury or disease), functional (e.g., how to exercise), social (e.g., home care), experiential (e.g., experiences in the hospital), ethical (e.g., their rights) and financial (e.g., possible costs of care) aspects of their care (Leino-Kilpi et al. 1998, 1999). This was the orientation base when designing the content of the patient education website. The content of education was also based on the Phase I study of the research on AOSP knowledge expectations and received knowledge (Paper I). In addition, we have added detailed knowledge in collaboration with practitioners in clinical practice.

The structure of the education

The structure of the website was designed to be simple to use and low in cost. Empowering knowledge is set at three levels: 1) basic (facts), 2) intermediate (explanations) and 3) advanced knowledge (detailed explanations). The website has a main page with a navigation bar on the left side and 14 subheadings. In total, 59 pages (5424 words) and 30 links are available. The text on the website is supported by illustrative pictures and a video. In addition, the website contains 22 frequently asked questions (FAQ) about preparation, the operation, and rehabilitation at home. Patients were also able to contact a nurse via email. Patients' questions were directed to an e-mail account shared by the nurses at the operating department. Once a day, the nurse responsible for patient education answered the patients' questions. The questions and the answers were printed and added to the patient's care documents.

The structure and the content of the website is presented in Paper II and Figure 5.

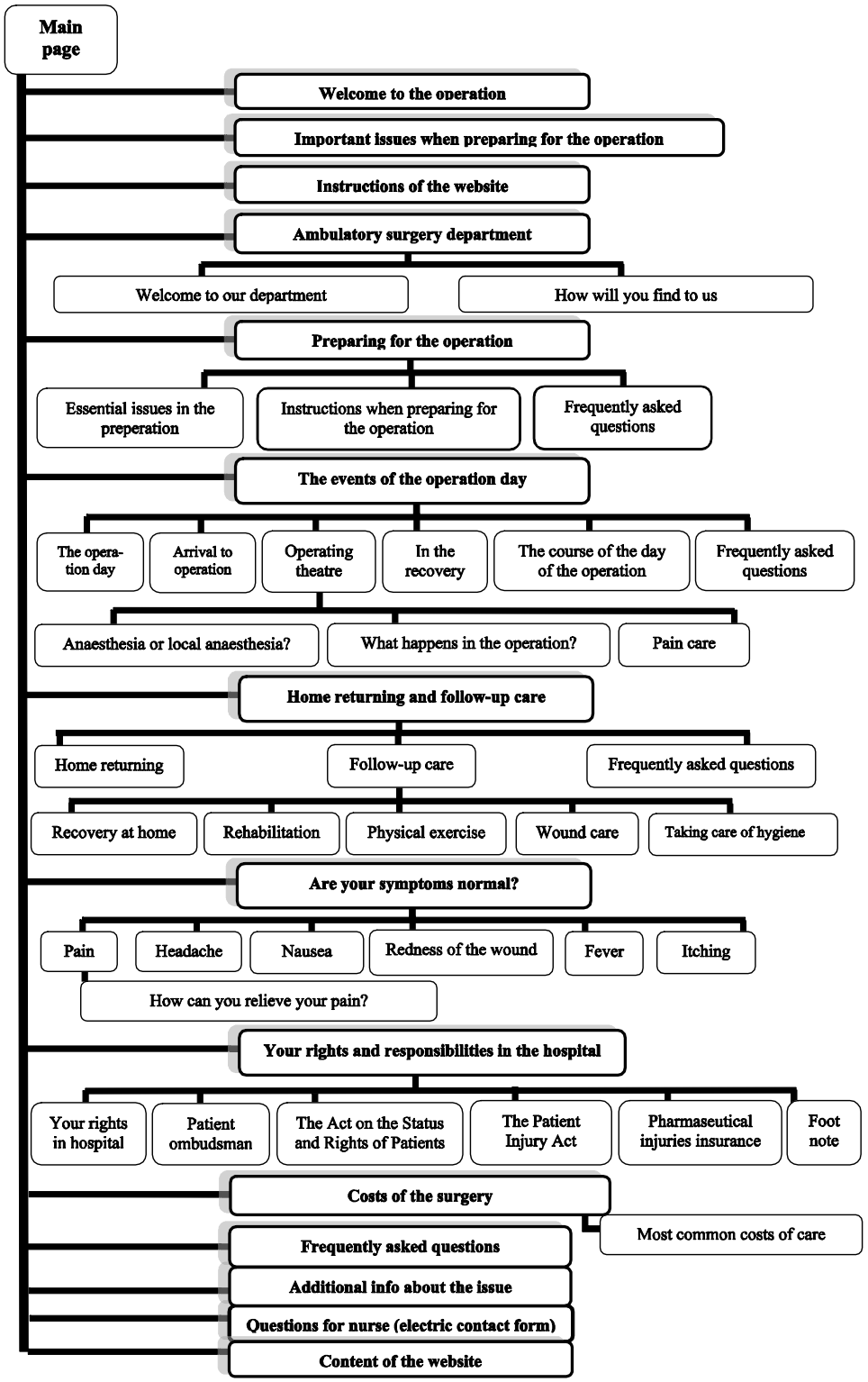


Figure 5. Structure of the cognitively empowering Internet-based patient education program.

Design of the website

Researchers of nursing science, experts in information system science, and experts in visualisation designed the website. They utilised existing instructions for the design (e.g., Cline & Haynes 2001, Nielsen 2003) and evaluation of the patient education website (Brooks 2001), or websites in general (e.g., eEurope 2002, Valtionvarainministeriö 2003, The Finnish Ministry of Finance Quality Criteria of Public Online Services 2004, Cline & Haynes 2001). When designing the website, they took into account accessibility, user friendliness, accuracy and a standard format, as well as quick downloading. The pages have a dynamic operation, which means that the content is recorded in a database. It is then published in an extranet. An information technology professional realized the service using PHP (PHP Group, http://www.php.net/) and MySQL (Oracle, Redwood Shores, CA) -programming environments. Ethical principles for website creating (transparency, financial disclosure, and honesty) were followed (eHealth Code of Ethics 2000, eEurope 2002, Health On the Net Code of Conduct).

In the structuring of the website, we used an analysis frame to check the layout, content, language and creation of the website (e.g., Salanterä et al. 2005). The language was checked by a language consultant. The utility and usability of the website was piloted by an expert panel consisting of experts in information system science (n=5), nurses (n=5), physicians (n=3), physiotherapists (n=2), representatives of nursing science (n=5) and patients (n=7). Nurses, physicians and physiotherapists also evaluated the clinical accuracy of the content.

Use of the website

Patients received a login ID and a password 6-145 days (mean=30, SD 22.2) before their operation. Patients visited the website 1–121 days (mean=14, SD 19.1) before the operation. Patients were asked about the usage and application time of the website. All patients used the website at least once. Nearly one-third of the patients (28%) used the website only once, 36% used it twice, 22% used it three times and 14% of the patients used it four to six times (mean 2.3 times). The application time of the website (based on the diaries) ranged from 10 to 300 minutes (mean=80.7, SD 66.71). Due to technical reasons it was not possible to track the use of the website by individual patients. (See Figure 6.)

All of the nurses in the operation ward received special education. This training included two lectures about the content of the CEI-BPE. In addition, they were taught how to use the Internet-based program. Nurses also had a printed version of the content of the cognitively empowering Internet-based patient education program.

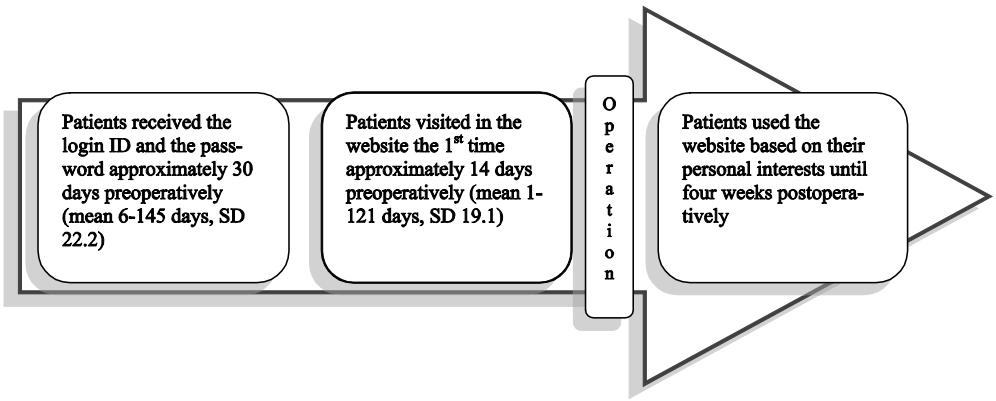


Figure 6. The ambulatory orthopaedic surgery patients' (experiment group) use of the cognitively empowering website during the surgery process.

4.2.3 Control intervention (Phase IIa & IIb)

In the control group, the patients participated individually in CEF-FPE with a nurse (in total eight nurses); this took place in a separate room in the ambulatory surgery unit approximately nine days preoperatively. The education session took about 22 minutes (mean range 10-40 min). The content of the patient education contained the same areas of empowering knowledge as the Internet-based patient education. Patients were given a written leaflet about the content of the session. Nurses were trained for this study and they knew the content of the website (CEI-BPE). They also had the printed version of the website available. (See Figure 7.)

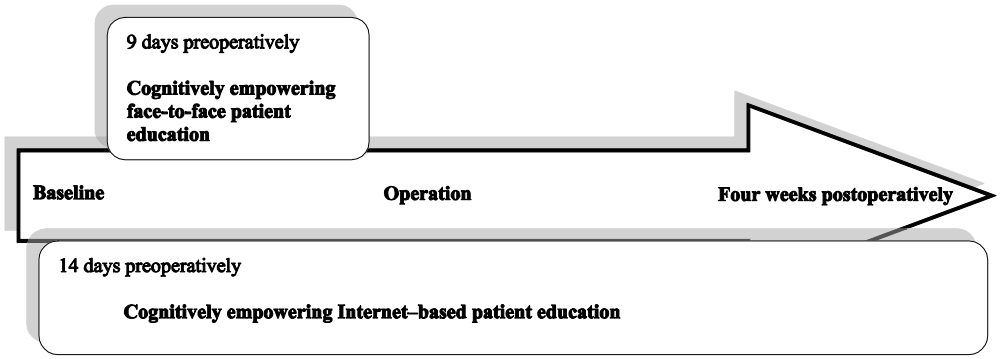


Figure 7. Time and the duration of education, with the ambulatory orthopaedic surgery patients receiving cognitively empowering Internet-based patient education or cognitively empowering face-to-face patient education.

4.3 Data collection and analyses

The empirical data are presented in Table 4. We collected the data for the descriptive and comparative study and the clinical study using questionnaires during the years 2005-2006. Based on the knowledge gained from the Phase I, we created and tested the website for a CEI-BPE in Phase II. The validity and reliability of all data collection-related issues are discussed in section 6.1.

Table 4. Design, samples and methods of data collection and analyses.

Design	Sample	Methods of data collection	Methods of analysis
Descriptive and comparative (Paper I)	Ambulatory orthopaedic surgery patients (n=120)	Socio-demographic variables (SosdemV) Hospital Patient's Knowledge Expectations Scale (HPKE) and the Hospital Patient's Received Knowledge Scale (HPRK)	Statistical analysis
Descriptive and evaluative (Papers II-VI)	Ambulatory orthopaedic surgery patients (n=147: experiment group n=72, control group n=75)	Socio-demographic variables (SosdemV), Knowledge Test (KT), Sufficiency of Knowledge (SoK), the Orthopaedic Patient Knowledge Questionnaire (OPKQ), The patients' evaluations of the education (PEE), The Diary on the use of the website (DUW; in experiment group), Preoperative Costs (PC), Intra- and Postoperative Costs (IPC), the Consultations (Con), Emotions (E) Symptoms (S), $EQ5D_{VAS}$ (The EuroQol Group 2008), Nurses documentations (Nd)	Statistical analysis

The instruments used in Phase I of this study were the Hospital Patient's Knowledge Expectations Scale (HPKE) and the Hospital Patient's Received Knowledge Scale (HPRK) (Paper I). We used these instruments in order to find out about AOSP expectations and the patients' perceptions of received knowledge about how they could manage their surgery and care. The HPKE and HPRK were designed to measure the general knowledge expectations and the perceptions of received knowledge of surgical patients (Leino-Kilpi et al. 2005, Rankinen et al. 2007). The statistical analyses used in this phase are shown in Table 6.

Phase I produced information about AOSPs' fulfilment of knowledge. We calculated the power analysis and it yielded a required total sample of 120 patients with a power level of 0.80 and significance level of 0.05. This calculation was based on an effect size near 0.30.

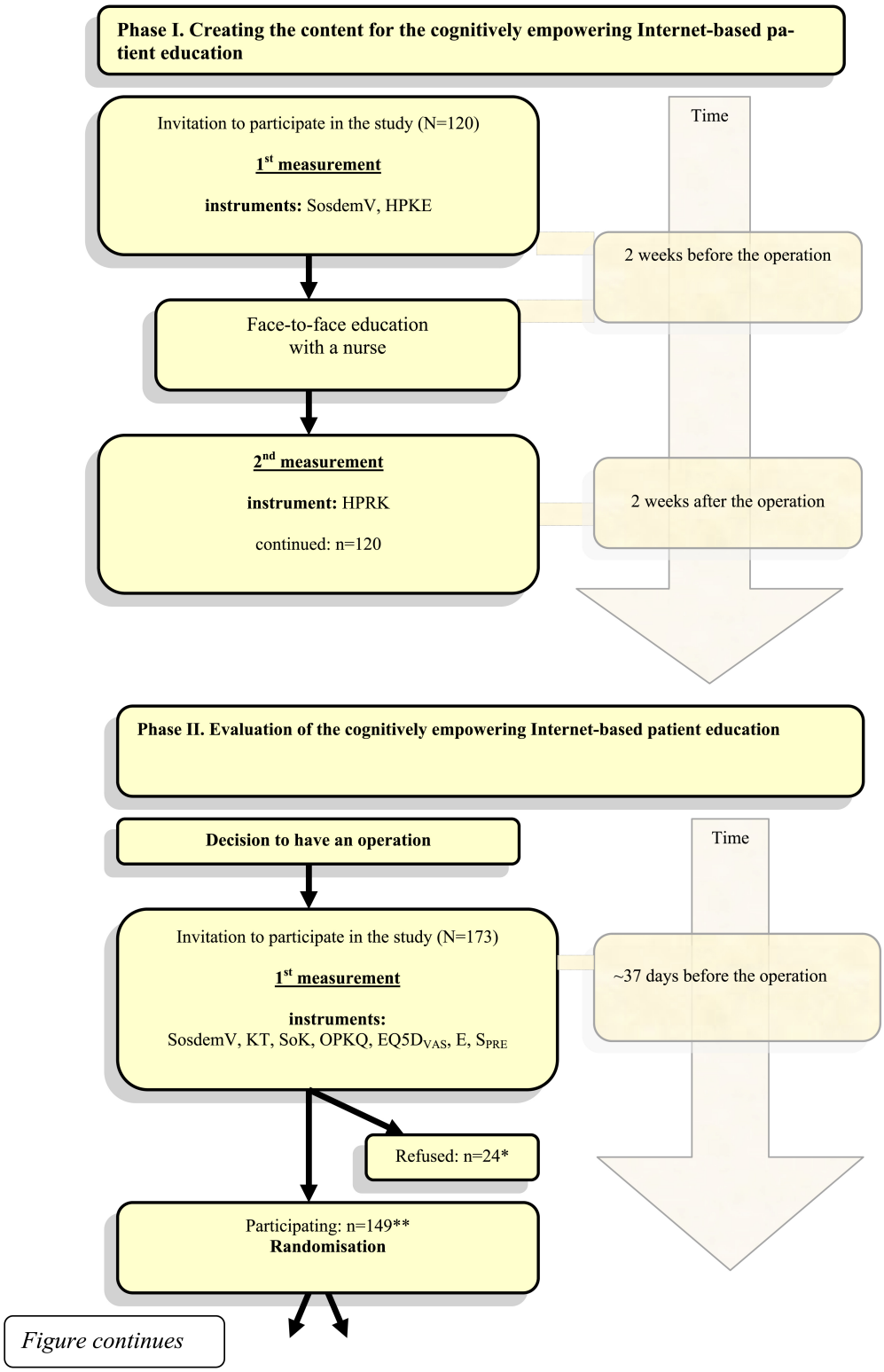
In Phase II, we planned the Internet-based patient education based on the results of the Phase I and created and tested it in a clinical trial setting (Papers II-VI, see also section 4.2). We calculated a power analysis in order to ensure the inclusion of a sufficient number of patients in the study (Burns & Grove 2005). Patients' knowledge was the main outcome of this study and the power analysis was based on the results of a study by Johansson et al. (2007) which used the Orthopaedic Patients Knowledge Questionnaire (OPKQ; Pellino et al 1998, Johansson et al 2007). In this study, we used the OPKQ in Finland with Finnish orthopaedic surgery patients, even though no previous studies have been done on ambulatory orthopaedic surgery patients. In the power analysis in Phase II, we determined that 72 patients per group (144 patients in total) were needed in order to detect a difference in the change between groups (measured by group interaction) with a power level of 0.90 and significance level of 0.05. The assumed means for the measurements, which we repeated three times, were 3.7, 4.0 and 4.3 for the control group and 3.7, 3.7 and 3.7 for the experiment group; the assumed variances were 1. We assumed a moderate correlation of 0.5 between the repeated measurements in both groups. (Paper IV)

In Phase II, we collected the data from the patients using eleven instruments:

1. The Knowledge Test (KT) was designed for this study and the content was based on that of the HPKE and HPRK (Leino-Kilpi et al. 2005)
2. The Sufficiency of Knowledge (SoK) was modified for this study and the content was based on that of the HPKE and HPRK (Leino-Kilpi et al. 2005)
3. The Orthopaedic Patient Knowledge Questionnaire (OPKQ) (Pellino et al. 1998, Johansson et al. 2007)
4. The Patients' Evaluations of Education (PEE) which was designed for this study
5. The Diary of the Use of the Website (DUW) in the CEI-BPE, which was designed for this study
6. Preoperative Costs (PC), which was designed for this study
7. Intra- and Postoperative Costs (IPC), which was designed for this study
8. the Consultations (Con), which was designed for this study
9. Emotions (E), which was designed for this study
10. Symptoms (S_{PRE}, S_{POST}), which was designed for this study
11. $EQ5D_{VAS}$ (The EuroQol Group 2008)

We sought data about nurses' use of time and their use of consultations from nurses' documentation. The study designs of Phases I and II and the flow of patients is presented in Figure 8.

We pilot tested the instruments with ambulatory surgery patients. We pilot tested the HPKE and HPRK with a sample of ten patients, but no changes were needed. We tested KT and SoK with 100 patients, PEE and DUW with 7 patients, and PC, IPC, Con, E and S (S_{PRE}, S_{POST}) with 17 patients. We then made minor revisions using the KT.



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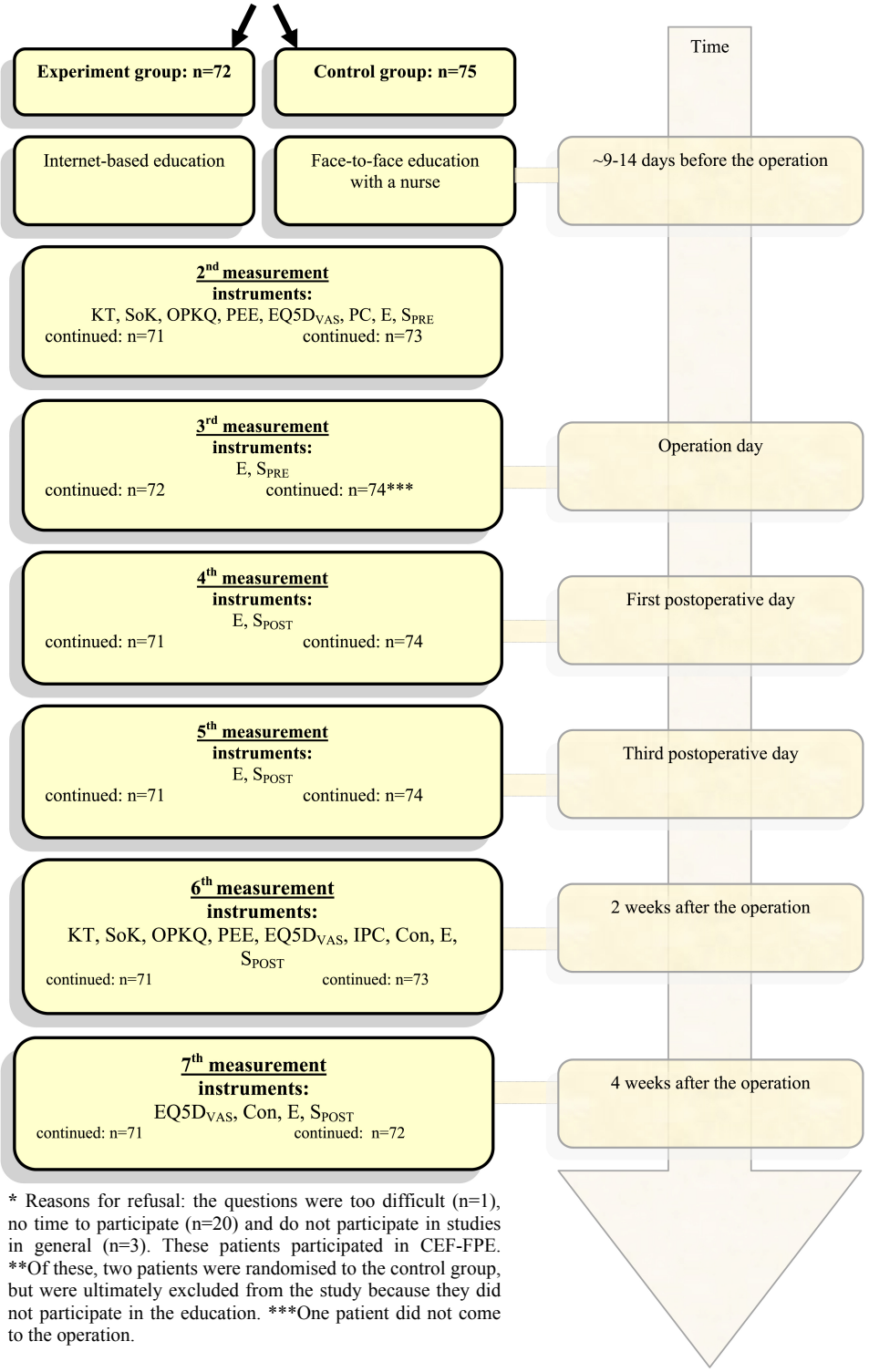


Figure 8. Study designs and flow of patients in Phases I and II.

The instruments that we used, the number of items and the response scale are presented in table 5.

Table 5. Summary of the instruments used in the studies.

Instruments	Items (number of items)	Response scales
SosdemV	gender, age, basic and professional education, employment status, type of operation/surgery, work in health care, long term illness, earlier ambulatory surgery	Variation in scales / Several different scales
HPKE and HPRK (Leino-Kilpi et al. 2005)	32 items (plus 13 sub-items – total 45), divided into: bio-physiological (7 items + 13 sub-items), functional (7), experiential (3), ethical (9), social (2) and financial (4) dimensions of empowering knowledge	Scale 1-4 1 = strongly disagree 4 = strongly agree 0 = not applicable
KT (the content was based on Leino-Kilpi et al. 2005)	27 items, divided into: bio-physiological (8), functional (4), experiential (3), ethical (5), social (3) and financial (4) dimensions of empowering knowledge	Scale 0-1 0 = incorrect 1 = correct 2 = do not know
SoK (the content was based on Leino-Kilpi et al. 2005)	32 items (plus 13 sub-items – total 45), divided into: bio-physiological (7 items + 13 sub-items), functional (7), experiential (3), ethical (9), social (2) and financial (4) dimensions of empowering knowledge	Scale 1-4 1 = strongly disagree 4 = strongly agree 0 = not applicable
OPKQ (Pellino et al. 1998, Johansson et al. 2007)	pre- and postoperative and knowledge applicable to all phases of care (39)	Scale 1-5 1 = not at all certain 5 = extremely certain
PEE	content and the utility of the education (18), practical arrangement of education (2), content of education (8), effect on function (2), recommendations (2), need for further education (1), patients' information sources (3)	Scale VAS 0-100mm a Vertical Visual Analogue Scale 0 (the left side) = the most negative expression (such as not at all/inadequate) 100 (the right side) = the most positive expression (such as clear/adequate/good)
	skill at using a computer	Scale 1-5 1 = extremely good, 5 = extremely poor
	frequency of computer use	Scale 1-5 1 = several times a day 5 = 1-2 times a month

Instruments	Items (number of items)	Response scales
DUW	usability of the website (7)	Scale VAS 0-100mm a Vertical Visual Analogue Scale (VAS; 100mm) 0 (the left side) = the most expression 100 (the right side) = the most positive expression (3 questions) and open (4 questions)
	moment in time when patients had used the website	open: moment (date)
	the duration of use	duration (minutes)
E	emotions (7)	Scale VAS 0-100mm A Vertical Visual Analogue Scale (VAS; 100mm) 0 (the left side) = the emotion does not exist at all 100 (the right side) = the intolerable existence of an emotion
S (S_{PRE}, S_{POST})	preoperative version: symptoms (5); and postoperative version: symptoms (16)	Scale VAS 0-100mm A Vertical Visual Analogue Scale (VAS; 100mm) 0 (the left side) = symptom does not exist at all 100 (the right side) = the intolerable existence of an emotion or symptom
$EQ5D_{VAS}$ (The EuroQol Group 2008)	self-rated health status	Scale Horizontal VAS 0-100mm A graduating horizontal visual analogue scale (0-100) 0 (the bottom) = the worst imaginable state of health 100 (the top) = best imaginable state of health
PC	Preoperative costs: out of pocket costs (6) and use of time (2) for preoperative examinations or patient education	open
IPC	Intra- and postoperative costs: out of pocket costs (11); and the use of time intra- and postoperatively (3): loss of working or free time because of the operation and sick leave	open
Con	the moment of and the reasons for the consultations (6): with someone in the operation ward, emergency ward, health centre, private general practice, a familiar doctor or nurse or someone else	open
Patients' documents	lengths of stay in operation ward	open

We conducted different statistical analyses and tests during Phases I and II depending on the data characteristics (see Table 6 for statistical analysis). In all tests, we set the level of statistical significance at $p < 0.05$ (Burns & Grove 2005). We analysed the data statistically using SAS System for Windows, release 8.2-9.1 (SAS Institute Inc., Cary, NC, USA) (Papers I, II, IV) and SPSS for Windows (version 16.0) (Papers III, V, VI). We calculated frequencies, percent distributions, means, standard deviations and statistical parameters.

Table 6. Statistical analyses for Phases I and II.

Phase and paper	Instruments	Variables	Statistical analyses/ test used
Phase I Creation of the content of the CEI-BPE Paper I	Hospital Patient's Knowledge Expectations (HPKE), Hospital Patient's Received Knowledge (HPRK) (Leino-Kilpi et al. 2005)	Patients' knowledge expectations before patient education and patients' expectations of received knowledge two weeks after operation	Paired T-test
		Socio-demographic variables and knowledge expectations and expectations of received knowledge	A one-way analysis of variance with contrasts
		Socio-demographic variables and the differences between knowledge expectations and perceptions of received knowledge in six summary variables (HIT)	A multinomial logistic regression analysis
Phase IIa Evaluation of the CEI-BPE user acceptance			
Paper II	The patients' evaluations of the education (PEE)	Evaluations immediately after preoperative patient education, preoperatively, and two weeks postoperatively	Paired T-test
	Diary of the Use of the Internet (DUW)	Evaluations after preoperative education until two weeks postoperatively	Descriptive statistics
Paper III	Preoperative Costs (PC), Intra- and Postoperative Costs (IPC)	Differences in the amount of pre-, intra- and postoperative costs between groups	Mann Whitney U –test
		Use of time compared between groups	Two independent samples, T-test
	Consultations (Con)	Patients' use of consultations pre-, intra- and postoperatively between the groups	Mann Whitney U -test
	Nurses documentations	The number of consultations with a nurse	Mann Whitney U -test

Phase IIb Evaluation of the outcomes of the CEI-BPE			
Paper IV	Knowledge Test (KT), Sufficiency of Knowledge (SoK),	Total means and six dimensions from both scales, as well as the effect of the patient education group, the measurement time and the interaction between the group and the measurement time	Repeated measures, analysis of variance with a grouping variable
		Pair-wise comparison between different measurement times of KT & SoK	Repeated measures, analysis of variance with a grouping variable
		The difference between the patient education groups at different measurements times	Two samples, t-test
	SoK, Orthopaedic Patient Knowledge Questionnaire (OPKQ)	The amount of agreement between the means of the SoK and OPKQ at three different points in time	Pearson Correlation
Paper V	Emotions (E)	Association between the repeated measurements, including the effect of the method of patient education, the measurement time and the interaction between the method of patient education and the measurement time	Binary logistic regression with generalized estimating equations. Model included the effect of the group, the measurement time and the interaction between the group and the measurement time
Paper VI	Symptoms (S)	Association between the repeated measurements, including the effect of the method of patient education, the measurement time and the interaction between the method of patient education and the measurement time	Ordinary logistic regression with generalized estimating equations. Model included the effect of the group, the measurement time and the interaction between the group and the measurement time
Summary	Evaluations of patient education (PEE)	Patients' evaluations of the utility of the website between the groups	Mann Whitney U-test
		The difference between the evaluations in two weeks postoperatively and after the effects of the education were calculated and compared between the groups	Mann Whitney U-test
	Socio-demographic variables (SosdemV), Knowledge Test (KT), Sufficiency of Knowledge (SoK)	Patients' socio-demographic variable relations to the patients' knowledge level and sufficiency of knowledge were tested	One-way analysis of variance with contrast and two-sample T-test. In significant relations, adjusted p-values were used according to Tukey's method

4.4 Ethical questions

We followed the basic principles of research ethics at every stage of the study (Medical Research Act 488/1999, ETENE 2001a, 2001b, Academy of Finland 2004, Burns & Grove 2005). Ethical discussion in this study concerns the process of obtaining the necessary permissions to carry out the research and the use of data collection instruments. In addition, we discuss ethical questions concerning the research and means of data collection (Burns & Grove 2005).

The study procedure was approved by the ethical committee of the hospital district (Phase II). In addition, we obtained permission to collect the data from the hospital's chief physician and director of nursing (Committee of Nursing Research) (Phase I & II). We obtained permission to use the questionnaires and modified questionnaires from the authors (Leino-Kilpi et al. 21st March 2005, Johansson 21st March 2005, Pellino 21st February 2005, EuroQol 16th March 2005). Most of the questionnaires were based on the framework of empowering patient education (Leino-Kilpi et al. 1998, 1999).

We obtained informed consent in writing from all of the patients before including them in the study (Phase 1 & II). We assured the patients that their decision of whether to participate or not to participate in the study would not affect their care. We provided both nurses and patients with written and oral information to make sure that they were aware of the purpose of the study.

All of the data used in this study were collected and handled anonymously and results were reported openly and honestly. In the intervention study, both groups received patient education. We chose not to use the "No-treatment" group due to ethical reasons. The researcher visited and contacted the operating ward several times to make sure that the data was being collected and the research was being processing without ethical problems. In order to ensure good ethical practice and to increase the reliability and credibility of the Internet-based patient education, we followed the quality criteria as defined by the eEurope 2002 Action Plan.

5. RESULTS

We report the results of this study in three parts, according to the research questions. First, the results from the creation of the content for CEI-BPE are presented (Phase I; Paper I). Second, user acceptance of the CEI-BPE is discussed: AOSPs' evaluations of the utility and usability of CEI-BPE (Phase IIa; Paper II) and the costs of care (Phase IIa; Paper III). Third, the cognitive and clinical outcomes of CEI-BPE are presented from the point of view of patients' knowledge (Phase IIb; Paper IV) and from the point of view of patients' emotions (Phase IIb; Paper V) and symptoms (Phase IIb; Paper VI). In addition, we also present some new results; the utility of the cognitively empowering Internet-based patient education (section 5.2.1) and the relationship between patients' knowledge level and their sufficiency of knowledge and socio-demographic variables (section 5.3.1).

5.1 Content of the cognitively empowering Internet-based patient education (Phase I)

In creating the content for the CEI-BPE, we evaluated AOSPs' knowledge expectations and the extent to which patients' expectations were met. We evaluated perceptions of the patients' knowledge expectations and patients' received knowledge twice: before the preoperative education and two weeks after the operation. We did so by using "The Hospital Patient's Knowledge Expectations Scale" (HPKE) and "The Hospital Patient's Received Knowledge Scale" (HPRK). Both of these scales included 32 items (plus 13 sub-items – total 45) which measured empowering knowledge (six dimensions of knowledge: bio-physiological, functional, experiential, ethical, social and financial).

AOSP had knowledge expectations in all dimensions of knowledge. The highest knowledge expectations were in the bio-physiological and functional dimensions of knowledge. In addition, patients showed statistically significant differences between their knowledge expectations and perceptions of received knowledge ($p \leq 0.001$-0.002) in total and in all dimensions of knowledge except bio-physiological knowledge (Figure 9) (Paper I). Based on these results, CEI-BPE should contain multidimensional knowledge emphasizing especially the dimensions of knowledge which were the most expected or in which the expectations exceeded the received knowledge; for example, the bio-physiological, functional and financial dimensions of knowledge.

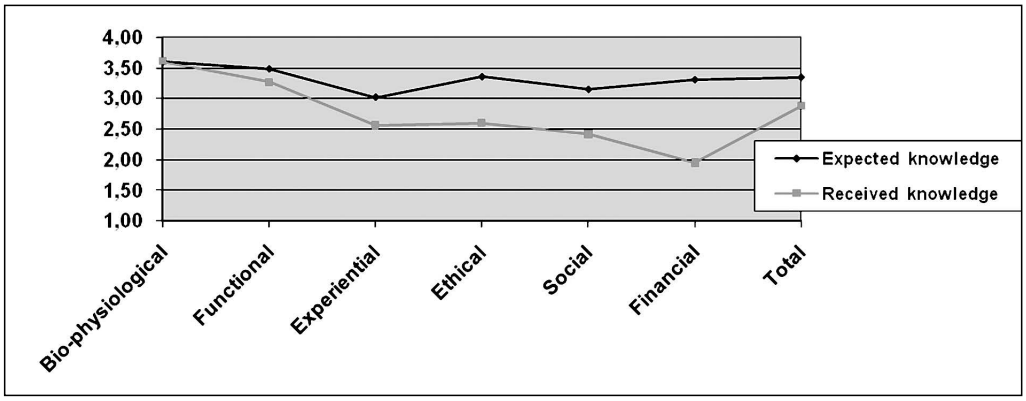


Figure 9. Ambulatory orthopaedic surgery patients' knowledge expectations and perceptions of their received knowledge (scale 1-4: 1 = strongly disagree, 4 = strongly agree) on the six dimensions of knowledge and total knowledge.

5.2 User acceptance of the cognitively empowering Internet-based patient education (Phase IIa)

User acceptance was based on patients' evaluations of the utility and usability of the cognitively empowering Internet-based patient education and patients' costs of care. In addition, we measured the costs of healthcare based on nurses' use of time.

5.2.1 Utility and usability of the cognitively empowering Internet-based patient education

In this study, we use the notion of utility for patients' perception of the usefulness of the website or face-to-face education and usability to refer to the ease of use of the website (Kirkley & Rewick 2003, Nielsen 2003, Silius & Tervakari 2003, the Finnish Ministry of Finance Quality Criteria of Public Online Services 2004).

Utility of the cognitively empowering Internet-based patient education

We evaluated the utility of the education twice: first, after AOSPs' education preoperatively and, second, two weeks postoperatively. We did so using "The Patients' Evaluations of Education" (PEE) instrument. The PEE included 18 questions about the practical arrangement of the education (2), the content of the education (8), its effect on patient function (2), recommendations (2), the need for further education (1) and patient information sources (3). In addition, patients in the experiment group evaluated the ***usability*** of the website during the surgery process using "The Diary of the Use of the Website" (DUW) instrument.

After the education, patients receiving CEI-BPE evaluated the ***utility of the education*** as rather high. Patients scored over 57.56 (scale 0-100) in their evaluation of the practical arrangement of the education, the content of the education, its effect on patient function, recommendations and the need for further education. Patients gave their lowest scores on

question concerning their need for additional education beyond that provided by the website (mean=57.56). ***Two weeks postoperatively, patients receiving CEI-BPE*** evaluated the ***utility of the education*** better than they did right after the education. (Paper II)

After the education, patients receiving CEF-FPE also evaluated the ***utility of the education*** rather high (>66.58; scale 0-100). Patients gave their lowest scores on question concerning their need for additional education beyond that provided by the nurse (mean=66.58). ***Two weeks postoperatively, patients receiving CEF-FPE*** evaluated the ***utility of the education*** still better than they did right after the education.

After the education, patients receiving CEF-FPE evaluated the practical arrangement of the education, the content of the education (except for the usefulness of the education and the effect of the content on understanding the operation better), and its effects on patients' function ($p \leq 0.001–0.028$) lower than did the patients receiving ***CEF-FPE***. Patients' recommendations for the education or for the need for additional education did not differ between the education groups ($p=0.103–0.476$).

The differences in patients' evaluations of the utility of the CEI-BPE and CEF-FPE between the ***education groups and measurement times*** did not change statistically significantly during the period under study, except that the change in the level of ease with which patients could arrange time for their education was statistically significantly better for patients receiving CEI-BPE than for patients receiving CEF-FPE ($p \leq 0.001$) (Table 7).

Table 7. Ambulatory orthopaedic surgery patients' evaluations of the utility of the cognitively empowering Internet-based patient education (CEI-BPE) and cognitively empowering face-to-face patient education (CEF-FPE) after education preoperatively (1st measurement) and two weeks postoperatively (2nd measurement). Differences between the education groups tested after education (D1) and the difference in change between the education groups tested (D2).

	After education experiment / control group n=71 / 73				Two weeks postoperatively experiment / control group n=71 / 73			
Utility items for the CEI-BPE or CEF-FPE	N	Experiment group Mean (SD)	Control group Mean (SD)	Difference **between groups** (D1) and p-value	N	Experiment group Mean (SD)	Control group Mean (SD)	Difference **in change between groups** (D2) and p-value
Practical arrangements of education								
1.a How easy was it for you to arrange time to read the education material / to attend the education	71/ 73	72.73 (24.01)	86.45 (15.24)	-13.72 **≤0.001**	70/ 73	79.16 (21.25)	87.26 (15.43)	8.10 **0.031**
2 How relaxed/peaceful was the situation when you used the Internet? / How relaxed/peaceful was the situation during the patient education session?	71/ 73	80.68 (19.12)	88.92 (12.84)	-8.42 **0.007**	70/ 73	84.01 (16.54)	90.77 (12.03)	1.14 0.430
Content of education								
1 How appropriate was the length of timed needed for the website / length of the education? (0 = too short, 100 = good length)	58/ 72	81.57 (18.20)	85.85 (20.31)	-4.28 **0.028**	61/ 73	83.85 (17.01)	87.08 (20.29)	3.23 0.802
2 How appropriate was the length of time needed for the website / length of the education? (0 = too extensive, 100 = good length)	57 /51	69.39 (28.84)	85.16 (19.58)	-15.77 **≤0.001**	52/ 56	75.52 (28.58)	88.48 (15.49)	1.96 0.743
3. How useful was the content of the website / education session? (0 = not useful, 100 = very useful)	71/ 73	80.97 (17.13)	80.68 (21.15)	0.29 0.596	70/ 73	81.99 (17.83)	82.59 (20.37)	0.60 0.872
4 Was the content of the website / education session supportive? (0 = not at all, 100 = very supportive)	71/ 73	81.04 (13.41)	86.40 (13.63)	-5.36 **0.005**	70/ 73	84.29 (13.44)	88.03 (12.20)	3.74 0.337
5 How clear was the content on received knowledge? (0 = not clear at all, 100 = very clear)	71/ 73	79.75 (15.15)	86.42 (14.35)	-6.66 **≤0.001**	70/ 73	84.06 (12.87)	86.47 (14.64)	4.10 0.095
6 How sufficient was the content of the website / written material? (0 = not sufficient at all, 100 = quite sufficient)	71/ 73	79.13 (15.42)	85.00 (12.80)	-5.87 **0.007**	70/ 73	83.47 (15.72)	87.07 (14.01)	2.40 0.393

7. How sufficient were the answers to your questions on the electronic form? */ How sufficient was the guidance you received from the nurse?	- / 73		86.88 (15.67)	-	-/ 73	-	87.75 (13.86)	-
8. Did the content of the received knowledge help you to understand the operation better? (0 = not at all, 100 = very well)	70/ 72	70.93 (21.97)	74.29 (22.61)	-3.36 0.266	70/ 71	71.07 (25.23)	80.90 (18.97)	5.86 0.461
Effect on patients' function								
1 How well can you act based on the received knowledge? (0 = not at all, 100 = very well)	71/ 73	82.77 (11.94)	88.86 (10.58)	-6.09 **≤0.001**	68/ 73	84.99 (14.98)	90.15 (9.96)	0.51 0.149
2 Did the content of the received knowledge reduce fear or anxiety? (0 = not at all, 100 = very well)	65/ 72	63.45 (26.94)	73.75 (23.62)	-10.30 **0.020**	67/ 72	73.06 (24.10)	78.68 (22.69)	3.88 0.403
Recommendations								
1 Would you recommend the website / written education material to others? (0 = not at all, 100 = strongly recommended)	71/ 72	84.46 (16.35)	81.93 (19.43)	2.53 0.323	69/ 73	87.87 (14.80)	85.36 (19.74)	0.51 0.200
2. Would you recommend I-BPE / F-FPE in general? (0 = not at all, 100 = very much)	70/ 73	83.31 (17.84)	84.51 (19.81)	-1.19 0.476	69/ 73	87.67 (14.29)	84.60 (23.32)	3.55 0.363
Need for further education								
1 Do you need additional education beyond that provided by the website / nurse? (such as further education by a nurse / website, additional written material) (0 = great need, 100 = no need)	71/ 71	57.56 (34.37)	66.58 (31.55)	-9.09 0.103	69/ 72	71.52 (32.40)	69.56 (32.04)	9.40 0.255

Mann-Whitney U-test
D2 = Difference in change (2^{nd} – 1^{st} measurement)
* This was not analysed, because only five patients had sent emails

After the education, patients receiving CEI-BPE reported that their main information resource was the Internet (mean=79.96; scale 0-100). ***Two weeks postoperatively,*** the main information resource was still the Internet (mean=78.15). ***After the education, patients receiving CEF-FPE*** reported that their main information resource was the nurse (mean=83.40). ***Two weeks postoperatively,*** the main information resource was still the nurse (mean=83.18).

After the education, the results of patients' information resources differed between the groups, except for the information received from relatives (p=0.725). ***The differences in patients' evaluations of the information resources*** between the ***education groups and the measurement times*** did not change significantly statistically during the time under study (p=0.140-0.611) (Table 8).

Table 8. Patients' evaluations of their use of information sources in the cognitively empowering Internet-based patient education (CEI-BPE) and cognitively empowering face-to-face patient education (CEF-FPE) after education preoperatively (1st measurement) and two weeks postoperatively (2nd measurement). Differences between the education groups tested after education (D1) and the difference in change between the education groups tested (D2).

	After education experiment / control group n=71 / 73				Two weeks postoperatively experiment / control group n=71 / 73			
Patients' information sources	N	Experiment group Mean (SD)	Control group Mean (SD)	Difference **between groups** and p-value	N	Experiment group Mean (SD)	Control group Mean (SD)	Difference **in change between groups** (D2) and p-value
I received information from a nurse	66/73	30.32 (37.08)	83.40 (16.04)	-53.08 **≤0.001**	69/71	45.46 (34.58)	83.18 (17.08)	12.36 0.140
I received information from relatives	68/72	22.87 (33.00)	21.21 (28.50)	1.66 0.725	69/71	27.12 (33.71)	18.55 (25.81)	5.94 0.593
I received information from the Internet	68/71	79.96 (19.67)	7.39 (15.17)	72.56 **≤0.001**	68/71	78.15 (25.71)	9.01 (18.16)	2.81 0.611

Mann-Whitney U-test
D2 = Difference in change (2nd – 1st measurement)
Scale 0-100 (0 = no information at all, 100 = a great deal of information).

Utility of the cognitively empowering Internet-based patient education

Only ***patients receiving CEI-BPE*** evaluated ***the usability of the website***. Their evaluations were rather high; patients found that the website operated technically correctly (mean=88.32; scale 0-100). They found it easy to navigate on the website (mean=85.69) and that the content was clear (mean=86.11). One-third (29%) of the patients said that all of the web pages on the website were helpful and one-third (28%) said that the web page on "preparation for the operation" was the most helpful. Patients mentioned that only a few of the web pages were unhelpful.

5.2.2 Costs of care with cognitively empowering Internet-based patient education

We evaluated AOSPs' costs of care in the public health service (out-of-pocket costs, use of time and consultations with health care organizations) and nurses' costs of care (use of time and consultations with other professionals, such as another nurse, a physician or an anaesthesiologist). Next, we evaluated patients' costs (out-of-pocket costs and use of time) after the education preoperatively using "The Preoperative costs" (PC) instrument and two weeks after surgery using "The Intra- and Postoperative Costs" (IPC) instrument. We also evaluated patients' consultations with health care organizations twice: two and four weeks after surgery. We did so using "The Consultations" instrument (Con). Finally, we evaluated nurses' costs of care pre- and intraoperatively using the nursing documentation (Figure 10).

Patients receiving CEI-BPE reported an average total of 24.28€ for ***preoperative out-of-pocket costs for care***, while patients receiving CEF-FPE reported average costs of 10.74€ in total. Patients in both groups reported their preoperative out-of-pocket costs of care mainly as total costs and most of the patients did not specify what these costs consisted of. The highest costs **for both groups** were travelling expenses (experiment mean=17.37€; control mean=9.89€). **In the group comparison,** both the experiment group and the control group had corresponding preoperative costs and there were no statistical differences in the total preoperative (p=0.051) expenses or in travelling expenses (p=0.650) (Table 9) (Paper III).

Patients receiving CEI-BPE reported an average total of 235.38€ for ***intra- and postoperative out of-pocket costs***, while patients receiving CEF-FPE reported an average cost of 239.74€ in total. The highest specified costs **for both groups** were hospital charges (mean=124.08-128.99€); these costs were also the ones most often mentioned by patients (n=69–70). **In the group comparison,** we found that both the experiment group and control group had similar total out-of-pocket costs intra- and postoperatively, with no statistical differences (p=0.095) (Table 9) (Paper III).

Table 9. Ambulatory orthopaedic surgery patient out-of-pocket costs (€), pre-, intra- and postoperatively measured with a) the Preoperative Costs (PC) instruments and b) Intra- and Postoperative Costs (IPC) instrument in the experiment and control group.

Out-of-pocket costs in Euros (€)	Number of patients reporting costs		Mean (s.d.) of reported costs (€)		difference p-value* (€)	
	Experi-ment group N=71	Control group N=73	Experi-ment group	Control group		
	n	n				
Preoperative costs, in total	58	60	24.28 (30.09)	10.74 (17.04)	13.54	0.051
Intra- and postoperative costs, in total	70	69	235.38 (235.64)	239.74 (264.22)	-4.36	0.095

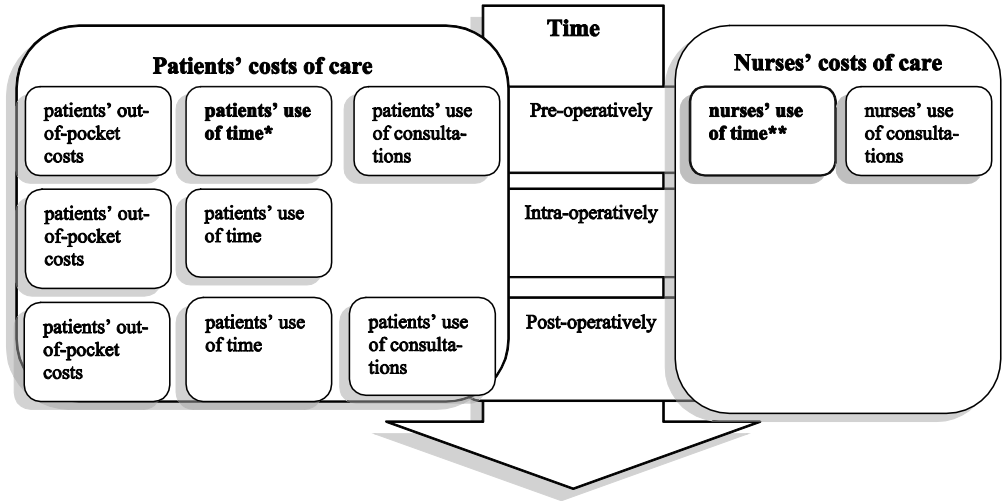
*Mann-Whitney U Test

Patients' use of time included an evaluation of patients' ***use of time pre-, intra- and postoperatively***. Patients receiving CEI-BPE used 85 minutes of their ***time preoperatively*** for education and 233 minutes in total for education (including laboratory tests and/or X-ray examinations, patient education), whereas patients receiving CEF-FPE used 61 minutes of their ***time preoperatively*** for education and 146 minutes in total for education. Patients receiving CEI-BPE used statistically more ***time preoperatively*** (laboratory tests and/or X-ray examinations, patient education and time in total) than patients receiving CEF-FPE ($p \leq 0.001$).

We measured patients' ***use of time intraoperatively*** by evaluating the patients' stay in the surgical ward (including the recovery room). Patients receiving CEI-BPE stayed in the surgical ward on average 5 hours 43 minutes, whereas patients receiving CEF-FPE stayed on average 5 hours 45 minutes in the surgical ward. There were no statistical differences in patients' ***use of time intraoperatively*** (stay in the surgical ward or in the recovery room; p=0.093-0.632).

We measured patients' ***use of time postoperatively*** by evaluating the patients' length of sick leave. Patients receiving CEI-BPE had 46 days (mean) of sick leave, whereas patients receiving CEF-FPE had 44 days (mean) of sick leave. There were no statistical differences in patients' ***use of time postoperatively*** (p=0.830).

Patients documented their ***consultations*** concerning their pre- or postoperative care. Patients in the group receiving CEI-BPE and CEF-FPE mostly had their consultations in the surgical ward or at their health centre, usually once. In the group comparison, there were no statistically significant differences in the amount of consultations between the groups (p=0.165-0.924)



Bold text represents statistically significant differences between the education groups
***Patients receiving CEI-BPE used significantly more *time* than patients receiving CEF-FPE**
****The nurses used significantly more time for patient education with the control group than with the experiment group (p≤0.001).**

Figure 10. Summary of ambulatory orthopaedic surgery patients' and nurses' cost of care pre-, intra and postoperatively when comparing the cognitively empowering Internet-based patient education (CEI-BPE) and cognitively empowering face-to-face patient education (CEF-FPE).

We evaluated ***nurses' use of time for patient education*** (including handling patient documents for the control group and the experiment group), reading and answering patients' emails (experiment group) and implementing patient education (control group). Nurses used, on average, 14 minutes for patient education with patients

receiving CEI-BPE (experiment group) and 29 minutes with patients receiving CEF-FPE (control group). The nurses used significantly more time for patient education with the control group than with the experiment group ($p \leq 0.001$). Based on patient education, **the differences** in the number of *nurses' consultations with, for example, other nurses or physicians* **were not statistically significant (p=0.594).**

5.3 Outcomes of cognitively empowering Internet-based patient education (Phase IIb)

5.3.1 Cognitive outcomes

We measured AOSPs' knowledge levels ("The Knowledge Test", KT) and estimates about their sufficiency of knowledge ("The Sufficiency of Knowledge", SoK) before the education, after the education preoperatively and two weeks postoperatively (Paper IV).

Patient knowledge level

Patients receiving ***CEI-BPE*** scored 0.48, on a scale ranging from 0 to 1, on ***the knowledge test*** (48% correct answers in total) before their education. After the education, patients' knowledge level increased in all dimensions except for the experiential dimension, and a total of 63% of their answers on the test were correct. Two weeks after the operation, a total of 65% of their answers were correct. The increase in the patients' knowledge was statistically significant ($p \leq 0.001$).

Patients receiving ***CEF-FPE*** scored 0.48 on ***the knowledge test*** before their education. After the education, patients' knowledge level increased in all dimensions except for the experiential and ethical dimensions, and they had a total of 57% correct answers on the test. Two weeks after the operation, a total of 62% of their answers were correct.

Patients receiving ***CEI-BPE improved their knowledge more*** in total (p=0.028) and in the functional (p=0.025) and ethical (p=0.005) dimensions of knowledge ***than did those in the control group***. In the ***comparison between the groups,*** both the experiment group and the control group scored similarly on the knowledge test (p=0.077–0.860). ***Patients' knowledge levels*** in both groups increased in all dimensions as well as in their total score ($p \leq 0.001$–0.011) (Table 10) (Paper IV).

Patient sufficiency of knowledge

Patients receiving CEI-BPE scored 2.73 in their ***sufficiency of knowledge*** (with a scale ranging from 1 (totally disagree) to 4 (totally agree)) before the education. After the preoperative education, their sufficiency of knowledge increased in every dimension and they scored 3.29 in total. Two weeks after the operation, patients' sufficiency of knowledge increased even more and they scored 3.40.

Patients receiving CEF-FPE scored 2.73 in ***sufficiency of knowledge***. After the education, patients' sufficiency of knowledge increased in all dimensions and they scored 3.05 in total. Two weeks after the operation, patients' sufficiency of knowledge increased even more and they scored 3.22.

Patients receiving ***CEI-BPE improved their knowledge more*** in the ethical dimension of sufficiency of knowledge (p=0.008) ***than did those in the control group***. Patients in ***the experiment group had significantly higher scores*** in sufficiency of knowledge in the experiential (p=0.050) and financial (p=0.048) dimensions ***than did patients in the control group***. ***Patients sufficiency of knowledge*** in both groups increased in all dimensions of knowledge as well as in the total score ($p \leq 0.001$) (Table 10) (Paper IV).

Table 10. Ambulatory orthopaedic surgery patients' knowledge level measured with the knowledge test (KT) and patients' estimations of their sufficiency of knowledge (SoK) at three different points in time (1st = before the operation (baseline), 2nd = after the education, 3rd =two weeks after the operation) in the experiment and control group. The effect of the education group (p1), time (p2) and the interaction between the education group and time (p1-p2).

Dimensions of KT and SoK	p1 Effect of group with KT	p1 Effect of group with SoK	p2 Effect of time with KT	p2 Effect of time with SoK	p1-p2 Interaction between group and time with KT	p1-p2 Interaction between group and time with SoK
Bio-physiological	0.195	0.295	**≤0.001**	**≤0.001**	0.099	0.894
Functional	0.393	0.082	**≤0.001**	**≤0.001**	**0.025**	0.383
Experiential	0.860	**0.050**	**0.011**	**≤0.001**	0.898	0.308
Ethical	0.118	0.084	**0.007**	**≤0.001**	**0.005**	**0.008**
Social	0.077	0.076	**≤0.001**	**≤0.001**	0.513	0.436
Financial	0.338	**0.048**	**≤0.001**	**≤0.001**	0.133	0.125
Total	0.163	0.065	**≤0.001**	**≤0.001**	**0.028**	0.059

Repeated measures analysis of variance with a grouping variable
Scale from 0 (no correct answers) to 1 (all answers correct)

Patients evaluated their knowledge level and their sufficiency of knowledge parallel to one another during the different measurement times and they correlated (0.247-0.461; $p \leq 0.001$-0.003) (Figure 11).

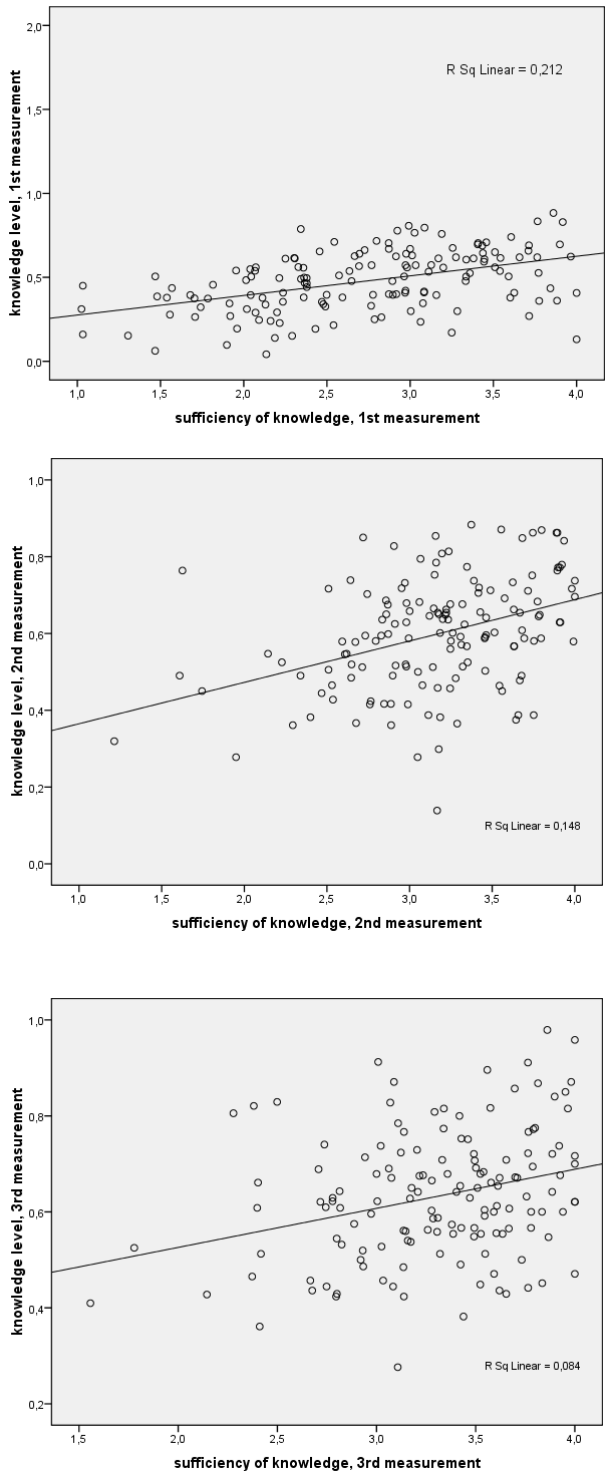


Figure 11. Scatter plots of knowledge levels and sufficiency of knowledge at three different measurement times (1st: before education; 2nd: after education preoperatively; and, 3rd: two weeks postoperatively).

Relationship between knowledge level and sufficiency of knowledge and socio-demographic variables

We tested the relationship between AOSPs' socio-demographic variables and their knowledge level and sufficiency of knowledge in order to see whether there are differences in the possibilities for AOSPs to become cognitively empowered.

Socio-demographic variables and knowledge level

We found that AOSPs' ***professional education*** was related to ***their knowledge level*** in the ***experiment group*** ($p=0.007$). After the education, patients who had no professional education reported having a lower knowledge level (mean=0.53) than those who had polytechnic or university education (mean=0.70) education ($p=0.015$). Age, gender, basic education and earlier ambulatory surgery were not related to the patients' knowledge level.

In the ***control group, age and earlier ambulatory surgery experience*** were related to the patients' knowledge level ($p<0.028$). Two weeks after the operation, the youngest patients (18-34 years old) reported having a lower knowledge level (mean=0.53) than did the older patients (mean=0.65, $p=0.032$). Patients who had had ambulatory surgery before had a higher knowledge level than those who had not had ambulatory surgery ($p\leq0.001$) before the education ($p=0.002$), after the education before operation and two weeks after the operation ($p=0.006$). Gender and the level of basic or professional education were not related to the knowledge level of patients in the control group (Table 11).

Socio-demographic variables and sufficiency of knowledge

Patients' ***age, gender and earlier ambulatory surgery experience*** were related to their ***sufficiency of knowledge*** in the ***experiment group***. Before the education, the youngest patients (18-34 years old) reported having a lower sufficiency of knowledge (mean=2.43) than did the older patients (mean=2.90, $p=0.045$). Women's sufficiency of knowledge was higher (mean=3.48) than men's after the education (mean=3.14, $p\leq0.001$) and two weeks postoperatively (mean=3.55-3.30, $p=0.010$). In addition, before the education patients who had had earlier ambulatory surgery had a higher sufficiency of knowledge than those who had not had ambulatory surgery (mean=2.94-2.53, $p=0.006$).

In the ***control group,*** patients' ***sufficiency of knowledge*** was related to their ***earlier ambulatory surgery experience***. Two weeks after the operation, patients who had had earlier ambulatory surgery had a higher sufficiency of knowledge (mean=3.34) than did those who had not had ambulatory surgery (mean=3.07, $p=0.030$). Other socio-demographic variables were not associated with patients' sufficiency of knowledge (Table 12).

Table 11. The relationship between ambulatory orthopaedic surgery patients' knowledge level and socio-demographic variables.

Object	Before education				After education				Two weeks after operation			
	Experiment group		Control group		Experiment group		Control group		Experiment group		Control group	
	mean (sd)	p	mean (sd)	p	mean (sd)	p	mean (sd)	p	mean (sd)	p	mean (sd)	p
Age* (1)		0.080		0.172		0.570		0.157		0.927		**0.028**
◦ 18-34	0.43 (0.18)		0.42 (0.20)		0.50 (0.20)		0.51 (0.16)		0.65 (0.17)		0.53 (0.13)	
◦ 35-50	0.49 (0.13)		0.50 (0.20)		0.65 (0.12)		0.58 (0.15)		0.65 (0.11)		0.64 (0.16)	0.057
◦ 51-69	0.51 (0.16)		0.52 (0.19)		0.63 (0.12)		0.60 (0.13)		0.65 (0.11)		0.65 (0.13)	**0.032**
Gender**		0.643		0.374		0.654		0.079		0.079		0.500
◦ female	0.49 (0.16)		0.50 (0.20)		0.64 (0.17)		0.60 (0.12)		0.68 (0.13)		0.63 (0.13)	
◦ male	0.47 (0.15)		0.48 (0.20)		0.62 (0.13)		0.55 (0.16)		0.63 (0.12)		0.61 (0.17)	
Basic education* (2)		0.902		0.668		0.155		0.786		0.574		0.764
◦ six years of schooling	0.46 (0.16)		0.44 (0.18)		0.58 (0.13)		0.59 (0.12)		0.64 (0.13)		0.64 (0.16)	
◦ nine years of schooling	0.48 (0.16)		0.50 (0.22)		0.62 (0.15)		0.57 (0.17)		0.64 (0.11)		0.61 (0.16)	
◦ twelve years of schooling	0.49 (0.15)		0.50 (0.18)		0.67 (0.14)		0.57 (0.13)		0.67 (0.13)		0.62 (0.12)	
Professional education* (3)		0.472		0.612		**0.007**		0.865		0.130		0.641
◦ no education	0.46 (0.22)		0.45 (0.17)		0.53 (0.17)		0.55 (0.10)		0.58 (0.09)		0.58 (0.14)	
◦ secondary level	0.45 (0.16)		0.46 (0.22)		0.59 (0.14)	0.737	0.59 (0.17)		0.65 (0.14)		0.64 (0.15)	
◦ upper secondary/college	0.48 (0.11)		0.55 (0.21)		0.66 (0.12)	0.054	0.59 (0.16)		0.66 (0.12)		0.64 (0.17)	
◦ polytechnic/university	0.55 (0.14)		0.50 (0.18)		0.70 (0.12)	**0.015**	0.55 (0.13)		0.70 (0.10)		0.59 (0.10)	
Earlier ambulatory surgery**		0.116		**≤0.001**		0.953		**0.002**		0.919		**0.006**
◦ yes	0.51(0.16)		0.55 (0.18)		0.63 (0.14)		0.62 (0.14)		0.65 (0.13)		0.66 (0.13)	
◦ no	0.44 (0.14)		0.40 (0.19)		0.63 (0.15)		0.52 (0.14)		0.65 (0.12)		0.57 (0.15)	

*One-way analysis of variance with contrast and **a two-sample T-test

Bold values = significant values; Compared to 18-34 year olds (1), six years of schooling (2), no education group (3), adjusted p-value using Tukey's method

Table 12. The relationship between ambulatory orthopaedic surgery patients' sufficiency of knowledge and socio-demographic variables.

	Before education				After education				Two weeks after operation			
	Experiment group		Control group		Experiment group		Control group		Experiment group		Control group	
	mean (sd)	p	mean (sd)	p	mean (sd)	p	mean (sd)	p	mean (sd)	p	mean (sd)	p
Age *(1)		**0.045**		0.399		0.293		0.369		0.118		0.711
◦ 18-34	2.48 (0.64)		2.54 (0.76)		3.14 (0.43)		2.89 (0.53)		3.24 (0.50)		3.16 (0.56)	
◦ 35-50	2.79 (0.58)	0.116	2.87 (0.76)		3.30 (0.56)		3.18 (0.51)		3.42 (0.46)		3.31 (0.52)	
◦ 51-69	2.93 (0.65)	**0.044**	2.73 (0.82)		3.40 (0.40)		3.06 (0.60)		3.50 (0.32)		3.19 (0.49)	
Gender**		0.566		0.296		**≤0.001**		0.806		**0.010**		0.694
◦ female	2.87 (0.64)		2.62 (0.86)		3.48 (0.40)		3.07 (0.57)		3.55 (0.37)		3.24 (0.48)	
◦ male	2.70 (0.63)		2.84 (0.71)		3.14 (0.48)		3.06 (0.55)		3.30 (0.44)		3.22 (0.55)	
Basic education*		0.914		0.829		0.728		0.331		0.368		0.432
◦ six years schooling	2.84 (0.63)		2.85 (0.85)		3.31 (0.41)		3.24 (0.49)		3.50 (0.31)		3.24 (0.41)	
◦ nine years schooling	2.75 (0.63)		2.74 (0.72)		3.33 (0.41)		3.00 (0.52)		3.45 (0.42)		3.17 (0.52)	
◦ twelve years schooling	2.76 (0.68)		2.69 (0.88)		3.23 (0.58)		3.10 (0.64)		3.31 (0.47)		3.33 (0.57)	
Professional education*		0.974		0.815		0.371		0.943		0.272		0.868
◦ no education	2.68 (0.43)		2.71 (0.82)		3.37 (0.39)		3.06 (0.45)		3.36 (0.35)		3.23 (0.46)	
◦ secondary level	2.82 (0.68)		2.63 (0.78)		3.30 (0.48)		3.01 (0.45)		3.54 (0.38)		3.17 (0.43)	
◦ upper secondary/college	2.78 (0.75)		2.91 (0.76)		3.34 (0.46)		3.15 (0.69)		3.39 (0.48)		3.24 (0.61)	
◦ polytechnic/university	2.77 (0.58)		2.73 (084)		3.12 (0.56)		3.06 (0.64)		3.29 (0.45)		3.32 (0.61)	
Earlier ambulatory surgery **		**0.006**		0.117		0.961		0.074		0.938		**0.030**
◦ yes	2.94 (0.60)		2.86 (0.73)		3.29 (0.45)		3.16 (0.43)		3.42 (0.45)		3.34 (0.43)	
◦ no	2.53 (0.63)		2.57 (0.83)		3.28 (0.53)		2.93 (0.68)		3.39 (0.39)		3.07 (0.59)	

*One-way analysis of variance with contrast and **a two-sample T-test

Bold values = significant values; Compared to 18-34 year olds (1) adjusted p-value by Tukey's method

5.3.2 Clinical outcomes

Emotions of ambulatory orthopaedic surgery patients

We evaluated AOSPs' emotions (fear, nervousness, worry, impatience, depression, anxiety and uncertainty) seven times during the surgical process: two times preoperatively, once intraoperatively before the surgery and four times postoperatively using "The Emotions" (E) instrument. We classified patient's estimations of their emotions into two categories: low (0≤29.9 mm), and moderate or high (30.0mm ≤ 100mm).

Patients reported their emotion scores as being rather low during the surgical process. Patients' scores for their emotions varied during the surgical process. *After the patient education,* patient scores for nervousness increased a significant amount statistically (p=0.026), but the differences in the scores for the other emotions were not statistically significant. *On the operation day,* the scores for fear (p=0.031) and nervousness (p≤0.001) increased and the scores for worry (p=0.004) and impatience (p≤0.001) decreased compared to the baseline. Two weeks *postoperatively,* the emotion scores for all patients had decreased significantly statistically. ***The method of patient education*** (CEI-BPE and CEF-FPE) had no significant effect on the emotion scores (p=0.194-0.794) (Figure 12).

We tested ***the method of patient education and the emotion scores at different measurement times*** and found no significant interactions (p=0.255-0.959). Thus, the change in the scoring of emotions was similar in both groups throughout the ambulatory surgery process (Figures 12) (Paper V).

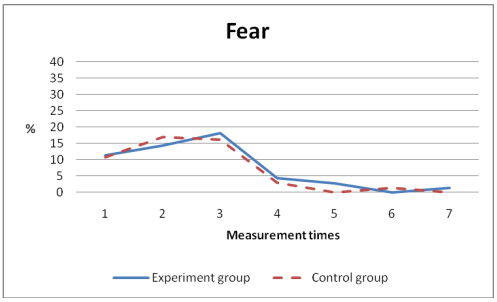


Figure 12a. The number of patients (%, n=71-75) giving moderate or high scores for **fear** at different measurement times (there were no differences between the groups, but the differences in measurement times 3-7 were statistically significant).

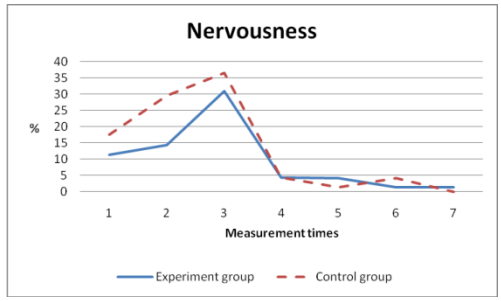


Figure 12b. The number of patients (%, n=71-75) giving moderate or high scores for **nervousness** at different measurement times (there were no differences between the groups, but the differences in measurement times 2-7 were statistically significant).

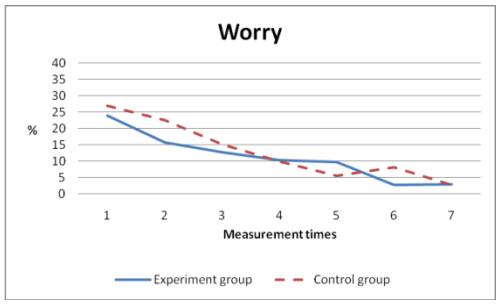


Figure 12c. The number of patients (%, n=71-75) giving moderate or high scores for **worry** at different measurement times (there were no differences between the groups, but the differences in measurement times 3-7 were statistically significant).

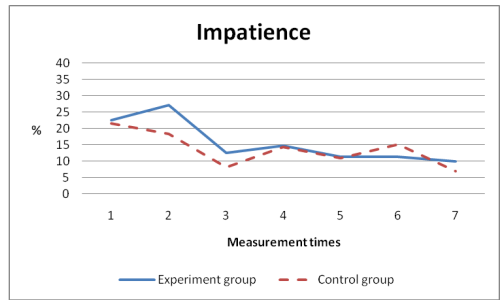


Figure 12d. The number of patients (%, n=71-75) giving moderate or high scores for **impatience** at different measurement times (there were no differences between the groups, but the differences in measurement times 3 and 5-7 were statistically significant).

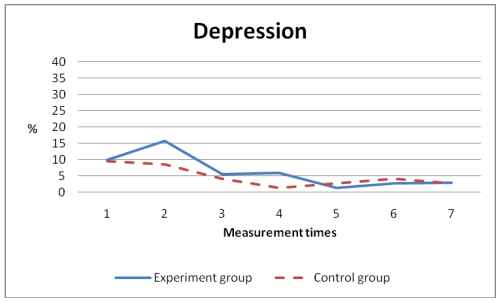


Figure 12e. The number of patients (%, n=71-75) giving moderate or high scores for **depression** at different measurement times (there were no differences between the groups, but the differences in measurement times 4-7 were statistically significant).

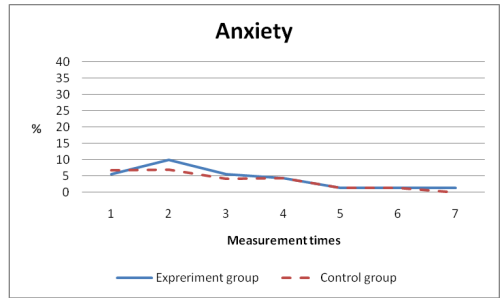


Figure 12f. The number of patients (%, n=71-75) giving moderate or high scores for **anxiety** at different measurement times (there were no differences between the groups, but the differences in measurement times 6-7 were statistically significant).

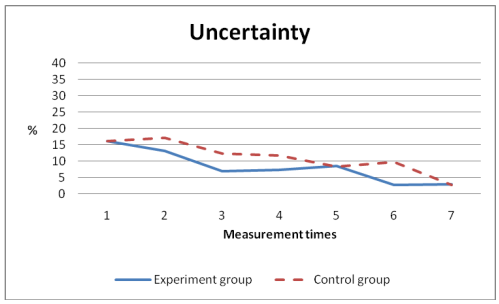


Figure 12g. The number of patients (%, n=71-75) giving moderate or high scores for **uncertainty** at different measurement times (there were no differences between the groups, but the differences in measurement times 5-7 were statistically significant).

Symptoms of ambulatory orthopaedic surgery patients

We evaluated the ***intensity of symptoms*** among AOSPs seven times during the surgical process: three times preoperatively using "The Preoperative Symptoms" (S_{PRE}) instrument and four times postoperatively using "The Postoperative Symptoms" (S_{POST}) instrument. S_{PRE} contained five symptoms which also occur preoperatively: headache, pain in the area being operated on, pain elsewhere, sleeplessness, and difficulties with movement. S_{POST} contained an additional eleven symptoms that especially occur postoperatively: vomiting, nausea, dizziness, tiredness, problems with urination, problems with digestion, problems with washing and with hygiene, swelling of the area being operated on, redness of the operation area, bleeding of the operation area, and fever. We classified patients' estimates of their symptoms into three categories: low ($0 \leq 29.9$ mm), moderate ($30.0\text{mm} \leq 69.9$ mm) and high ($70.0 \leq$ 100mm).

Patients did not report many severe symptoms during their surgery process. The severity of symptoms varied during the surgery process. *Before the patient education,* only a few of the patients scored their symptoms high. *After the patient education,* patient scores for difficulties with movement had decreased significantly statistically ($p=0.018$). On the operation day, patients reported less severe symptoms ($p \leq 0.001$-0.013) compared to the baseline assessment. Two weeks *postoperatively,* patients' symptom scores had all decreased significantly statistically from the baseline assessment.

There was no difference in ambulatory orthopaedic surgery patients' intensity of symptoms between ***the experiment group and control group*** ($p=0.084$-0.589), except that the patients in the experiment group scored their pain somewhere else higher than did those in the control group at four weeks postoperatively ($p=0.033$). (Figures 13)

We tested ***the method of patient education and the intensity of symptoms*** at different measurement times and found no significant interactions ($p=0.258$-0.903). Thus, the change in the intensity of symptom scores was similar at different points in time in both groups throughout the ambulatory surgery process (Figures 13) (Paper VI).

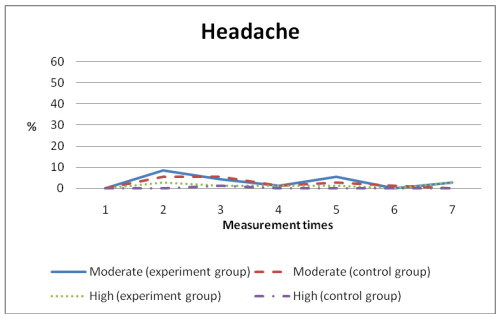


Figure 13a. The number of patients (%, n=71-75) giving moderate or high scores for **headache** at different measurement times (there were no differences between the groups, but the differences in measurement time 4 were statistically significant).

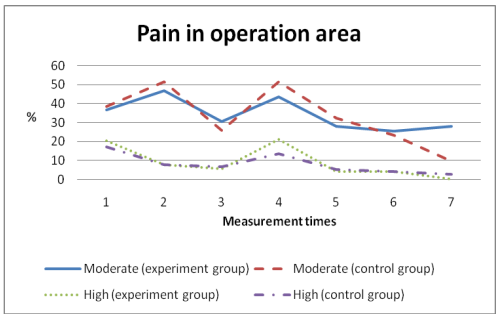


Figure 13b. The number of patients (%, n=71-75) giving moderate or high scores for **pain in operation area** at different measurement times *(there were no differences between the groups, but the differences in measurement times 3 and 5-7 were statistically significant).*

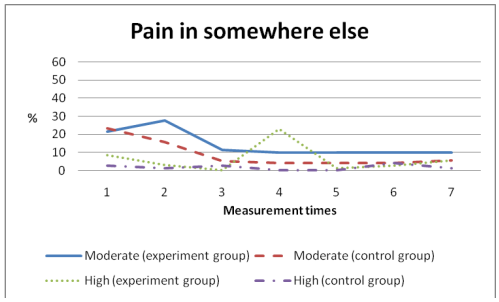


Figure 13c. The number of patients (%, n=71-75) giving moderate or high scores for **pain in somewhere else** at different measurement times *(there were no differences between the groups except 7th measurement, but the differences in measurement times 3-7 were statistically significant).*

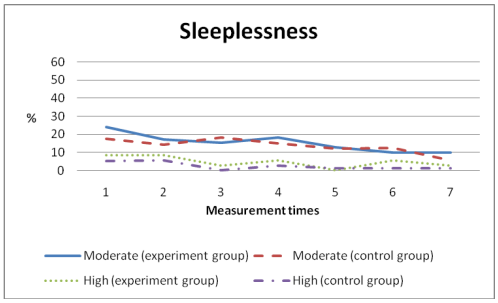


Figure 13d. The number of patients (%, n=71-75) giving moderate or high scores for **sleeplessness** at different measurement times *(there were no differences between the groups, but the differences in measurement times 3 and 5-7 were statistically significant).*

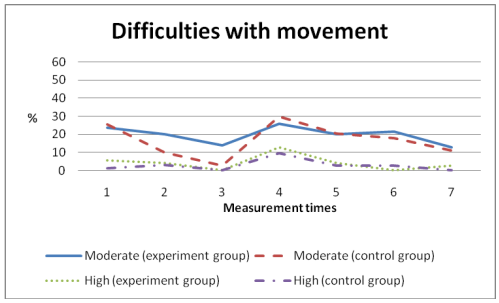


Figure 13e. The number of patients (%, n=71-75) giving moderate or high scores for **difficulties with movement** at different measurement times *(there were no differences between the groups, but the differences in measurement times 2-4 and 7 were statistically significant).*

Patients reported that the **symptoms which were only measured postoperatively** were rather intense on the 1st postoperative day. Almost half of the patients in both groups evaluated their tiredness, problems with washing and hygiene, and swelling of the operation area as being moderate or high on the 1st postoperative day. **Still four weeks after the operation** (7th measurement), approximately 7% of the patients in both groups reported experiencing moderate fatigue, but reported that all of the other symptoms were mild (0-5.6%). Patients' evaluations of their symptom intensity decreased significantly during the ambulatory surgery process at different **measurement times** (COR=0.03-0.55; p= ≤0.001-0.038).

The method of patient education (the experiment group and the control group) had no significant effect on postoperatively evaluated symptoms (p=0.283-0.981). We tested **the interaction between the method of patient education and the symptoms (measured only postoperatively) at different measurement times** and found no significant interactions (p=0.159-0.959). The change in reported intensity of symptoms was similar in both groups at different points in time throughout the ambulatory surgery process.

5.4 Summary of the results

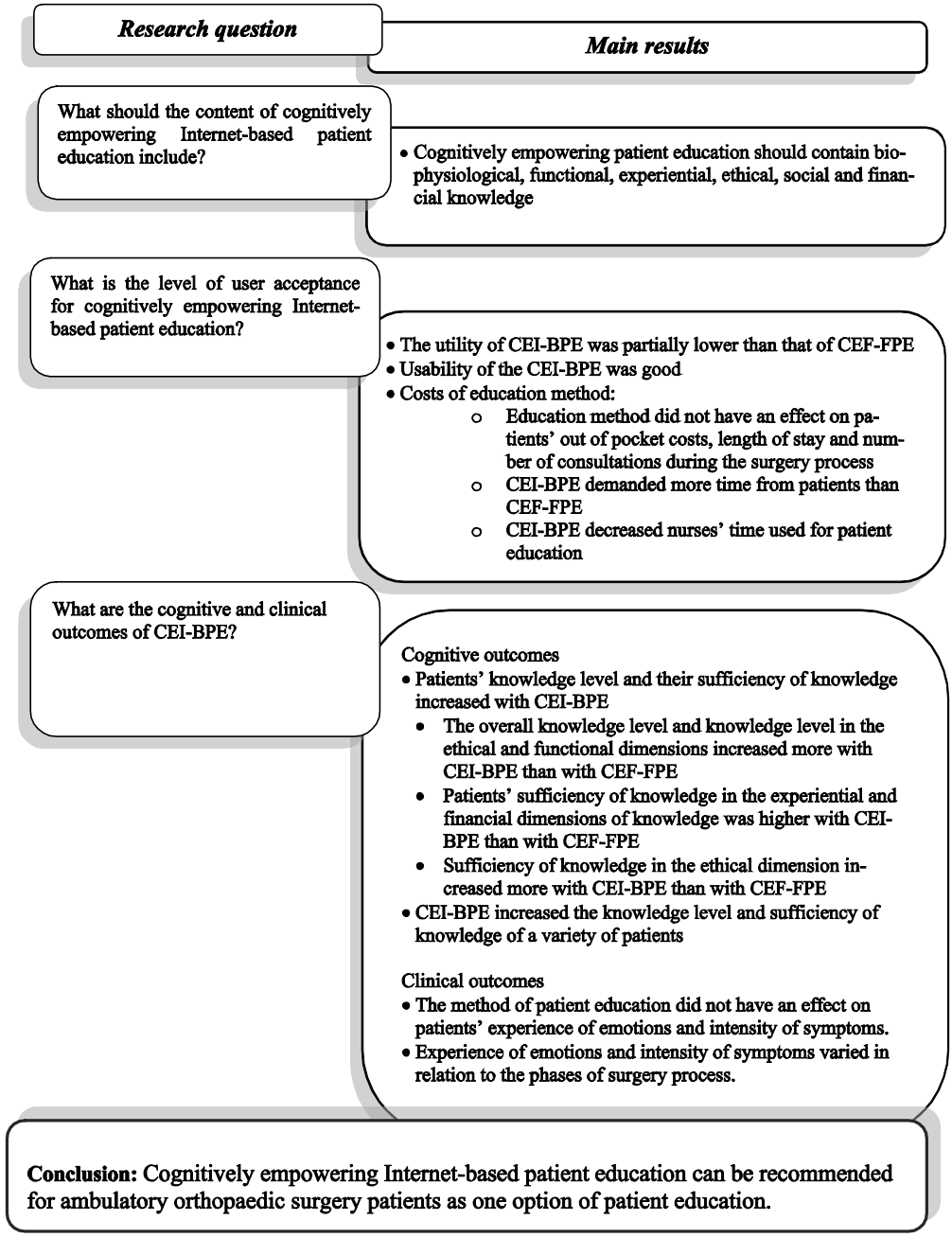


Figure 14. The main outcomes of the study (CEI-BPE= cognitively empowering Internet-based patient education, CEF-FPE = cognitively empowering face-to-face patient education).

6. DISCUSSION

The aim of this study was to create and evaluate an Internet-based patient education programme aiming to cognitively empower ambulatory orthopaedic surgery patients. To achieve this, the research process had the following two purposes: to create the content for cognitively empowering Internet-based patient education and to evaluate it. This chapter discusses the validity and reliability of the study and its main findings in relation to previous literature. In addition, conclusions and suggestions for nursing practice and for nursing research are presented.

6.1 Validity and reliability of the study

Validity and reliability are the most important criteria in assessing the quality of a study. Validity is a measure of the truth and accuracy of a study in relation to the phenomenon of interest, while reliability represents the consistency of the measurement. Validity and reliability are not an all-or-nothing, either-or question, but, rather, a matter of degrees, and they can vary from one study to another. (Polit & Beck 2006, Burns & Grove 2005, Borglin & Richards 2010, LoBiondo-Wood & Haber 2010.) In the next chapter, we discuss the validity and reliability of the study process. We begin by discussing the instruments and the interventions. Then, we discuss the validity and reliability of the sample, the data collection and the analysis.

6.1.1 Instruments

Appropriate and validated instruments are vital for a study which evaluates the outcomes of an intervention (Zwarenstein et al. 2008, Borglin & Richards 2010). A valid instrument truly reflects the concept it is supposed to measure and produces trustworthy results. Validity can be divided into content and criterion validity. (Trochim 2006, Waltz et al. 2010, Borglin & Richards 2010, LoBiondo-Wood & Haber 2010.) Content validity ensures a match between the target of the study and the instrument used for data collection. We confirmed the content validity of the instruments via a broad review of literature dealing with the instruments. Criterion validity indicates how accurate one particular measure is compared with another measure (ideally the golden standard) measuring the same phenomenon.

The instruments used in this study were either modified from existing instruments (KT, SoK), designed for this study (PEE, DUW, PC, IPC, Con, E, S (S_{PRE}, S_{POST})) or used as originally designed for this study (HPKE and HPRK and OPKQ). (See Table 13) A panel of experts containing three nurses, two physicians and three to five researchers tested the face validity of all of the instruments. They confirmed the items of the instruments.

The knowledge test and the sufficiency of knowledge instruments worked fairly well. Based on the response rate, the respondents found these instruments to be easy to use

(see Tables 7, 8, 10-12). Respondents only found the experiential and ethical questions to be difficult and further development is suggested. The criterion validity of Sufficiency of Knowledge was tested. We used the Orthopaedic Patient Knowledge Questionnaire as a criterion instrument for SoK. The correlations between these two instruments were high (Pearson correlation 0.710–0.742) and this established the criterion validity of the Sufficiency of Knowledge instruments (Table 13).

Hospital Patient Knowledge Expectations and Hospital Patient Received Knowledge instruments have previously been shown to be valid (Leino-Kilpi et al. 2005, Rankinen et al. 2007) as has the Orthopaedic Patient Knowledge Questionnaire (Pellino et al. 1998, Johansson et al. 2007). Based on the response rates and Cronbach's alfpha coefficients, these instruments also functioned well in this study (Table 13).

Evaluations of the utility of the education were based on the Patients' Evaluation of Education (PEE) instrument. It seems that patients had no trouble evaluating the education, since the number of answers was considerable. The variance in the answers supports the sensitivity of the instrument.

Evaluation of the cost of care was based on patients' evaluations of their Pre- (PC), Intra- and Postoperative (IPC) Costs. In addition, we measured the costs of health care organisation by taking into account nurses' use of time for patient education and nurses' consultations (Con). With these measurements, it was possible to capture the costs of care only partially. In the future, more accurate instruments are needed. Also, the developed instruments measured the costs of care in general and special emphasis should be paid to the costs of education itself. Assessing of costs was difficult for the patients, since there were a fair amount of missing data (see Table 9).

We developed for this study the instruments that measured the extent to which patients experienced different emotions and symptoms. Both instruments had VAS-scales ranging from 0 to 100. Even though VAS has previously been used in measuring both patients' experiences of emotions and symptom intensity, there is no golden standard that the results could be compared to (Collins et al. 1997, Kelly 2001). In this study, patients did not experience strong emotions or severe symptoms. We associated both the patients' experiences of emotions and the intensity of symptoms with the phases of the surgery process rather than with the education. It was not possible to determine any golden standards based on this study.

The reliability of the instrument can be assessed, for example, in terms of its internal consistency by using Cronbach's alpha coefficient. It shows how homogenously items make up one sub-dimension of the instrument. For a new measure, Cronbach's alpha coefficient of 0.7 can be considered acceptable. Very high alpha coefficients may also indicate a measure that is too homogenous. The reliability of the instrument can also be assessed, for example, with a test-retest method which measures the stability of an

instrument over time. (Burns & Grove 2005, Trochim 2006, LoBiondo-Wood & Haber 2010.)

The Knowledge Test, Sufficiency of Knowledge, Patient Education Evaluation instruments, Hospital Patient Knowledge Expectations and Hospital Patient Received Knowledge instruments can be estimated as internally consistent. The high values of Cronbach's alpha coefficient suggest that there might be too many items measuring the same thing when using the Hospital Patient Knowledge Expectations and Hospital Patient Received Knowledge instruments. The amount of these items could be decreased to get a shorter and more convenient instrument. On the other hand, the results of Cronbach's alpha coefficient might indicate that, for example, the questions measuring the experiential dimension of knowledge were not appropriate. (See Table 13 for details.)

We used the Knowledge Test, Sufficiency of Knowledge, Patient Education Evaluation instruments, Orthopaedic Patients Knowledge Questionnaire, Emotions and Symptoms (S_{PRE}, S_{POST}) -instruments at several time points before and after the interventions. The instruments were able to distinguish differences between the measurement times, indicating change in time and confirming the sensitivity and stability of the instruments (Tables 7-8, 10, Figures 12-13, Papers III-VI).

As a whole, the instruments were easy to use, patients were able to answer them, and their responses were logical. Further development of the Preoperative Costs of care instrument and the Intra- and Postoperative Costs of care instrument is needed.

Table 13. Validity and reliability of the main the instruments of the study.

Instruments	Content validity	Criterion validity	Reliability
Knowledge Test (KT)	literature on knowledge test and knowledge of empowerment expert panel*		Cronbach's alpha coefficients: • 0.960 for the total KT • 0.660 (experiential) - 0.880 (bio-physiological) for its subscales
Sufficiency of Knowledge (SoK)	literature on sufficiency of knowledge and knowledge of empowerment expert panel*	SoK and OPQK instruments correlated at three different points in time (Pearson correlation 0.710–0.742; $p \leq 0.001$).	Cronbach's alpha coefficients: • 0.970 for the total SoK • 0.830 (experiential) – 0.970 (bio-physiological) for its subscales
Patient Education Evaluation (PEE)	literature on the evaluation of education expert panel*		Cronbach's alpha coefficients • 0.856 - 0.885
Orthopaedic Patient Knowledge Questionnaire (OPKQ)	literature on knowledge of empowerment	SoK and OPQK instruments correlated at three different points in time (Pearson correlation 0.710–0.742; $p \leq 0.001$).	
Hospital Patient Knowledge Expectations (HPKE) & Hospital Patients Received Knowledge (HPRK)	literature on AOSP knowledge expectations and their perception of received knowledge		Cronbach's alpha coefficient: • 0.930 for the total HPKE • 0.771 (experiential) – 0.953 (economical) for its subscales • 0.901 for the total HPRK • 0.762 (functional) – 0.970 (economical) for its subscales

*the expert panels consisted of three nurses, two physicians and three researchers

6.1.2 Interventions

The validity of the intervention contains the contents of the education, implementation of the education and concerns about the threats pertaining to the validity of the education. We ensured the content validity of the patient education by confirming the relevance of the content and the implementation of the education. The validity of face-to-face education (Phase I) was based on knowledge about empowerment. All of the nurses who participated in the patient education sessions were trained for this study. The validity of the Internet-based and face-to-face education (Phase II) was based on literature searches, an expert panel and a pilot test. The content of the Internet-based education was based on literature searches about previous studies on empowerment and the results of the first study phase (Phase I, Paper I). In addition, we made use of the knowledge of practitioners in clinical practice. The education was supported by designing the structure of the website so that it was easy to use and by structuring the knowledge from basic to advanced knowledge using the six dimensions of knowledge. An expert panel made up of experts in information system science (n=5), nurses (n=5), physicians (n=3), physiotherapists (n=2), representatives of nursing science (n=5) and patients (n=7) pilot tested and evaluated the content, structure, design and the use of the website. The face-to-face patient education contained the same structure and information as the Internet-based patient education.

We ensured and tested the validity and stability of implementing the education methods by arranging regular meetings between the nurses and researchers during the data collection. In the meetings, the content and experiences of the education were discussed. In addition, all of the nurses who participated in the Internet-based or face-to-face education sessions were trained for this study (Phase II).

Threats regarding the validity of the Internet-based and face-to-face education were similar (Phase II). We controlled the threats, which included history, maturation and testing threats (Polit & Beck 2006, Borglin & Richards 2010), through randomisation. Both groups of patients had similar socio-demographic data and similar experiences with previous operations and Internet use. The maturation threat was minimal, because of the rather short data collection period (8 weeks). A testing threat might occur due to the several measurements that we used in both education groups – the outcomes might also be a result of a testing threat rather than the patient education itself. The results might also reflect patients' awareness of being in a study and the instruments themselves may improve, for example, patients' knowledge (Hawthorne effect; external validity). However, this effect was similar in both groups.

The interventions that we used were complex; the Internet-based education in particular was complex. Complex interventions are usually described as interventions that contain several interacting components. A key question when evaluating a complex intervention is about its practical effectiveness (Medical Research Counsil 2000). An Internet-based education intervention worked well in the ambulatory setting.

There were no difficulties with the users (patients or nurses) and how they made use of the websites. However, due to the technology that was used, we were not able to get information about the detailed use of the website, for example which pages were used and how often or for how long of a time. Such evaluations would give more detailed information that would aid the development of the program.

6.1.3 Sample, data collection and data analysis

The sample size and randomization of the sample ensured the validity of the study (Zwarenstein et al. 2008, Borglin & Richards 2010). The main outcomes in this study pertained to patients' knowledge level and their sufficiency of knowledge. The sample sizes were based on the results of a power analysis from a previously used instrument measuring patients' knowledge (see section 4.3 and papers I and IV). The sample sizes were achieved as planned in both phases of the study. Stratified random sampling ensured the similarity of the samples, especially during Phase II. There were no differences in the patients' socio-demographic variables and their knowledge level or their sufficiency of knowledge at baseline, which serves to strengthen the reliability of this study (Table 2).

Recommendations for acceptable response rates vary; Badger and Werrett (2005) recommend a response rate of over 60%. We exceeded this by a large margin in all phases of the study. This improves the generalization of the results. Only two patients dropped out, during Phase II of the study, which shows that the patients were motivated to participate (Burns & Grove 2005). The same researcher collected the data was collected during the entire study and the researcher reminded the patients to respond during the study phases. This may have had an impact on the low drop-out rate. During the process of recruiting the patients, we discovered (Phase II) that several patients did not have an Internet connection in their home and were not able to participate. Only a few patients declined to participate otherwise, increasing our ability to make generalisations based on the results.

Statistical analyses for comparing the study groups in Phase II were carried out according to a pre-established analysis plan for ensuring the validity of the study. The amount of missing data was small: there were only a few patients who did not provide data for all measurement times. It was not possible to blindly perform the analysis, since we already knew the education groups in advance. Two separate persons performed most of the statistical analysis: the main researcher and the statistician.

6.2 Discussion of the results

The aim of the study was to create cognitively empowering Internet-based patient education with ambulatory orthopaedic surgery patients and evaluate it. To achieve this, the research process had the following two purposes: first, to define and explore the content of the cognitively empowering Internet-based patient education and,

second, to evaluate it. This was the first study which evaluated cognitively empowering Internet-based patient education in the field of ambulatory orthopaedic surgery patients.

Creation of the content of CEI-BPE (Paper I)

This study showed that multidimensional knowledge is essential in Internet-based patient education. This result is supported by earlier research, suggesting that the important dimensions of knowledge for patients are bio-physiological (Linden and Bergbom Enberg 1995, Fitzpatrick et al. 1998, Bernier et al. 2003, Leino-Kilpi et al. 2009), functional (Linden and Bergbom Enberg 1995, Thatcher 1996, Sigurdardottir 1996, Leino-Kilpi et al. 2009), social (Bernier et al. 2003, Leino-Kilpi et al. 2009), experiential, ethical and financial (Leino-Kilpi et al. 2009). Of these, the bio-physiological and functional dimensions have been found to be the most crucial for patients. This was also the case in this study (see Paper I).

In this study, patients' knowledge expectations differed among the different patients. For the most part, these expectations were fulfilled. Patients' expectations differed most from received knowledge in terms of the financial and ethical dimensions. A lack of received knowledge has been reported in previous studies as well (Linden & Bergbom Enberg 1995, Sigurdardottir1996, Fitzpatrick et al. 1998, Bernier et al. 2003). We should put more emphasis on offering this type of knowledge to patients. Since patients have individual knowledge expectations and their perceptions of received knowledge vary, it is important to design patient education so that it is as individualized as possible. This presents challenges for the health care system.

Internet-based education offers the possibility to develop content for patient education that is multidimensional and comprehensive, from which patients can choose the relevant knowledge based on their individual needs. Another advantage of Internet-based education is that it is available throughout the entire surgery process, as compared with face-to-face education, where education is limited to a particular place and time. In addition, Internet-based patient education is easily available for family and next of kin, who can also benefit from it (Raleigh et al. 1990, Heino 2005). On the other hand, it might be difficult for patients to locate and identify the essential knowledge from amongst all available information. Another challenge for the patient might be the difficulty in identifying one's own knowledge expectations. In face–to-face patient education, a nurse can play a major role in adapting education according to patient's needs and help in identifying the essential knowledge for the patient. In addition, during the course of the face-to-face interaction, the nurse can ensure that knowledge is understood by the patient. (Kettunen 2001, Virtanen et al. 2007.) These limitations can be overcome in Internet-based education by providing a clear structure, which makes it possible for the patient to deepen their knowledge in a step-by-step process, if needed. The possibility to interact with nurses via e-mail or some real-time communication software, such as Skype or Messenger, is also recommended.

Evaluation of the level of user acceptance for cognitively empowering Internet-based patient education (Paper II, III, summary)

We evaluated user acceptance according to utility and usability and the cost of the cognitively empowering Internet-based patient education for the users. Based on these evaluations, we found that users approved of the education.

Ambulatory orthopaedic surgery patients' evaluations of the utility and usability of cognitively empowering Internet-based patient education (Paper II, Summary)

Ambulatory orthopaedic surgery patients in both education groups evaluated the utility of the education as being considerably high. Patients in both groups also found the content of the education equally helpful. The patients were willing to recommend the particular type of education that they received. In addition, the patients did not differ in their need for further information or education. It can be considered that both education methods served patients' interests and that patients found the education useful (Hering et al. 2005, Wofford et al. 2005, Beranova & Sykes 2007, Johansson et al. 2007, Edward et al. 2011).

There are some issues that could still be improved in the Internet-based patient education. Patients in the Internet-based patient group evaluated the practical arrangements of the education less favourably than did those in the face-to-face group. Patients receiving Internet-based patient education found it difficult to arrange time to read the material, even though it was available all the time. The fact that most of the patients worked right up until the time of the operation may explain the lack of time. For the face-to-face group, the visit to the hospital occurred during a normal working day, whereas the websites were available all of the time. It might be challenging for patients to arrange time to prepare for the surgery if that time is not already scheduled. Despite the lower evaluation regarding the practical arrangements of the education, all patients who received Internet-based education came to the operation and were properly prepared. Two patients in the face-to-face education group did not come to the preoperative education, whereas all patients in the intervention group visited the website. Patients might need motivation to participate in the education (Kettunen 2001, Virtanen et al. 2007).

Some patients reported that the content of the Internet-based patient education was too extensive and less clear than the face-to-face patient education. It seems that some patients wish to have contact with a nurse in order to be able to discuss the content of the education (Foy & Timmins 2004, Virtanen et al. 2007, Kruzik 2009). In interactions between patients and nurses, the responsibility for the education is shared.

Previous studies have measured patient satisfaction rather than utility from a wider perspective. Usually, patients are satisfied with Internet-based education programs (Scherrer-Bannerman et al. 2000, Lewis 2003, Wofford et al. 2005, Nguyen et al. 2006, McMullan 2006, Keulers et al. 2007, Atack et al. 2008, Fleisher et al. 2008, Edward et

al. 2011). Thus, satisfaction is only one dimension of utility. This study gave a more comprehensive picture of the utility of the Internet-based patient education and we were able to identify the strengths and challenges of this type of education.

Based on the results, there is a need for developing the website further. Patients expect the knowledge to be multidimensional (Rankinen et al. 2007, Leino-Kilpi et al 2009); this represents a challenge when developing the website further. The content should be structured so that central knowledge is easy to find. The patients in this study found the website easy to use and supported its clear structure. This was realised during independent and frequent use (Cumbo et al. 2002). The interactivity of the website could be developed further. Earlier studies have shown interactivity and peer support to be useful (Brennan et al. 2001, Franklin et al. 2006), and they can improve the patients' understanding of knowledge. The understanding of knowledge could also be improved through interactive knowledge tests, a virtual hospital or games.

Costs of care with the cognitively empowering Internet-based patient education (Paper III)

AOSP out-of-pocket costs were rather low in both education groups. This is consistent with an earlier study done on the Finnish tax-based health care system (Virtanen et al. 2009). The result of this study showed that with the Internet-based patient education, the out-of-pocket costs of patients did no decrease, although several studies have assumed that they would (Griffiths et al. 2006, Berger et al. 2009, Tate et al. 2009). Our result did not come as a surprise, as the out-of-pocket costs of surgery consist mainly of the actual operation, not the education. In future studies, the specific costs related to Internet-based patient education, such as lost working time and salary or the cost of data transmission, should be evaluated in more detail. At the moment, we know very little about patient education costs for ambulatory orthopaedic surgery patients (Johansson et al. 2004 and 2005, Correll et al. 2006, Knee & Jacobs n.d.).

Patients receiving Internet-based patient education used more time in their preparation for surgery than did patients receiving face-to-face education. Those patients wanted to read websites several times and for a longer period of time than was possible for patients in the other group. There is no consensus regarding an optimal point of time or length of time for the education (Schoessler 1989, Fredericks 2009). Based on our results, patients might need several education sessions during different phases of the surgery process. This was possible with Internet-based patient education, which allowed the independent use of the website. Patients used the website whenever it suited them and for as long as they wanted. This resulted in more possibilities to become cognitively empowered (Zhang et al. 2000, Clement et al. 2002, Hassling et al. 2003, Valaitis 2005). Internet-based education gives us a new tool for a more individual-based patient education.

Voluntary use of the website provided patients with sufficient knowledge and they did not have any more contact with the healthcare system than did the patients who participated in face-to-face education (Zulfiquer & Pattanayak 2009). Only five patients participating in the Internet-based patient education sent e-mails to a nurse to confirm issues related to the surgery process. All patients came to the operation properly prepared and the operations were done as planned. This was not the case with the face-to-face group. Two patients missed the education and one did not come to the operation. These cancellations caused additional costs for the organization (Correll et al. 2006). There were no differences in patient hospital stays between the groups. However, earlier studies proved that with patient education in general, hospital stays can be shortened (Way et al 2003, Correll et al. 2006, Howell & Rogers 2009).

Internet-based patient education reduced the use of the resources needed in care for health care organization, meaning the nurse' use of time for education. This has been seen in previous studies as well (Griffiths et al. 2006, Berger et al. 2009, Tate et al. 2009). The Internet-based education decreased by half the amount of time that nurses spent one patient education. The amount of time saved is remarkable since the number of ambulatory surgeries is increasing and the need for patient education is increasing as well (OECD Health Data 2010). In the future, patient education expectations should be more systematically evaluated so that special expectations can be identified and fulfilled. We need to take into consideration the fact that the maintenance of websites and possible interactivities require resources.

Outcomes of the CEI-BPE

Cognitive outcomes (Paper IV, summary)

This study showed that with patient education, it is possible to increase patients' knowledge level and their sufficiency of knowledge. With the Internet-based patient education, the increase of knowledge in some dimensions was significantly better than with the face-to-face education. This result is in line with earlier studies (Lewis 2003, Kirsch & Lewis 2004, Wantland et al. 2004, Hering et al. 2005, Wofford et al. 2005, Beranova & Sykes 2007, Groves et al. 2010). Patients receiving Internet-based education improved their knowledge level more in total and in the functional and ethical dimensions of knowledge. In addition, the sufficiency of knowledge in the ethical dimension improved more over time compared to the control group. Altogether, patients in the experiment group gained better sufficiency of knowledge in the experiential and financial dimensions when compared with patients in the control group.

The reason for the versatile improvement in patients' knowledge with Internet-based education might be based on the multidimensional knowledge offered. In previous studies, the type of knowledge offered has usually focused on one or a few dimensions of knowledge only (e.g., the bio-physiological dimension, in Goldsmith & Safran

1999, or the experiential dimension, in Hering et al. 2005), resulting in an increase in knowledge in a narrow area. The results of this study prove that the multidimensional content of the website was relevant for the patients. Face-to-face education had the same content, but patients did not receive enough knowledge and they did not succeed as well in the knowledge test as did the Internet group. This can be a result of not knowing what the patients expected. Patients' expectations could be evaluated with knowledge tests (Strömberg et al. 2006, Keulers et al. 2007, Groves et al. 2010). Tests could be used before the education to identify patients' knowledge gaps.

Patients' knowledge level and the experience of sufficiency of knowledge increased parallel to one another in both education groups, resulting in patients' cognitive empowerment. In previous studies, the evaluation of patients' empowerment has been based only on, for example, the sufficiency of patients' knowledge (Bandura 1977, Anderson et al. 1991, Funnell et al. 1991, Anderson et al. 1995, Funnell & Adersson 2003). This study gave more diverse information on patients' cognitive empowerment, as empowerment was measured objectively with a knowledge test and subjectively by measuring the sufficiency of knowledge. In the future, emphasis could be put on defining the level of empowerment that is sufficient for the patient to act and make decisions about his or her care.

The results of this study suggest that a variety of patients can improve their knowledge through Internet-based education. Internet-based education is not only for young and more educated patients, as previous studies have proved (Lorence & Park 2007, Rahmqvist & Bara 2007, Brouwer et al. 2010). Especially, women seem to benefit from it. Women are used to using the Internet for seeking information about health (Rice 2006, Cutili 2010).

Clinical outcomes (Papers V, VI)

The method of education did not have an effect on patients' experiences of emotions or the intensity of symptoms. These results are controversial, since earlier studies have shown that education has an impact on patients' experience of emotions (Johansson et al. 2004, 2005, Wofford et al. 2005) or the intensity of symptoms (Goldsmith & Safran 1999, Coll et al. 2004a, Johansson et al. 2004, 2005, Wofford et al. 2005). In this study, the variation in the ways patients experienced emotions and the intensity of symptoms was related to the different phases of the surgery process. This is supported by other studies, suggesting that patients' emotions are affected by issues other than the education itself (Carr et al. 2005). The effect of different education methods on patients' experiences of emotions and intensity of symptoms remains unclear (e.g. Shuldham 1999, Johansson et al 2004, Wofford et al 2005).

Mainly, the patients' did not experience strong emotions at any phase of the ambulatory surgery process in either group. This was possible to detect since there were seven different measurement times. Previous studies have only used one to three

measurement times (Gillies & Parry-Jones 1997, Gillies et al. 1999, Carr et al. 2005, Mitchell 2010). Preoperatively, many of the patients were nervous. On the day of the operation and right before the operation, nervousness and fear increased, whereas the experience of worry and impatience decreased. Postoperatively, the number of patients experiencing these emotions decreased. However, two weeks after the operation nearly 10% of patients were still experiencing serious impatience. There were only a few patients experiencing moderate or high levels of depression or anxiety preoperatively and barely any in the postoperative phase. In previous studies, the prevalence of these emotions has been higher (Gillies et al. 1999, Carr et al. 2005, Mitchell 2010). This difference might be explained by cultural issues: Finnish people have strong confidence in the public health care system (Paper V).

Some patients in both education groups had severe symptoms. These results are consistent with the findings from previous studies (Cardosa et al. 1994, Beauregard et al. 1998, McHugh & Thoms 2002, Apfelbaum et al. 2003). Patients gave the highest scores to the level of pain intensity, sleeplessness and tiredness on the 1st postoperative day. Four weeks after the operation, only a few patients had severe symptoms. However, approximately 10% of patients still experienced moderate pain or sleeplessness or had difficulties with movements and tiredness. It is essential to identify these patients and to take care of their symptoms in order to prevent the complications and ensure the recovery process (Cardosa et al. 1994, Bardiau et al. 2003, Watson et al. 2004). The results of this study also indicate that ambulatory orthopaedic surgery patients' recovery process lasts longer than four weeks, which suggests that a longer follow-up period is necessary (Paper VI). However, the overall low occurrence of strong emotions and severe symptoms confirms the fact that ambulatory orthopaedic surgery patients are a relatively healthy group.

6.3 Suggestions for nursing practice

The importance of patient education is mentioned in the national healthcare plan (Terveys 2015 Health 2015 public health program –kansanterveysohjelma, National Knowledge Society Strategy 2007-2015, Kaste 2008-2011, Attractive and Health Promoting Health Care 2009–2011) and also in several international (European Commission 2003, eHealth ERA 2007a,b) programs. Patient education will be even more important in the future. A growing elderly population will need orthopaedic operations. Hospital stays are being shortened and people need to be able to care for themselves at home. (OECD Health Data 2010.) The number of people using the Internet is growing rapidly and the younger generations in particular demand online information, since they are already used to receiving information online in other aspects of their life.

This study proved that Internet-based patient education is a viable option for educating patients. It does not have to replace face-to-face education, but it gives an individual

considerable freedom of choice regarding time and the frequency and depth of the education. It also reduces the amount of time that nurses spend on patient education. Hospitals should consider hosting their own specific websites. Without developing websites for patient education, we are missing a valuable opportunity to promote the possibilities for patients to become cognitively empowered and active participants in their own care.

Based on the results of this study, we make the following suggestions for nursing practice:

Creating the content for cognitively empowering Internet-based patient education

- Patients expect multidimensional knowledge about the different phases of the surgery process. In addition to bio-physiological and functional knowledge, they also expect experiential, ethical, social and financial knowledge. This should be considered when designing new websites and Internet-based education programmes, and the content of the education should be based on scientific material.

User acceptance of the cognitively empowering Internet-based patient education

- Internet-based patient education is comparable to face-to-face education and it was well accepted by patients. It saved professionals time when it was being used. However, creating a website can be time consuming.

Outcomes of the cognitively empowering Internet-based patient education

- Internet-based patient education increased patients' knowledge level and their sufficiency of knowledge. Nurses should be active in designing educational websites and support patients in using them, and, in this way, support patients in becoming cognitively empowered.
- Patients' knowledge level should be diagnosed and evaluated routinely and used as the basis for patient education. A knowledge test and sufficiency of knowledge instruments could be used for this purpose. These instruments could also be used in the realization and evaluation of the outcomes of the education.
- Clinical outcomes vary during the surgery process and they should be monitored, even though this study did not show that there would be a connection between empowering education and the experience of emotions or the intensity of symptoms.

6.4 Suggestions for nursing research

Even though Internet-based education has been possible for a period of time, the scientific creation and evaluation of an Internet-based education program has been scarce. Website development is needed and future research should look at the cognitively empowering power of Internet-based patient education from different perspectives. Based on the results of this study, we make the following suggestions for nursing research:

Content of cognitively empowering Internet-based patient education

- This study evaluated the knowledge areas of cognitively empowering patient education for ambulatory surgery patients. The depth and value of the knowledge that is needed for cognitively empowering patients was just as important for this study. In addition, the relevance of different types of knowledge content for the patient should be evaluated.

User acceptance of the cognitively empowering Internet-based patient education

- The developed website was quite well accepted by the patients. Still, we need studies on the structure of the website and the presentation of knowledge.
- In this study, we tested interactivity by measuring the frequency of e-mails and other contacts between the patients and the personnel. The interactivity of the website should be developed and studied further.
- There is a distinct need for economical evaluation tools. The costs of patient education are very difficult to measure. What is cheap for the organization might be expensive for the patient. Both aspects are hardly ever studied in the same study.

Outcomes of the cognitively empowering Internet-based patient education

- Cognitive empowerment is only one part of patient empowerment. Future studies should evaluate the effect of Internet-based patient education for ambulatory surgery patients on other dimensions of empowerment as well - does the education and cognitive empowerment support patient decision-making and their actions towards managing their health and care?
- The instruments used in this study should be further validated. The knowledge test developed for this study could be recommended as an evaluation tool for knowledge testing within this specific patient group.
- The patients' experiences of emotions and the intensity of symptoms have not been evaluated as widely in previous studies. The instruments in this study could be tested in other patient groups. They provide subjective information about patients' emotions and symptoms.

7. CONCLUSION

This study showed that the possibilities for patients to become cognitively empowered can be increased with the help of cognitively empowering Internet-based patient education. A website that included multidimensional knowledge was accepted by the users. Thus, the utility of cognitively empowering Internet-based patient education was partially lower than that of cognitively empowering face-to-face patient education. Patients used the website without any problems and evaluated it as easy to use. There were no differences between the out-of-pocket costs for the different types of education. However, the nurses saved time when using the cognitively empowering Internet-based patient education. This study also showed that cognitively empowering Internet-based patient education increased patients' knowledge level and their sufficiency of knowledge more than face-to-face education. Patients' experiences of emotions and the intensity of symptoms did not differ between the education groups. As a summary, we can recommend that cognitively empowering Internet-based patient education be used as an alternative method to face-to-face education with ambulatory orthopaedic surgery patients.

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