How women with breast cancer learn using interactive cancer communication systems

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Abstract

To provide insights about how women with breast cancer learn from interactive cancer communication systems (ICCSs), this study examined how use of different types of services that employ conceptually distinct pedagogical methods relates to learning outcomes. The study sample included 231 recently diagnosed, lower income breast cancer patients. Participants were provided a free computer, Internet access and training in how to use an ICCS called the Comprehensive Health Enhancement Support System ‘Living with Breast Cancer’ program. Data comprised survey information collected at pre-test and 4 months after using the system and computer records of how women used the system (use data). The findings suggest that use of the information and interactive services independently contributed to perceived information competence, though the communication services, including both discussion group and ask an expert, did not. Consistent with expectations, use of discussion group and interactive services amplified the learning effects of using the information services. However, use of the ask an expert service did not amplify the learning effects of using the information services as predicted. Some constructivist pedagogical methods—specifically online support groups and intelligently designed, computer-driven interactive services—may supplement and extend the learning potential of information services delivered via a transmission-oriented pedagogical approach.

Introduction

While interactive cancer communication systems (ICCSs) have been found to improve cancer patients’ ability to find the information they want, [1] research often fails to specify ‘how’ people actually learn in these settings. A common, but incomplete, understanding of online health education for cancer patients is that people are passive receivers of information or ‘vessels into which knowledge is poured’ [2]. This assumption encourages views of knowledge acquisition that undervalue active learning and undervalue the role of communication with others or reciprocal interactions with educational tools that can be shaped to yield contextually appropriate information. Importantly, evidence demonstrates that learners do poorly in transferring newly learned skills and knowledge to situations that are different from the learning context. The act of learning involves gaining understanding, and context is valuable for enhancing understanding as ‘context gives meaning to learning’ [2].

Educational theories have broadly focused on two views of learning: education as a transmission process and education as a constructivist process.

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In a transmission view, the learner acquires knowledge in a one-way process in which an instructor, peer or Web resource provides information designed to enable learning. For example, one common pedagogical method found in nearly all ICCSs is posting health information that is available for patients to read at their convenience [3], which viewed in isolation can clearly be interpreted as a transmission approach to health education. However convenient and appropriate it may be to provide patients access to educational materials on the Web, this approach by itself does not capitalize on learning that may occur as a result of interaction with others, such as peers, experts or mentors [4], and it does not capitalize on use of interactive computer tools that present information that is tailored to the users’ priorities, values and situation. Transmission approaches to education can be used with learning tools and technologies, such as Internet learning portals and communities of learning. However, the transmission approach when used by itself may blunt the potential role of these powerful technologies due to the use of an impoverished underlying communication and educational strategy [5].

A complementary approach includes constructivist educational methods that encourage active learners to communicate with each other and interact with different resources to maximize their learning potential [6]. The constructivist perspective conceives of communication as a two-way process in which meaning is created by means of dialogue [7]. In this model, communication is a transformative and creative experience and is more than just the ‘passing of static knowledge back and forth between participants’ [4].

Within a comprehensive ICCS, there is the opportunity to employ both transmission and constructivist pedagogical strategies to enhance learning outcomes. Passive strategies such as provision of static information may be conceived of as following a transmission approach to learning within an ICCS, while online discussion with peers, discourse with a cancer expert and use of interactive programs arise from constructivist models of learning [8].

To provide insights about how people learn within ICCSs, this paper reports on how using different types of services relates to learning outcomes focusing on a particular ICCS called the Comprehensive Health Enhancement Support System (CHESS) ‘Living with Breast Cancer’ program, which is a computer-based system that provides patients and their families with a wide range of services, including information, social support, decision support and skills training. CHESS was developed at the University of Wisconsin—Madison’s Center for Health Systems Research and Analysis [9–22].

### CHESS service types and theorized effects on learning

CHESS offers four basic types of services, which are explicated as they relate to transmission-oriented and constructivist educational theories and described below.

#### Information services

Information services are the primary communication strategy used in most health education Web sites. They are user driven in the sense that the user is the primary determinant of where she/he goes and what she/he sees. There may be prompts from the computer, but the computer is not, for the most part, guiding the user. The computer is a passive participant in the delivery of information to the user; it tends not to guide or direct. This type of learning environment can be categorized as a transmission-oriented pedagogical method. Examples of this would be Library Articles or Frequently Asked Questions where the user asks to see articles on certain topics or Personal Stories where the user can read about the experiences and thoughts of other individuals who faced the same sorts of challenges that the user faces. The user selects these services and indicates the kind of information she/he wants, and the computer delivers the information via text, audio or video files.
Communication services
Another category of services within CHESS includes communication services that serve a conversational function in that the computer links people together so that they can communicate with one another via the computer. Through such communication, the user is presumed to learn, and the medium by which this information is acquired is the computer-mediated person-to-person connection. From a conceptual standpoint, we posit that there are two conceptually distinct subcategories within communication services—peer-to-peer and patient-to-expert communication.

Discussion group
One type of communication service is the discussion group, which enables peer-to-peer communication in which patients can anonymously share information and support. It is a text-based, asynchronous bulletin board that has consistently been the most frequently used service within CHESS [14]. The groups are monitored by a trained facilitator to ensure that discussions are supportive and do not contain unchallenged, inaccurate or harmful information. However, the facilitator does not take an active role in guiding the women about what they should communicate about. Research on learning indicates that informational support from others can be valuable to people coping with a chronic illness. Informational support refers to receiving information from others regarding a variety of issues, and benefits include sharing important information and learning how to get what you want [23]. Informational support can include sharing information about one’s own experiences with breast cancer so other women know what to expect or the sharing of other medical information that one finds through other means (e.g. the Internet, television, doctors, brochures). Furthermore, a constructivist framework argues that much learning is social and takes place in ‘communities of practice’ where people interact with, and learn from, one another in similar activities [24]. Communities of practice also provide ample opportunity for breast cancer patients to observe and model the behavior of other successful cancer survivors consistent with Bandura’s Social Learning Theory [25]. These communities of learning may develop in formal places of learning such as a classroom, but are as likely to occur in less formal learning environments such as an online support community. Sometimes learning is direct, but more of this type of learning occurs informally or incidentally [24].

Ask an expert service
Another type of communication service is the ask an expert service, which enables patient-to-expert dialogue by providing users the ability to ask questions of an expert trained by the National Cancer Institute (NCI) and receive a response within 48 hours. To answer patients’ questions, the expert uses well-established medical textbooks (e.g. Diseases of the Breast) or computer resources (e.g. the NCI’s Physician Data Query database). The CHESS expert employs a constructivist pedagogical approach in that her teaching is highly interactive and responsive to the user’s particular life context and takes into account a specific patient’s individuality by encouraging her to make sense of the information she shares relative to her own health context and set of concerns [26].

Interactive services
In interactive services, the computer takes an active role in guiding the user, making suggestions, offering feedback, identifying deficits and shaping the user’s behavior. In these services, the computer plays a role traditionally identified as counseling, coaching or teaching. Interactive services use data about users to shape feedback or prompts to users, in keeping with the notion that information will be most useful when it is consistent with the users’ particular contexts and/or preferences [27]. This category of services has some conceptual parallels to information tailoring, which is a message strategy that provides specific content or messages to individuals based on data they provide [28]. However, tailoring typically does not involve a non-recursive process in which the user and computer influence one another in an ongoing, dynamic manner. Significantly, the efficacy of computer-generated
tailored messages over general material for reaching desired educational outcomes has been supported across a variety of domains [29–32]. Interactive services include the following: action plan that helps women to make desired lifestyle changes by walking them through their personal assets and obstacles to increase their likelihood of success; decision aid, which empowers women to make treatment decisions based on their own values and priorities, such as reducing the likelihood of recurrence or obtaining minimally invasive or noxious treatments; health tracking that tracks women’s symptoms and psychosocial status over time while pointing out how some of the factors may relate to one another and Journaling, which guides women though a series of guided writing exercises intended to help them make sense of their cancer experience, relieve stress and improve emotional well-being. Interactive services are similar to the ask an expert service in that both offer expert advice and take into account the individual life context of the user. However, a signal conceptual distinction is that the former services are provided solely by the computer, while the latter service is delivered through the computer by a professional human information specialist. There are also parallels between the interactive services and discussion group in that both are genuinely interactive and take into account the individuality of the user. Again, however, the interactive services provide expert advice solely by the computer, while in the discussion group service, the computer merely serves as a communication conduit.

Hypotheses

There are two primary hypotheses being examined in this study. The first hypothesis, seeking to reaffirm past literature, is to demonstrate that information, communication and interactive services will each have independent positive effects on learning outcomes.

Hypothesis 1

Information, communication (i.e. discussion group and ask an expert) and interactive service use will each be positively associated with health information competence.

Second, based upon constructivist theory, we hypothesize that optimal outcomes will be obtained when people use communication or interactive services based on constructivist models ‘in addition’ to transmission-oriented information services. It is expected that the acts of communicating with others or using interactive services that take a more active role in guiding the user will enhance learning outcomes beyond merely reading static information services alone. This leads to the second hypothesis.

Hypothesis 2

The effect of information service use on health information competence will be amplified when people are more involved in discussion group, ask an expert or interactive services.

Methods

Data collection procedure

The data analyzed in this study were collected as a part of a larger Digital Divide Pilot Project (DDPP) where 231 underserved women with breast cancer in rural Wisconsin and Detroit, MI, USA, were given access to CHESS for 4 months. Participants were paid $15 for each completed pre- and post-test. Patients were identified through a variety of sources, including the NCI’s Cancer Information Service, hospitals and clinics, public health departments and the Medicaid program. They were eligible if they were at or <250% of the federal poverty level, within 1 year of diagnosis or had metastatic breast cancer, not homeless and able to read and understand an informed consent letter. After submitting their pre-test, all study participants were loaned a computer and given Internet access for 4 months. They also received personal training to learn how to use the computer and the Internet, but the majority of time was spent on learning how to use CHESS. Recruitment began in Wisconsin in May 2001 and ended in April 2003. Detroit recruitment began in June 2001 and ended in April 2003.
Measures

Health information competence
The principal dependent variable was ‘health information competence’, which reflects a breast cancer patient’s perception that she was able to receive and appropriately use health information [33]. Health information competence is a valuable measure for learning as it prioritizes the individual’s self-perception about whether she has the information she needs to cope with cancer and is also consistent with Bandura’s [25] concept of self-efficacy—confidence in one’s ability to perform relevant behaviors in a particular situation, which is related to adjustment to illness [34]. It is speculated that optimal patterns of use behavior within an ICCS will contribute to patients’ perceptions of mastery over events and ability to meet challenges as they occur. Information competence was measured by five items that asked, on a five-point scale ranging from 0 = ‘never’ to 4 = ‘always’, if respondents (i) know what they want to learn about their health, (ii) can determine how and where to get information, (iii) believe that health information is more difficult to obtain than other information (reversed), (iv) are satisfied with the way they learn about health and (v) feel in control of how and what they learn about their health. Scores of the five items were averaged to construct an index of perceived information competence (pre-test reliability $\alpha = 0.75$, post-test reliability $\alpha = 0.79$). Previous studies have found that CHESS does have a positive effect on health information competence [1], though no research has been conducted to understand which of the conceptually distinct services within CHESS contribute to this effect. In the current study, the change in information competence from the pre-to post-test was statistically significant (pre-test $M = 2.37, SD = 0.69$; post-test $M = 2.83, SD = 0.64$, $t(10) = 10.21$, $P < 0.001$): effect size calculated via Cohen’s $d = 0.69$.

Control variables
We controlled statistically for variables in order to reduce error in the dependent variable: i.e. ‘age’, ‘education’, ‘ethnicity’ (a dummy variable with non-Caucasian coded 0 and Caucasian coded 1) and ‘live alone’ (‘yes’ coded 1). In addition, we controlled for self-reported disease-related factors such as ‘stage of cancer’ [early stage (0, 1, 2) coded 0 and late stage (3, 4 or inflammatory) coded 1] and ‘number of days between diagnosis and intervention date’. Previous studies suggest both of the former variables are associated with the level of psychological adjustment and distress [35, 36]. Finally, the pre-test level of the dependent variable was also statistically controlled.

CHESS use
A browser automatically collected use data on an individual keystroke level as participants used the system. This capability enabled us to track each user’s code name, data, time spent and URL of every Web page requested. The key variables of interest are four measures of CHESS service use: information (M = 35.46, median = 16.89, SD = 56.78, range = 475.4), discussion group (M = 506.18, median = 62.59, SD = 1369.35, range = 12743.8), ask an expert (M = 27.96, median = 6.46, SD = 51.64, range = 432.0) and interactive service (M = 27.85, median = 9.88, SD = 52.86, range = 500.7). These measures are operationalized as total time spent (as measured by minutes) in each service during the 4-month study period. In addition, we took the logarithm of CHESS use and used these as our independent variables because of the positively skewed distribution of the variables. Time exposed to particular services was selected as our independent variable based on the assumption that the more people are exposed to content, the more opportunity they will have to learn from it, and time of exposure to specific media has been found in previous research to specifically predict higher levels of cancer-related knowledge [37].

Analytic framework
Hierarchical regression analyses were performed to test the relation between CHESS service use and information competence. Previous research showed that some CHESS use variables (as measured by time spent in each service) were highly correlated. Therefore, zero-order correlations were computed to
determine whether collinearity might affect analyses. Because preliminary analysis showed a high correlation between information and interactive services ($r = 0.709, P < 0.01$), we modified the regression analyses to reduce biasing by collinearity.

To examine the main effect of the four types of CHESS service use (H1), the control variables and the pre-test score of the dependent variable (i.e. information competence) were entered as an initial set in the regression model. In the next block, we entered either information or interactive service use along with discussion group and ask an expert service use because of multicollinearity caused by information and interactive service use variables. In other words, we ran two separate regression analyses to test the main effects.

We ran two separate regression analyses to test the interaction effects (H2). This was necessary for two reasons. First, tests of interaction effects may be spurious when interactions are computed from highly correlated main effect variables [38–40]. The reason for this is that ‘when the correlation between $X$ and $Z$ increases, so does the correlation between $XZ$ and the quadratic terms $X^2$ and $Z^2$, which results in an overlap between the variance explained by $XZ$ (i.e., interaction term) and the variance explained by the quadratic terms’ (p. 616) [39]. Following recommendations [39, 40], we additionally controlled the quadratic terms of highly correlated main effect variables (i.e. information and interactive service use), though our theoretical model includes only linear and interaction terms. Thus, the interaction term between information and interactive service use was entered in the final block of a hierarchical regression model following control variables, linear terms of the four types of CHESS service use and quadratic terms of two components of the interaction term.

Second, because correlations between use scores of components of the other two interaction terms (i.e. information and ask an expert service use, information and discussion group service use) are weak (0.048 and 0.068, respectively), we ran interaction tests between information and the two communication service use after controlling only for demographics, pre-test information competence and finally the four types of CHESS use variables. Finally, consistent with recommendations for testing interaction terms, all the main effect variables were standardized prior to creating the interaction terms [40].

**Results**

Among 286 participants recruited originally, 231 patients (81%) completed both pre-test and 4-month post-test surveys. Table I shows demographic and disease-related characteristics of the study participants. The sample had a mean age of 51 years and 62.3% of the DDPP participants were Caucasian, 35.9% African–American and 1.7% other minorities. More than half of them had at least some college education. On average, women had been diagnosed ~4 months before the start of the DDPP study with more than two-thirds of them being in the relatively early stages of cancer. In addition, about a fourth of them lived alone.

As shown in Table II, we ran zero-order correlation analyses among independent and dependent variables. First, there were significant correlations among independent variables. A strongly significant correlation was found between

<table>
<thead>
<tr>
<th>Table I. Demographic characteristics (n = 231)</th>
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</thead>
<tbody>
<tr>
<td>Age; mean (SD)</td>
</tr>
<tr>
<td>Ethnicity</td>
</tr>
<tr>
<td>Caucasian</td>
</tr>
<tr>
<td>African–American</td>
</tr>
<tr>
<td>Other minorities</td>
</tr>
<tr>
<td>Live alone</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>Education</td>
</tr>
<tr>
<td>Some junior high</td>
</tr>
<tr>
<td>Some high school</td>
</tr>
<tr>
<td>High school degree</td>
</tr>
<tr>
<td>Some college</td>
</tr>
<tr>
<td>Associate or technical degree</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
</tr>
<tr>
<td>Graduate degree</td>
</tr>
<tr>
<td>Days between diagnosis and intervention; mean (SD)</td>
</tr>
<tr>
<td>Stage of cancer</td>
</tr>
<tr>
<td>Early stage (stage 0, 1, 2)</td>
</tr>
</tbody>
</table>
information and interactive service use ($r = 0.709$, $P < 0.01$), while moderate or weak correlations were found between discussion group and ask an expert service use ($r = 0.434$, $P < 0.01$) and between discussion group and interactive service use ($r = 0.142$, $P < 0.05$). Correlations among the other three pairs were not significant. Second, there were two significant and positive correlations between the independent and dependent variables. The dependent variable is change score in information competence computed via the regression of the post-test on its pre-test counterpart. Information ($r = 0.175$, $P < 0.01$) and interactive service use ($r = 0.155$, $P < 0.05$) had significant and positive relationships with changes in information competence, though use of the two communication services did not.

Table II. Zero-order correlations among primary variables

<table>
<thead>
<tr>
<th>Information services</th>
<th>Discussion group</th>
<th>Ask an expert service</th>
<th>Interactive services</th>
<th>Change in information competence^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information services</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discussion group</td>
<td>0.068</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ask an expert service</td>
<td>0.048</td>
<td>0.434**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Interactive services</td>
<td>0.709**</td>
<td>0.142*</td>
<td>0.052</td>
<td>1</td>
</tr>
<tr>
<td>Change in information competence^a</td>
<td>0.175**</td>
<td>0.059</td>
<td>0.073</td>
<td>0.155*</td>
</tr>
</tbody>
</table>

^aPost-test score was regressed on pre-test counterpart to create change scores (i.e. residuals) in information competence from pre- to post-test. *P < 0.05, **P < 0.01.

Table III. Summary of two regression analyses predicting information competence (post-test): main effect^a

<table>
<thead>
<tr>
<th>Control variables (seven)</th>
<th>Model I^b</th>
<th>Model II^b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-0.065</td>
<td>-0.074</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>-0.019</td>
<td>-0.031</td>
</tr>
<tr>
<td>Live alone</td>
<td>-0.021</td>
<td>-0.028</td>
</tr>
<tr>
<td>Education</td>
<td>-0.005</td>
<td>-0.009</td>
</tr>
<tr>
<td>Days between diagnosis and intervention</td>
<td>0.047</td>
<td>0.037</td>
</tr>
<tr>
<td>Early or late stage</td>
<td>-0.037</td>
<td>-0.045</td>
</tr>
<tr>
<td>Information competence (pre-test)</td>
<td>0.455***</td>
<td>0.463**</td>
</tr>
<tr>
<td>$R^2$ change (%)</td>
<td>20.2**</td>
<td>20.2**</td>
</tr>
<tr>
<td>Main effect: CHESS use (three)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information service^c</td>
<td>0.162**</td>
<td>-</td>
</tr>
<tr>
<td>Ask an expert^c</td>
<td>0.058</td>
<td>0.062</td>
</tr>
<tr>
<td>Discussion group^c</td>
<td>0.011</td>
<td>-0.001</td>
</tr>
<tr>
<td>Interactive service^c</td>
<td>-</td>
<td>0.164**</td>
</tr>
<tr>
<td>$R^2$ change (%)</td>
<td>3.0*</td>
<td>3.0*</td>
</tr>
</tbody>
</table>

^aCell entries refer to the standardized regression coefficient.
^bBecause of high correlation between information and interactive service use, we ran two separate regressions. For example, information service use was entered along with ask an expert and discussion group use in the main effect block of Model I and interactive service use was included in Model II along with the two communication services use.
^cLog transformed due to the positive skewness of the distribution. *P < 0.05, **P < 0.01, ***P < 0.001.

When two combinations of the three out of four CHESS services were entered into each regression model after these control variables, two CHESS use variables were significant. In the first model, there was a significant main effect for information service use ($\beta = 0.162$, $P < 0.01$), even after controlling for demographic variables. In the second model, interactive service use also had a significant relationship with information competence ($\beta = 0.164$, $P < 0.01$). However, communication
service use for ask an expert and discussion group was not significantly associated with the dependent variable in both models. Although we ran two different models to test the main effects, the control (20.2%) and CHESS use blocks (3.0%) in each model explained the same amount of variances in the dependent variable. In addition, the patterns that emerged from regression analyses were also consistent with those from zero-order correlations among independent and dependent variables (see Table II).

Table IV summarizes the results of two hierarchical regression models testing the interaction effects of use of information services and the two communication services on patients’ information competence (H2). The first model tested the interaction between highly correlated information and interactive services after controlling for demographics, pre-test information competence, use of the four CHESS services (main effects) and the quadratic terms of two components of the product term. The second model tested the interaction between use of the information service and the two communication services after controlling for demographics, pre-test information competence and CHESS use main effects. As shown in Table IV, the interaction between information and interactive services was significant (β = 0.206, P < 0.01) as was the interaction between information services and discussion group use (β = 0.163, P < 0.01). Comparing two models, the control (20.2%) and CHESS use blocks (3.5%) explained the same amount of variances. Additionally, the interaction effect block in the first model explained additional significant variances (2.1%) in information competence and the same block in the second model also explained significant variances (2.6%).

In order to examine the nature of these findings, we plotted them in Figs 1 and 2. As shown in Fig. 1, for both high- and low-interactive service users, information competence increased as patients used the information services more. Additionally, consistent with our hypothesis, there was a significant positive relationship between information service use and information competence being stronger for patients who spent more time in the interactive services than for patients who spent less time using these services.

Similarly, the plot illustrated in Fig. 2 indicates that there is a very weak positive effect of information service use among those who used discussion group less, but a stronger positive relationship between information service use and health information competence among those who used discussion group more. The interaction between information and ask an expert service use did not reach statistical significance.

**Discussion**

These findings partially support the first hypothesis in showing that information and interactive services
were associated with higher health information competence. However, contrary to the hypothesis, use of the communication services did not independently contribute to the enhanced learning outcomes.

Results also partially support the second hypothesis indicating that interactive services may supplement and extend the learning potential of information services delivered via a transmission-oriented pedagogical approach. Researchers should continue to examine the best way to develop intelligently designed, computer-driven interactive services that can optimize specified learning outcomes. This study also found a significant interaction between use of the discussion group and the

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**Fig. 1.** Interaction between information and interactive service use in predicting 4-month information competence. To illustrate the significant interaction effect, mean values were assigned to the control and other CHESS service variables that did not form the interaction term. In addition, mean values were assigned to the quadratic terms because our true model did not include them.

**Fig. 2.** Interaction between information and discussion group use in predicting the 4-month information competence. To illustrate the significant interaction effect, mean values were assigned to the control and other CHESS service variables that did not form the interaction term.
information services on information competence. However, use of the ask an expert service was not related to perceived information competence either independently or in combination with information services. In terms of ICCS interventions, it appears that health information competence may relate more to the experiential knowledge that one obtains from one’s peers rather than to the factual knowledge one would receive from an expert.

One limitation of this study is that it used self-reported information competence as a sole measure of learning. Future research might also employ a more objective measure of breast cancer knowledge as a dependent variable. However, one of the theoretical arguments of constructivist learning is that knowledge should be constructed in a way that is most meaningful to the learners themselves rather than matching an externally imposed objective template. Surely, however, there is room for some expert-constructed learning in health education as research indicates that women do sometimes have misperceptions about breast cancer treatments and causes. Objective measures of knowledge may reveal learning benefits from communicating with a cancer expert that were not found in this study. Thus, it is important to recognize that use of services might produce important benefits that are not reflected in this single, subjective dependent variable [17, 18].

Another limitation of this research is that the independent variable of use behavior is measured solely in terms of time spent within the various service categories. Clearly, there are a variety of other strong measures of use behavior, such as level of engagement or the efficiency of a given session. For example, one might expect that a very well-designed tailored information system may deliver information more efficiently and deliver the same outcomes in a shorter amount of time than a non-tailored system.

From a methodological standpoint, future studies should explore additional measures of patients’ ICCS use that are both theoretically relevant and meaningful to the particular research questions being examined. For example, it seems likely that the mechanism for the effects of communication services is not just how much time they use the services but rather the type of issues people talk about [18]. Future research should look at not just how much dialogue occurs between patients within ICCSs but also what they talk about to determine how both the quantity and quality of interaction effect learning outcomes.

On this note, it is worth reminding the user that while a trained facilitator monitored the discussion groups in this study, by design the facilitator did not take a very active role in guiding conversation around specific educational objectives. That said, the CHESS model of online support groups is more structured than the vast majority of support groups on the Web, which does not have a facilitator at all [41]. No studies have been conducted on the effects of having a facilitator or not within online support groups, and future research should examine the added benefit of a facilitator who takes a more active role in guiding conversation around educational objectives.

Finally, while this article takes an important step forward in contributing to understanding how people learn from ICCSs, the correlational analysis is only suggestive; an experimental design would permit stronger inferences regarding how different types of service utilization contribute to health education outcomes. A current clinical trial funded by the NCI being conducted at the University of Wisconsin—Madison Center of Excellence in Cancer Communication Research is employing an experimental design looking at the differential effects of providing users different configurations of CHESS services including information, communication and interactive services. While it is hypothesized that there will be some knowledge gains from providing users information services alone, it is expected that offering information services in combination with communication and interactive services will demonstrate significantly stronger outcomes. Results of this study will be forthcoming and should allow for a more conclusive opportunity to quantitatively demonstrate the added value of constructivist pedagogical methods. This article represents part of this effort by offering a theoretical
framework and some quantitative insights about how users appear to learn as a result of using an ICCS.

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Conflict of interest statement

None declared.

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