A Quantitative and Qualitative Inquiry into Future Teachers' Use of Information and Communications Technology to Develop Students' Information Literacy Skills

Enquête quantitative et qualitative auprès de futurs enseignants portant sur l'utilisation des technologies de l'information et de la communication pour développer les compétences informationnelles des élèves

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Abstract

This study aims to understand how preservice programs prepare future teachers to use ICT to develop students' information literacy skills. A survey was conducted from January 2014 through May 2014 with 413 future teachers in four French Canadian universities. In the spring of 2015, qualitative data were also collected from 48 students in their final year of an initial teacher training program. Our findings suggest that although future teachers receive formal ICT training as part of their program, information literacy is not formally addressed. Nevertheless, information literacy is perceived to be an important skill. In addition to a lack of formal training, future teachers perceive that barriers such as time constraints and lack of access to necessary technologies in the classroom will prevent them from helping students develop information literacy skills. Based on these results, we propose some practical implications and recommendations for preservice programs and education policy makers.

Résumé

Cette étude vise à mieux comprendre comment la formation initiale en enseignement prépare les futurs enseignants à utiliser les TIC pour développer les compétences informationnelles des élèves. Dans un premier temps, une enquête a été réalisée entre janvier et mai 2014 auprès de 413 futurs enseignants dans quatre universités québécoises. Dans un second temps, au printemps 2015, des données qualitatives ont été recueillies auprès de 48 futurs enseignants au cours du dernier trimestre de leur formation initiale. Nos analyses suggèrent que si les futurs enseignants reçoivent une formation à l'utilisation pédagogique des TIC, les compétences informationnelles ne sont pas explicitement abordées, et ce, bien qu'elles soient perçues comme essentielles. De plus, les contraintes de temps et l'accessibilité aux outils informatiques sont

pressenties comme des défis importants. Sur la base des suggestions des participants, nous dégageons des retombées pratiques pour la formation initiale et pour les détenteurs d'enjeux en éducation.

Introduction

Information and communication technology (ICT) and the Internet have spurred profound changes, with enormous repercussions on socioeconomic systems, including education systems (Conference Board of Canada, n.d. ; Livingstone, 2012). ICT is increasingly present in Canadian classrooms (e.g., interactive smart boards, laptops, and tablets), and even more so in students' daily lives (e.g., social media and mobile technologies). The exponentially expanded access to knowledge and information provided by this massive influx of ICT tools calls for teaching practices to be redesigned. Teachers are in a position to help children develop new sets of technical and cognitive skills that will equip them to assess the usefulness of digital tools to access meaningful information (and exclude irrelevant information), manage it, use it effectively for learning, and share it ethically in collaborative online spaces.

The International Computer and Information Literacy Study (ICILS, International Association for the Evaluation of Educational Achievement (IAE), 2013) investigated how school-aged children (in their eighth year of school) develop these skills. Results suggest that information literacy should be taught in school, and that it would be naive to believe that children develop these skills on their own, as a natural by-product of ICT access.

However, in her study of 5,436 Canadian students from grades 4 to 11, Steeves (2014) suggests that schools do not play a clear, well-defined role in the development of these skills. Of those surveyed, 92% of Canadian youth stated that they knew how to find information online, but only 45% of them said that their teachers helped them develop these skills. Although some students are currently receiving pedagogical support to develop information literacy skills, this finding suggests that many do not.

In sum, if it is universally recognized that information literacy is essential for 21st century students, then future teachers should be trained to use ICT in order to help students develop these skills. The observed differences in pedagogical support for information literacy skills in Canadian schools (Steeves, 2014) could result in inequalities between children who grow up to mobilize those skills and those who do not (IAE, 2013).

Karsenti and Dumouchel (2011) shed some light on the disparities in the pedagogical use of ICT to develop students' information literacy skills in Canadian schools. They conclude that these skills are generically embedded within subject courses, which complicates didactic transfer in terms of both managing and evaluating pedagogical activities across the curriculum. On the subject of the generic nature of information literacy, Astolfi (2008) and Frisch (2003) underscore that there is no traditional model for teaching and learning information literacy, unlike core subjects such as languages, math, chemistry, or physics, and that a lack of theoretical clarity further complicates the didactic transfer process.

Many models focus on the use of ICT for core subjects in teacher training programs. For example, Mishra and Koehler (2006) proposed the Technological Pedagogical Content

Knowledge framework (TPACK) to provide the theoretical grounds for ICT integration in domain-specific (e.g., maths, language) teacher training programs. However, ICT use for the purpose of developing students' information literacy skills has been neglected.

Nonetheless, authors such as Beheshti, Cole, Kuhlthau, and Bilal (2013), have proposed the use of ICT to enable inquiry-based learning (IBL). IBL is a teaching approach based on the information search process (ISP) model for library and information skills (Kuhlthau, Turock, George, & Belvin, 1990). According to IBL, teachers use targeted interventions (pedagogical support) as their students independently search a variety of information sources to find information with which to build domain-specific knowledge. As such, IBL can be considered a constructivist teaching approach. Other such approaches include problem-based learning and project-based learning (PBL), both based on Vygotsky's (1978) conception of the "zone of proximal development" (ZPD), and Wood et al.'s (1976) idea of "scaffolding." These teaching approaches are now recognized by Canadian teacher training programs (see Gouvernement du Quebec, 1996). However, even though these teaching approaches are well recognized by policymakers, Hattie (2015) found that IBL shows an effect size of only d=0.31. Although it remains unclear how well information literacy is addressed in educational standards and teacher training programs (Willer & Eisenberg, 2014), lack of information literacy skills could be part of the explanation for the limited effects of IBL on learning on core subjects learning (Hattie, 2015).

Probert (2009) and Stockham and Collins (2012) suggest that teachers do not fully grasp the theoretical framework or teaching models for information literacy. Tanni (2013) argues that even teachers who are digital natives—they have grown up with the Internet—lack the knowledge and expertise to incorporate information literacy into their teaching practice. Furthermore, empirical evidence from a study by Dumouchel and Karsenti (2013) demonstrates that Quebec's future teachers are inadequately trained in information literacy. These findings are echoed by many authors around the world, such as Togia, Korobili, Malliari, and Nitsos (2015), who propose that the main barriers to effective information literacy integration are insufficient teacher training, time, and infrastructure.

Other determinants of effective information literacy integration in the classroom have been considered in the literature (Siddiq, Scherer, & Tondeur, 2016), including affective and cognitive factors such as perceived value and self-efficacy (Andreassen, & Bråten, 2013). For example, French Canadian studies of future teachers' self-efficacy in information literacy (Dumouchel & Karsenti, 2013; Fournier, 2007) obtained high self-efficacy scores despite lack of training, but low formal assessment scores. The discrepancy between teachers' self-efficacy in information literacy and their actual performance also challenges the value of self-developed information literacy skills.

The motivation for the present exploratory study arises from these concerns. The aim is to gain a deeper understanding of the factors that influence future teachers to use ICT to develop students' information literacy skills for their future careers, and to offer practical recommendations for teacher training programs and policymakers concerning information literacy in education.

Theoretical Framework

To avoid a conceptual blur in the understanding of information literacy, media literacy, ICT literacy, and the like, we will first clarify the concept of information, and second the construct of information literacy as used in this study. Third, we will discuss the social cognitive framework we used to develop the data collection questionnaire.

Information

The concept of *information* is abstract by nature, and it lends itself to interpretation. For example, Zins (2007) counted over 120 different definitions. For simplification purposes, our definition is based more on a pragmatic than an exhaustive approach.

On the one hand, inspired by the post-positivist paradigm, we adapted the definition proposed by Popper (1972), which refers to the "contenus de journaux, livres, œuvres d'art et bibliothèques" (the content of newspapers, books, works of art, and libraries; our translation) (p. 120). Because this definition dates from the 1970s, we may add all the content of the new media and storage formats that are currently available via ICT: digital data, logs, blogs, electronic books, and multimedia file formats, as well as those to come. In the digital information age, our definition of information must therefore cover all digital content and digital objects that can be transmitted (accessed and distributed), organized (stored and archived), retrieved (from the Internet, libraries, and archives), evaluated (for relevance and reliability), and processed (by computers and individuals). Thus, access, organization, location, evaluation, processing, and transmission are the common and essential attributes for recognizing multiple potential forms of information.

Information Literacy

Like information, the construct of *information literacy* is fluid in meaning. In other words, it varies according to the context, discipline, culture, and usage. UNESCO (2011) proposes that information literacy is closely connected to the principles of democracy, human development, and lifelong learning. UNESCO's definition is based on the broad notion of "learning to learn," and it is referred to as "media and information literacy."

According to the International Association for the Evaluation of Educational Achievement (IAE, 2013), the main difference between media literacy and information literacy is that for media literacy, the emphasis is on measuring the understanding of information as an outcome, whereas the emphasis for information literacy is mainly on the information management process. Hence, the IAE describes computer and information literacy as: "an individual's ability to use computers to investigate, create, and communicate in order to participate effectively at home, at school, in the workplace, and in society." (p. 17). This definition implies the following multidimensional assessment framework: 1) knowing about and understanding computer use, 2) accessing and evaluating information, 3) managing information, 4) transforming information, 5) creating information, 6) sharing information, and 7) using information safely and securely.

The IAE measures these seven dimensions independently of the domain-specific knowledge (reading, mathematics, sciences), as opposed to the PISA integrated approach to ICT

assessment (OECD, 2015), which focuses on digital reading or the use of ICT tools for solving mathematics problems. Furthermore, the OECD (2015) results also suggest that ICT has little impact on students' achievement in these areas, and that better returns on investments in education systems could be linked to information literacy.

Generally speaking, information literacy may be represented as the overall information research process (Helvoort, 2010), as schematized below in Figure 1.
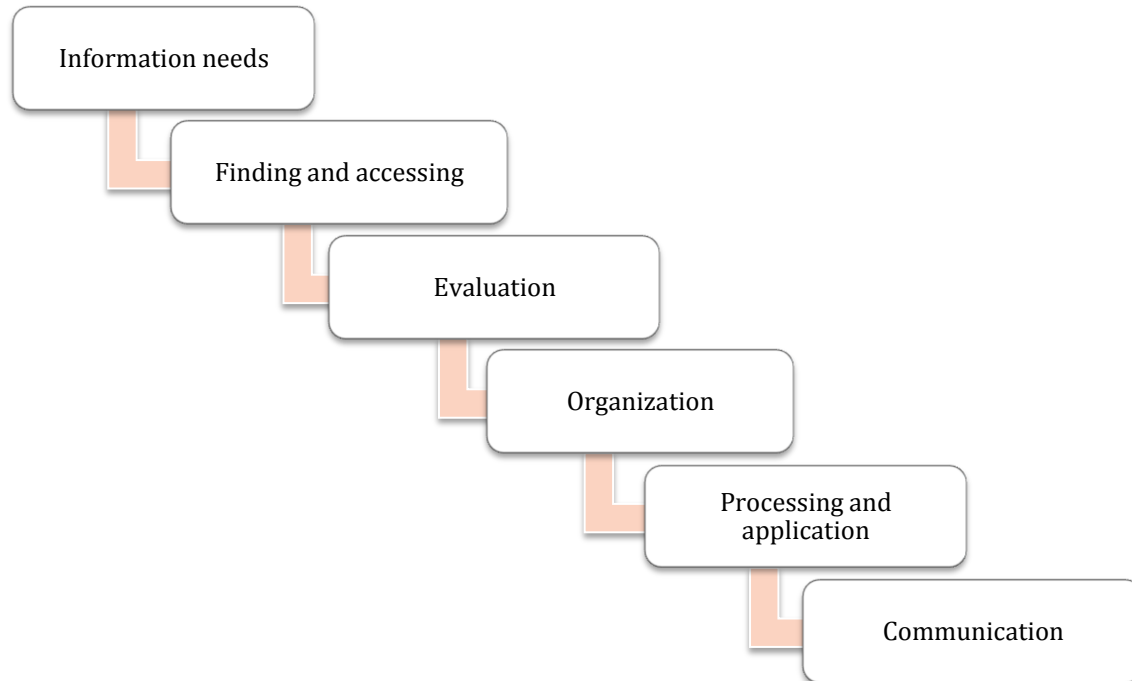

Figure 1. The overall information research process.

Figure 1 illustrates the components of the information research process. They include defining and formulating information needs; finding and accessing information; evaluating retrieved information; organizing, processing, and using the information; and communicating it. This process has been adopted repeatedly in the literature and is now the subject of many practical guides for teachers (see http://karsenti.ca/informationsearch.pdf developed by Karsenti, 2014).

On the conceptualization of information literacy, Boubée and Tricot (2010) suggest adding further dimensions to the above-mentioned information research process to better represent the information literacy construct, as illustrated in Figure 2.
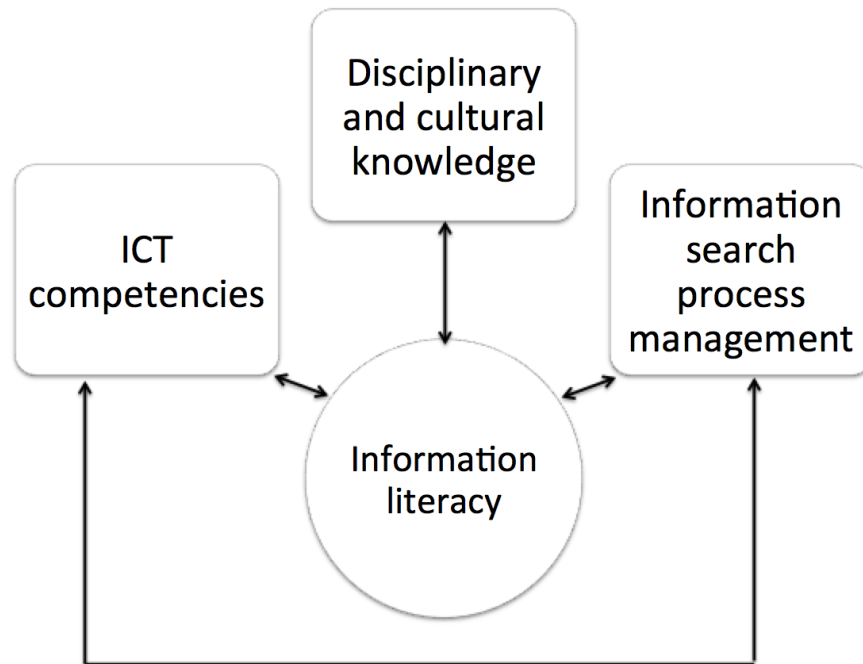
Figure 2. Components of information literacy. Image inspired by Boubée and Tricot (2010).

The first dimension in Figure 2 refers to the ICT competencies required to access online content, process it, apply it, and share it. These are the technical skills that are required for the information research process. In terms of information literacy, these skills include using a computer and its functions as well as working with research interfaces and other associated tools such as bibliographic data, document management software, and Web applications (Boubée & Tricot, 2010).

The second dimension refers to the disciplinary and cultural knowledge that underlies the original need for information such as a knowledge gap needing to be filled (Dervin, 1983) the formulation of a search strategy, and the delimitation of the information landscape (Marchionini, 1988). Disciplinary and cultural knowledge are also essential for evaluating and judging the information retrieved through search engines. The proliferative expansion of knowledge obliges us to continuously sort, interpret, and evaluate information that may be true or false. However, issues arise concerning the criteria and tools we use to make these judgments. In our view, judgments are based on disciplinary knowledge and culture, which provide an interpretative grid for our judgments as well as tools for evaluating and processing information in order to construct meaning (Montiel-Overall, 2007). Accordingly, Van Deursen and Van Diepen (2013) demonstrated that disciplinary knowledge is statistically associated with the ability to discriminate and evaluate information.

The third dimension refers to the ability to manage the overall information research process, which in reality is more iterative than the linear process illustrated in Figure 1. On this issue, some authors (Brand-Gruwel, Wopereis, & Vermetten, 2005; Uribe-Tirado & Castaño-Muñoz, 2012) suggest the notion of meta-competency in their models of information literacy,

referring to the skills required to regulate the information research process in an iterative manner as the meaning is constructed from the retrieved information.

In sum, whereas information literacy has been broadly defined in the literature and debates persist as to its components and scope, in the present study we have adopted a conceptual framework that includes the basic ICT competencies and the management of the information research process, similar to the IAE (2013) model.

Method

We used a sequential mixed method research design (Creswell & Plano Clark, 2007) that combines a large-scale quantitative survey, followed by a smaller qualitative data collection and analysis. An explanatory design was used: qualitative data were collected to supplement the quantitative data and enable a deeper analysis. Rather than for triangulation purposes, the qualitative results were used to respond to the research objectives that were derived from the quantitative results, as presented below.

Participants and Material

The convenience sample of the quantitative portion of the present study comprised 413 French Canadian future teachers enrolled at four universities located in the province of Quebec, Canada (University1 n=214; University2 n=126; University3 n=61; University4 n=12). The average age of the participants was 22.72 years (SD = 3.15; range 18–40 yrs). Of the sample, 79.7% were women, at a proportion similar to that for the education labor market in Quebec (81% women, 19% men [Centrale des syndicats du Québec, n.d.]). The main study programs were elementary and preschool teaching (36.1%; n=149), high school teaching (21.1%; n=87), special education (32%; n=132), physical education (9.4%; n=39), and one student enrolled in ethics and religious studies (0.2%).

In Quebec, the teacher training program includes 8 trimesters. On average, the participants had completed 4.19 trimesters, with a mean of 2 trimesters (n=81) and the 50th percentile at 4 trimesters. Of the participants, 86% had received some formal ICT training as part of their initial teacher training program (1 dedicated course on ICT integration in traditional subject teaching).

A self-administered questionnaire was developed in two phases. In the first phase, the concept of information literacy was operationalized according to the above-mentioned definition. In the second phase, we drew on social cognitive theories to construct a questionnaire designed to extract information about key influential factors for future teachers' use of ICT to develop students' information literacy skills.

To operationalize the information literacy concept, we identified several scales that have been used to measure information literacy and that specifically target university students (Beile O'Neil, 2005; Directorate of Libraries of the University of Montreal, 2006; Kent State University, 2011; Mittermeyer & Quirion, 2003 UNESCO, 2013). After analyzing these scales, we retained the following nine key components as indicators of information literate teachers:

1. Be able to identify a variety of information sources to find answers to problems in creating teaching scenarios, texts, presentations, etc.
2. Use Web search engines (e.g., Google, Bing) to find useful information about teaching practices (e.g., course content, assessment tools, study guides)
3. Use library research tools and specialized education documentation centers (e.g., BANQ, UNESCO, GRICS) to find useful information about teaching practices
4. Evaluate the usefulness of ICT for teaching
5. Determine the criteria for evaluating information found on the Internet and evaluate it effectively
6. Set up a filing system to organize documents and digital links
7. Synthesize and structure information retrieved from the Internet to write reports, prepare teaching scenarios, create presentations, solve problems, etc.
8. Share Web information on teaching practices
9. Respect copyrights and privacy on the Internet

In the second phase, we used these nine indicators to develop questions about teachers' attitudes, perceived social norms, and perceived behavioral controls related to the use of ICT to develop students' information literacy skills. To do so, we followed the recommendations by Fishbein and Ajzen (2010). Participants were asked to rate their personal opinions on a seven-point scale. The principal investigator conducted the survey from January through May 2014. IBM SPSS Statistics v. 23 was used for data entry and analysis.

For the qualitative phase of the study, a convenience sample of 48 future teachers in the final trimester of their training program at a single French Canadian university was used. The sample included 24 men and 24 women with an average age 26 years. The participants responded to structured written questions about their use of ICT to develop students' information literacy skills. The responses were then subjected to thematic coding analysis (Miles & Huberman, 2003) to classify the responses into a limited number of categories, or meaning units, related to our research objectives.

Quantitative Results

This section first presents the results of the statistical analysis of the quantitative data. Given the ongoing debates on the appropriateness of using seven-point scale data for parametric analyses (Carifio, & Perla, 2008) and robustness, only the nonparametric test results are presented here. Three qualitative research objectives were then derived from the quantitative results, and are presented below in a separate section.

Self-reported Information Literacy Competencies

The first block of questions assessed perceived competency according to the nine information literacy indicators. The responses were rated on a scale from 1 to 7 (1 = lowest perceived competency; 7 = highest perceived competency).

Overall, self-reported competency was quite high, with left-skewed distributions (Figure 3).
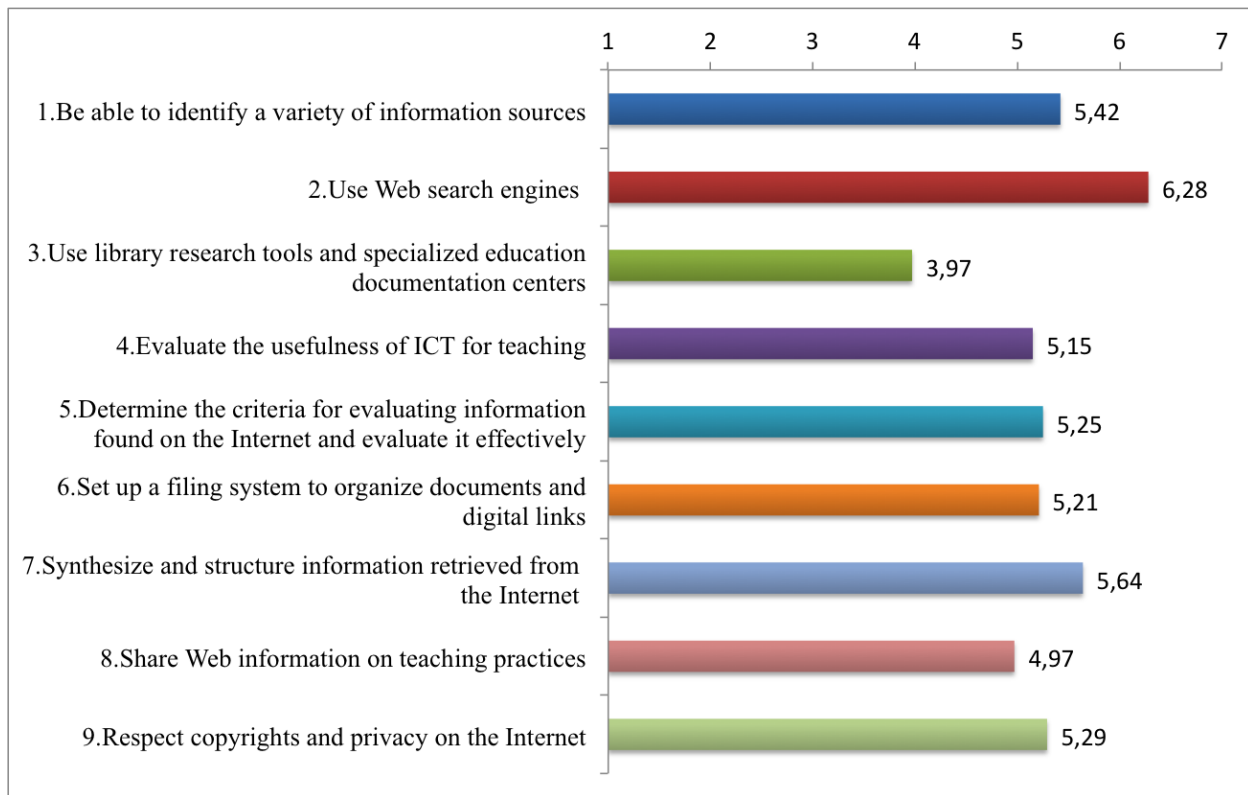
Figure 3. Self-reported information literacy competencies.

The results presented in Figure 3 suggest that future teachers felt most competent to "Use Web search engines" ($M = 6.28$, $SD = 0.932$, n=410, skewness of -1.77, kurtosis of 4.48) and least competent to "Use library research tools" ($M = 3.97$, $SD = 1.59$, n=410, skewness of -0.3, kurtosis of -0.74). Results for the other indicators were "Be able to identify a variety of information sources" ($M = 5.42$, $SD = 1,137$), "Evaluate the usefulness of ICT for teaching" ($M = 5.15$, $SD = 1.186$), "Determine the criteria for evaluating information found on the Internet and evaluate it effectively" ($M = 5.25$, $SD = 1.173$), "Set up a filing system" ($M = 5.21$, $SD = 1.577$), "Synthesize or structure information retrieved from the Internet" ($M = 5.64$, $SD = 1.243$), "Share Web information on teaching practices" ($M = 4.97$, $SD = 1.579$), and "Respect copyrights and privacy on the Internet" ($M = 5.29$, $SD = 1.505$).

Mann–Whitney's *U* test was conducted to test the hypothesis that student teachers who received formal ICT training as part of their program would obtain higher average scores on the indicators compared to those who did not. The results were significant only for indicator 4, "Evaluate the usefulness of ICT for teaching" ($U = 13\ 428.5$, $z = 4.42$, $p = .000$, $r = .23$). For this indicator, student teachers who received formal ICT training as part of their program had an average rank of 215.43 (*Mdn* = 5.32, n=354) versus 142.71 for those who did not (*Mdn* = 4.45, n=56). No other statistical differences in the indicators were found between participants who received (or did not receive) formal ICT training as part of their training program.

The hypothesized gender differences in self-reported information literacy competency were also assessed. The results indicate higher perceived competency for men (*Mdn* = 5.53, *n*=79) according to the indicator "Share Web information on teaching practices" compared to women (*Mdn* = 5.06, *n*=326, *U* = 10 860.5, *z* = -2.2, *p* = .03, *r* = -.11). In contrast, perceived competency was significantly higher for women (*Mdn* = 5.68, *n*=327) for the indicator "Respect copyrights and privacy on the Internet" compared to men (*Mdn* = 4.93, *n*=78, *U* = 9 613, *z* = -3.48, *p* = .001, *r* = -.17). No other statistical differences between males and females were observed.

Self-reported Attitudes Towards the Use of ICT to Develop Students' Information Literacy Skills

To obtain information about attitudes toward the use of ICT to develop students' information literacy skills, "outcome evaluation" questions inspired by Davis' (1989) Technology Acceptance Model (TAM) were developed for each of the nine information literacy indicators. Davis (1989) suggests that usefulness and perceived ease predict attitudes toward a given technology. For each of the indicators, three responses were formulated as follows: "is an effective way of teaching," "makes my job easier," and "is something I enjoy doing." Responses were rated on a seven-point scale (1 = is not at all effective, 7 = is very effective; 1 = makes my job harder, 7 = makes my job easier; 1 = is something I do not enjoy, 7 = is something I enjoy). The highly skewed results suggest that the participants generally had a positive attitude toward the use of ICT to develop students' information literacy (Figure 4).
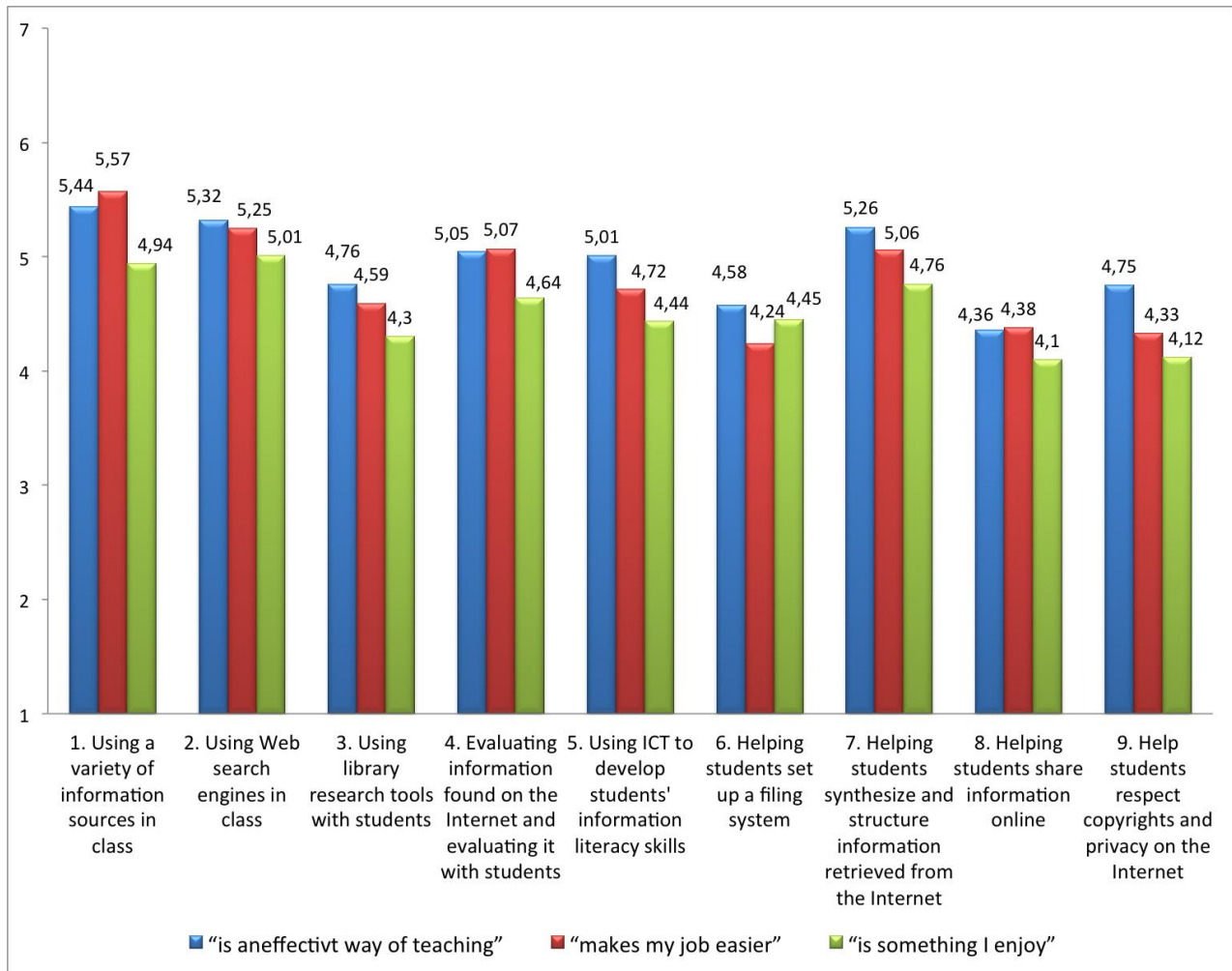
Figure 4. Self-reported attitudes toward the use of ICT to develop students' information literacy skills.

Spearman's test was conducted to assess the hypothesis that the attitudes were related to the duration of the initial training program. This hypothesis is based on the proposition that as future teachers become more effective in subject-area didactics, attitudes toward the integration of generic skills, such as information literacy, would decrease.

For the first response formula, "is an effective way of teaching," the number of trimesters spent in teacher training was significantly correlated to four of the nine information literacy indicators: "Using library research tools with students" (r_s = -.142% BCa CI[-.24, -.043,], p = .005), "Evaluating information found on the Internet and evaluating it with students" (r_s = -.149% BCa CI[-.243, -.05,], p = .003), "Helping students set up a filing system" (r_s = -.184% BCa CI[-.282, -.078,], p = .000), and "Helping students respect copyrights and privacy on the Internet" (r_s = -.198% BCa CI[-.296, -.098,], p = .000). No statistically significant correlations were observed between teacher training duration and the five other indicators for this formula.

For the second response formula, "makes my job easier," training duration was significantly correlated to two of the nine indicators: "Helping students set up a filing system"

($r_s = -.150\%$ BCa CI[-.257, -.051,], $p = .003$) and "Helping students respect copyrights and privacy on the Internet" ($r_s = -.122\%$ BCa CI[-.228, -.026,], $p = .017$). No statistically significant correlations were observed for the seven other indicators.

For the third response formula, "is something I enjoy," training duration was significantly correlated to two of the nine indicators: "Helping students set up a filing system" ($r_s = -.156\%$ BCa CI[-.249, -.058,], $p = .002$) and "Helping students respect copyrights and privacy on the Internet" ($r_s = -.120\%$ BCa CI[-.221, -.021,], $p = .019$). No statistically significant correlations were found for the seven other indicators.

In line with our hypothesis, time spent (duration) in the initial training program does not appear to improve attitudes toward information literacy. On the contrary, the indicators show declining attitudes with increased training duration.

Perceived Social Norms for the Use of ICT to Develop Students' Information Literacy Skills

We used Fishbein and Azjen's (2010) definition of perceived social norms in a two-step approach to assess social norms. First, we identified a set of referents for the future teachers with respect to the use of ICT to develop students' information literacy skills. Second, we captured future teachers' beliefs about the opinions these identified referents might have about engaging students in information literacy skills.

For each of the nine information literacy indicators, we asked the participants whether the opinions of their current university professors, future employers, current peers, and future students mattered on a seven-point bipolar scale. The results are shown in Figure 5.
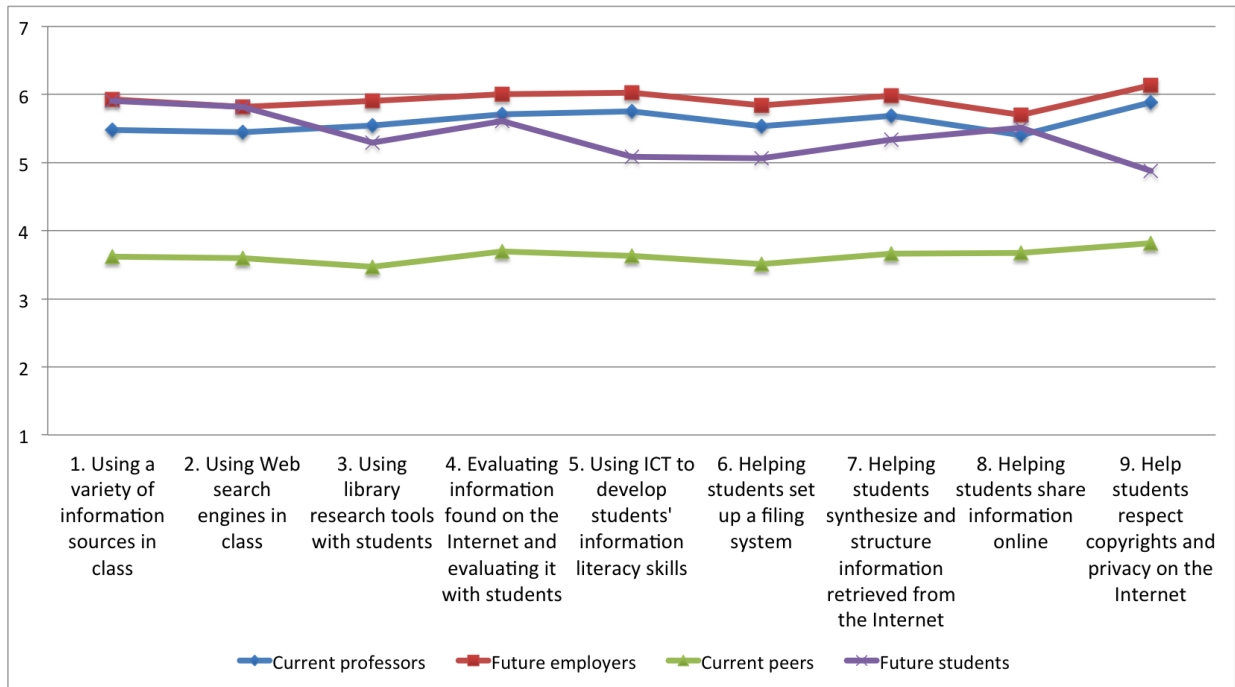
Figure 5. Whose opinion matters on the use of ICT to develop students' information literacy skills.

The results shown in Figure 5 suggest that the opinions of current peers matter less than the opinions of current professors, future employers, and future students. Therefore, current peers were not included in the second step of the analysis.

In general, future teachers believed that the referents would have positive opinions about engaging in students' development of information literacy (Figure 6).
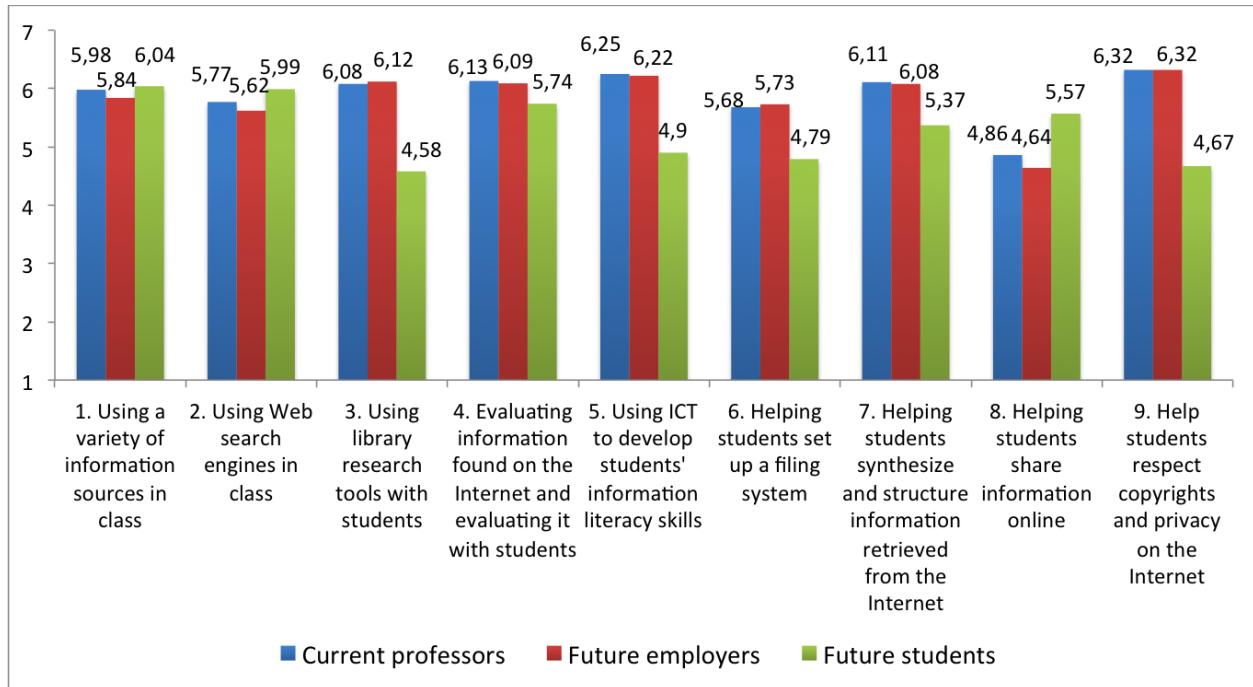
Figure 6. Beliefs of future teachers concerning referents' opinions about the use of ICT to develop students' information literacy skills.

However, our data indicate that beliefs about future students were less enthusiastic for certain indicators, such as the use of library tools ($M = 4.58$) and copyrights/privacy ($M = 4.67$), whereas beliefs about the opinions of current professors ($M = 6.08$; 6.32) and future employers ($M = 6.12$; 6.32) were quite positive for the same indicators. In addition, for the perceived opinions of current professors and future employers, sharing information online received the lowest score ($M = 4.86$; $M = 4.64$), whereas the opinions of future students were more positively perceived ($M = 5.57$).

Perceived Control Over the Use of ICT to Develop Students' Information Literacy skills

We assessed future teachers' perceived control over information literacy teaching by asking participants to evaluate three dimensions of control for each of the nine information literacy indicators, as follows: 1) feelings that their teacher training program prepared them to use ICT to develop students' information literacy skills; 2) belief that the necessary time will be available in class to use ICT to develop students' information literacy skills; and 3) belief that the required equipment will be available in class to use ICT to develop students' information literacy skills. The results are shown in Figure 7.
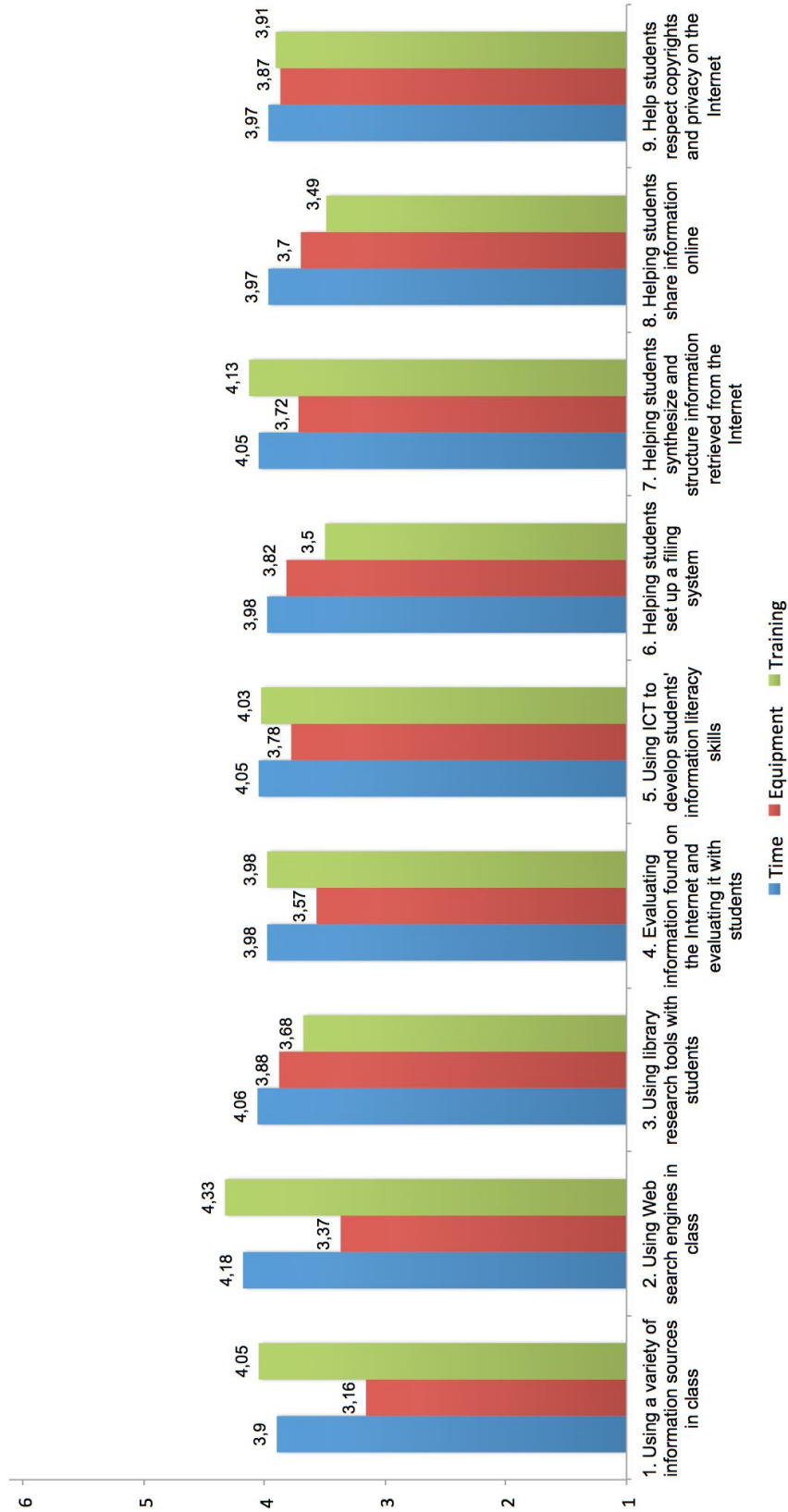
Figure 7. Perceived control over the use of ICT to develop students' information literacy skills.

The scores on preparation for using ICT to develop students' information literacy skills are generally situated at the lower end of the seven-point scale. This is especially true for "using ICT to help students share information online ($M = 3.49$), "using ICT to help students set up a filing system" ($M = 3.5$), and "using library research tools with students" ($M = 3.68$).

The scores on available time are in the lower range of the seven-point scale, and are particularly low for equipment availability: "using multiple sources of information" ($M = 3.16$) and "using Internet search engines" ($M = 3.37$).

Qualitative Results

In light of the quantitative results, we developed qualitative questions to further explore the following issues:

1. How could initial training programs better prepare future teachers to use ICT to develop students' information literacy skills?
2. Why would using ICT to develop students' information literacy skills be useful (or not) for future teachers?
3. What are the most effective ways or strategies for teachers to develop students' information literacy skills?

The participants' responses were subjected to thematic coding analysis (Miles & Huberman, 2003) to classify them into a limited number of categories, or meaning units.

Responses to the first question, "How could initial training programs better prepare future teachers to use ICT to develop students' information literacy skills?" were analyzed to identify emergent categories. Six categories were identified.

The first category concerns courses on information literacy instruction. Of the participants, 41.7% suggested that more courses in this area would better prepare them to teach information literacy. The following are examples of statements that fell into this category:

- "Better introduce this aspect into all the pedagogical and instructional courses. It should go beyond just using PowerPoint."
- "Aside from the course called Pedagogical Use of Technology, I can't say that my training helped me on this point. At university, the professors don't ask for anything more than a few slideshows."

The second category concerns the number of courses on ICT offered in their training program: 22.5% of participants suggested increasing the number. In the third category, 20.8% wanted to take specialized ICT courses for their teaching subject. In the fourth and fifth categories, 12.5% suggested more collaboration with schools, and 6.3% suggested using specific software and teaching devices. Finally, a small number (2.1%) wanted to have access to educational resources for teaching and learning information literacy.

For the responses to the second question, "Why would using ICT to develop students' information literacy skills be useful (or not) for future teachers," we applied content analysis

according to pre-established categories to determine whether it was more useful for students (77.1%) or teachers (22.9%) to develop these skills.

The following examples of respondents' statements illustrate the usefulness for teachers:

- "I help them with their homework in high school, and every night we browse the Internet."
- "By developing information literacy in my students, I can integrate education reform better."
- "Better integration of competency 8" (ICT integration).

The connection that some participants (22.9%) made between information literacy and their teaching strategies is noteworthy, and so is the connection with encouraging autonomy during homework help and implementing the Quebec Education Program (http://www1.mels.gouv.qc.ca/sections/programmeFormation/primaire/index_en.asp), which has adopted a constructivist theory of learning supported by information literacy.

For the third question, "What are the most effective ways or strategies for teachers to develop students' information literacy skills?" the responses were classified by content analysis, obtaining the 10 following categories:

1. Problem- and project-based learning (60%)
2. Demonstration/modeling (31.3%)
3. Ongoing teacher training (10.4%)
4. Creating educational resources (10.4%)
5. Assessing information literacy (8.3%)
6. Improving access to ICT in the classroom (8.3%)
7. Varying teaching activities (6.3%)
8. Collaborating with information professionals (6.3%)
9. Peer learning (4.2%)
10. Teaching the overall information search process (4.2%).

The responses below illustrate the first two categories:

- "Guided Internet searches with the students and peer workshops to demonstrate effective search methods."
- "Assigning a computer-based project where the students have to do research. Explaining and demonstrating at project start how to do an effective search."

Discussion

Although this study consists of an exploratory overview of key factors that could influence future teachers to use ICT to develop their students' information literacy skills, we hope that our results will contribute to inform the development of initial teacher programs as well as policymakers' decisions.

Although our data on self-reported information literacy competency are in line with previous research (Dumouchel & Karsenti, 2013; Fournier, 2007), we found lower perceived competency in using library tools and sharing information on the Web compared with the other indicators. In fact, using library research tools was scored lower in terms of both future teachers' attitudes and future students' social norms. Because our results also indicate that the perceived opinions of future employers and current professors are more positive for these two indicators, it would be worthwhile to consider revising teacher training programs to increase the focus on library research tools and sharing information on the Web.

Moreover, initial training program duration does not appear to improve attitudes toward information literacy. On the contrary, this attitudinal decline suggests the following hypothesis: teachers begin their training with a generally positive attitude toward the information literacy indicators, but as they gain expertise in subject teaching and familiarize themselves with the available textbooks and other materials, attitudes toward the use of ICT to develop information literacy decline. Given the importance of developing these skills in children, this attitudinal trend needs to be investigated further, and in our opinion, quickly reversed. In other words, explicitly preparing teachers to use ICT to develop information literacy skills in children should be a clear training objective.

Our results also indicate that although student teachers who received formal ICT instruction in their training program scored higher on the self-reported competency "Evaluate the usefulness of ICT teaching," formal ICT training did not appear to impact the other information literacy indicators. This suggests that currently available ICT training programs do not address information literacy as conceptualized in the present study. As it happens, the OECD (2015) has recommended increasing the focus of teachers' training on information literacy to harness the potential of ICT in the classroom.

Interesting gender-related differences in self-reported information literacy competency were also observed. Although men and women viewed themselves as equally competent on many information literacy indicators, men felt more competent to "Share Web information related to the teaching practice" whereas women felt more competent to "Respect copyrights and privacy on the Internet". Further studies are needed to explore these results more deeply.

Additionally, the factor "perceived control" (training, time, access to technology in the classroom) was scored at the lower end of the seven-point scale, suggesting potential action avenues for schools and initial teacher training programs. In particular, the qualitative results of this study support three practical implications for initial teacher training programs:

1. More instructional courses in information literacy
2. More ICT courses
3. Specialized ICT courses for individual teaching subjects.

Conclusion

This study has a number of limitations. First, the data collection was based on self-reports that were intended to capture future teachers' perceptions and beliefs. Second, because our questionnaire was not validated, it cannot be used to test the appropriateness of the social

cognitive theories underlying the development of the items. Moreover, because this survey addressed future teachers, the use of ICT to develop students' information literacy skills could differ substantially in a real school environment. We therefore suggest that future studies on information literacy skills be conducted in samples of practicing teachers.

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