Educ Inf Technol
Education and Information Technologies
DOI 10.1007/s10639-014-9323-y

Use of webquest design for inservice teacher professional development

Sinem Iskeceli-Tunc · Diler Oner

Abstract This study investigated whether a teacher professional development module built around designing WebQuests could improve teachers' technological and pedagogical skills. The technological skills examined included Web searching and Web evaluating skills. The pedagogical skills targeted were developing a working definition for higher-order thinking skills, and designing WebQuest tasks to improve such skills. This case study was carried out with six inservice teachers. After the training, all the teachers showed improvement in their Web searching and evaluating skills. Furthermore, teachers adopted a working definition for higher-order thinking skills, and, using Web resources, they designed activities that promote students' higher-order thinking. This study provides evidence supporting the use of design-based activities in learning technological and pedagogical skills and suggests an effective inservice teacher professional development module.

研究关注webquest是否能提高教师的技术和教学能力。技术能力包括网络搜索和网络评价技能。教学能力指发展一个高阶思维能力培养的操作性定义并且能够设计一个webquest任务来提高这样的技能。研究结果发现教师的技术技能得到了提高；教师采用高阶思维能力的操作性定义并且使用网络资源，他们能够设计活动来促进学生的高阶思维能力发展。

Keywords WebQuests · Teacher professional

Recent approaches to technology integration highlight the role of authentic design activities in order to develop effective teacher knowledge about technology (Koehler and Mishra 2005; Koehler et al. 2007). Such knowledge requires understanding the complex relationships among content, pedagogy, and technology, and can be viewed as an integrated form of these knowledge structures. Theoretical constructs, such as the Technological Pedagogical Content Knowledge (TPCK), aim to describe and explain this type of teacher knowledge (Mishra and Koehler 2006). From this standpoint, effective professional development should go beyond the typical workshop models in

S. Iskeceli-Tunc
Eyuboglu High School, Esenevler Mh. Dr. Rustem Eyuboglu Sk. No:8, Umraniye, 34762 Istanbul, Turkey
e-mail: sinem.iskeceli@eyuboglu.k12.tr

D. Oner (✉)
Faculty of Education, Department of Computer Education and Educational Technology, Bogazici University, Bebek, 34342 Istanbul, Turkey
e-mail: diler.oner@boun.edu.tr

Published online: 02 April 2014

已有的研究提出“学习技术设计”给积极参与者和教师的中介来有效发展教师的能力是至关重要的

which technological knowledge is usually treated as independent from the other two bases of teacher knowledge. This perspective proposes *learning technology by design* for effective teacher development in which the active participation and agency of teachers are the key elements (Koehler et al. 2007; Mishra and Koehler 2006). In learning by design, teachers develop professional skills by designing materials or activities with technology to teach specific content. Thus, learning technology by design could be viewed as a whole-task instructional approach for teachers; whole-task approaches have been found to result in higher performance on skill acquisition compared to the part-task approach (Lim et al. 2009). In other words, with the learning technology by design approach, technological and/or pedagogical skills are taught in the context of a meaningful task, rather than as isolated procedures.

In this study, a teacher professional development module is proposed that exemplifies the learning technology by design approach and is built around designing WebQuests. The effectiveness of this module is examined by looking at both the technological and pedagogical skills teachers develop after participating in it. The types of technological skills examined include Web searching and Web evaluating skills. The pedagogical skills targeted were adopting a working definition for higher-order thinking skills, and developing WebQuest tasks to improve such skills.

教师通过设计通过技术来教特殊内容的材料和活动来发展专业技能。因此，学习活动设计被认为是一种全面的任务教学方法对于教师而言；全面的任务教学方法也能发现对技能获得产生更高的效果，相比于部分任务的方法。

1 WebQuests

Bernie Dodge, who created and named the concept, defined WebQuest as an inquiry-oriented tool for learning in which most of the information with which learners interact comes from Internet resources (Dodge 1997). Students are given a task and they are led to use Web[1] resources in order to complete it. A WebQuest can be either short-term, which takes one to three class periods, or long-term, completed in 1 week to a month. The whole learning process is scaffolded by the teacher under six main parts: *introduction, task, resources, process, evaluation*, and *conclusion*. The *introduction* aims to grab the readers' attention, defines the topic of WebQuest, and provides necessary background information. In the *task* section, a general description of the task as an end product of the WebQuest activity is given. Next, the *process* section explains the steps required to achieve the task. The websites that students need to explore in order to complete the task are presented in the *resources* section, which is typically embedded within the process section. In the *evaluation* section, students are given the rubric for the evaluation of their performance. The *conclusion* summarizes what students have learned and/or suggests further extensions of the activity (MacGregor and Lou 2004–2005).

Dodge (2001) stated that "WebQuest is designed to use learners' time well, to focus on using information rather than looking for it, and to support learners' thinking at the levels of analysis, synthesis, and evaluation" (par.3). Therefore, two major purposes drive the use of WebQuests in classrooms: (1) making use of Web resources, and (2)

[1] The Internet and the Web are related terms that have often been used interchangeably (Metzger et al. 2003). However, they are not synonymous (ibid.). While the Internet is a global network, the Web only refers to only one of the communication protocols used over the Internet. As the Webquests mainly use Web-based resources, the term "Web" is preferred in this study to refer to the types of resources avaliable through the hypertext transfer protocol (i.e., http).

developing higher-order thinking. Web resources are researched and provided as hyperlinks by the teacher, so that students can focus on the task without time-consuming Web-searching (March 2003–2004). The teacher who creates the WebQuest examines and carefully selects the websites. This also enables avoidance of inappropriate materials, privacy issues, copyright and plagiarism, and malware. Therefore, in this study the WebQuest design created the appropriate context for teachers to acquire Web searching and evaluating skills. Furthermore, since a real WebQuest requires a higher-level task, it also creates the context for developing pedagogical skills; that is, developing a working definition for higher-order thinking and creating WebQuest tasks based on this definition.

1.1 Web skills

Teachers need to develop specific skills to be able to incorporate Web resources into their teaching. Out of several skills regarding Web use—such as accessing and evaluating Web resources, the creation and distribution of Web pages (Kuiper et al. 2008), and the use and production of Web resources (Kabakci et al. 2010)—the focus was on developing teachers' Web searching and evaluating skills, as these are the most relevant to the WebQuest design.

1.2 Web searching skills

Web searching skills require making use of various search strategies using a search engine. These can include the organization of keywords and symbols in order to conduct an effective search on the Web, as well as the ability to extend and narrow search results (Olcay 2003). Some of the symbols and techniques frequently used in Web searching include Boolean search commands (and, or), search engine math commands (+, −, “”), power searching commands (filetype:, site:, *), and specific searches, such as image or academic searches (Barker 2007a). By employing these strategies, users can enhance the accuracy and relevance of search results (Noruzi 2005). Table 1 describes frequently used Web searching strategies, some of which are given by Barker (2007b), Olcay (2003) and Noruzi (2005).

1.3 Web evaluating skills

Unlike traditional sources of information, such as books or journals, Web resources are not controlled before publication (Harris 2010). Moreover, while traditional sources are typically written by professionals, anyone can publish a Web page. For this reason, not all information on the Web is equally reliable or valuable (Grassian 1995). Therefore, it is incumbent upon teachers to develop a set of criteria to judge the credibility and reliability of Web resources.

Researchers have proposed numerous criteria for evaluating Web resources (Alexander and Tate 1999; Barker 2007b; Harris 2010; Grassian 1995; Johns Hopkins University (JHU) Library Guides 2012; Kurbanoglu 2002). While Kurbanoglu (2002) defined 18 dimensions (intended purpose, scope, integrity, content, accuracy, reliability, objectivity, currency, consistency, originality, links, style of writing, target group, design, credentials, connectivity, operability, and cost), Harris (2010)

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Table 1 Frequently used Web searching strategies

Command	Function	Example
Use of dash (−)	Excludes search results related to a word that appears after the dash	Space travel –game
Use of asterisks (*)	Allows searching for a term that matches any text that follows	heat* (to get results related with "heating" or "heated")
Use of quotation marks ("…")	Allows searching for an exact word or phrase	"history of democracy"
The use of *filetype:*	Limits the query according to a specific file type and provides results with a special file format	differentiated instruction filetype:pdf
The use of *site:*	Limits the search to a specific domain or site	site: www.stanford.edu/ application
Use of appropriate keywords	Keywords should be exact and specific	"apartments for rent in Portland" (to find information about rental apartments in Portland)
Use of academic databases	The use of Google Scholar or any other academic database to find an academic resource	Search for "webquest" within http://www.eric.ed.gov/

created a four-criteria model (the CARS Checklist: Credibility, Accuracy, Reasonableness, Support) for evaluating Web resources. Alexander and Tate (1999) suggested an evaluation model focusing on authority, accuracy, objectivity, currency, and coverage of Web resources. The following criteria appeared to be common to the various web evaluating models suggested: 权威，准确性，客观性，时效性和覆盖面

Authority This criterion is difficult to evaluate because most Web documents are posted without the name of the author. According to Alexander and Tate (1999), authority is "[t]he extent to which material is the creation of a person or organization that is recognized as having definitive knowledge of a given subject area" (p. 11). In order to determine the authority of a website, questions such as "is it clear who is responsible for the contents of the page?" can be asked (Johns Hopkins University (JHU) Library Guides 2012).

Reliability Reliability is closely related to the accuracy of the information, which refers to detailed, exact, comprehensive, and up-to-date information (Harris 2010). The identities of the author and publisher are good indicators of the reliability of the source (Barker 2007b). Moreover, Kurbanoglu (2002) stated that the author's expertise and training in an area may help to determine the reliability of the sources. The existence of the contact information of the author, such as an email or mailing address, is significant not only in terms of the possibility of communicating with the author, but also of verifying his or her existence. In addition, the URL extension may also provide clues about the author; that is, some of the abbreviations used in URLs provide information about the nature of the organization (i.e., .com = commercial, .gov = government, .org = non-profit organization, .edu = education, etc.). A Web page that belongs to an educational or official institution will tend to be considered more reliable (Grassian 1995).

Coverage In printed sources, coverage and intended audience are often addressed in the introduction. However, Web resources usually lack this kind of information (Alexander and Tate 1999). Web resources targeting a specific group of users may not be appropriate for other users (Barker 2007b). For instance, a resource prepared for children is probably not useful for college student (ibid.). Therefore, teachers will need to judge whether information presented would be appropriate for their students' level.

In the training, teachers were provided with a simple Web evaluation decision flowchart (Fig. 1), which they could use to consider the three main criteria (authority, reliability, and coverage) in order to quickly assess the Web resources. First they were told to examine the URL address and determine the nature of the organization associated with the information. If the Web page was created by a person, they were to determine whether the author could be considered an expert in the related area. Thus, teachers were first told to evaluate the Web page in terms of the authority and reliability criteria. Then they were asked to consider whether the coverage would be appropriate for their students.

2 Pedagogical skills

webquest要能够促进问题解决，创造力，设计和判断的能力

One of the main purposes of using WebQuest in classrooms is to develop students' higher-order thinking[2] (Crawford and Brown 2002; Polly and Ausband 2009; Young and Wilson 2002). For this purpose, WebQuest tasks should "go well beyond retelling and engage their students in problem solving, creativity, design, and judgment" (Dodge 2001, p. 9). In this study, the type of thinking skills students develop by working with WebQuests is defined in terms of the *Integrated Thinking Model* (ITM) as "goal directed, multi-step, strategic processes such as *designing*, *decision-making*, and *problem solving*" (Iowa Department of Education 1989). This definition is adopted in this study because it better operationalizes a real WebQuest task. In other words, it models higher-order thinking in terms of the higher-level tasks students are expected to complete. It also closely matches Dodge's description (2001, p. 9) given above.

In ITM, different processes, which are referred to as "thinking," are described as an interactive system, not an accumulation of distinct skills (Jonassen 1996). The essential core of higher-order thinking is defined as *complex thinking*, which is formed as the interaction of content, critical, and creative thinking skills, and involves three major processes: *decision making, designing*, and *problem solving* (Iowa Department of Education 1989). According to this model, reorganization of knowledge through critical thinking skills (based on the ability to analyze, evaluate, and establish connections between several pieces of information) and generation of knowledge through

[2] The terms *higher-order thinking* and *critical thinking* are used interchangeably to define the type of cognitive skills students develop when working with WebQuests. Some studies have indicated that WebQuest develops students' higher-order thinking skills (Crawford and Brown 2002; Polly and Ausband 2009; Young and Wilson 2002), while others have argued that it promotes students' critical thinking skills (Gohagan 1999; March 1998; Perkins and McKnight 2005; Vidoni and Maddux 2002). According to Mathew and Lally (2010), although the terms are not exactly synonymous, they are definitely related concepts. In this sudy, the term "higher-order thinking" is prefered and defined using the Integrated Thinking Model (Iowa Department of Education 1989).

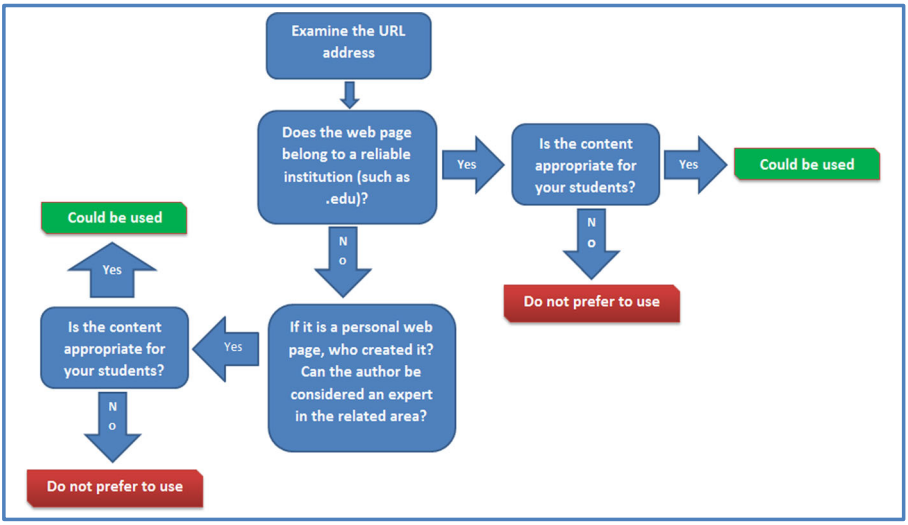

Fig. 1 Decision flow chart to evaluate the credibility of Web content

creative thinking skills (based on the ability to synthesize, elaborate, and imagine possible relationships among pieces of information) allow the ability to conceive new ideas, solve problems, and make decisions (Lima et al. 2004).

In this study, teachers introduced ITM as a way to conceptualize higher-order thinking. Generally, if an activity or a task invites students to solve a problem, design an authentic product, or asks them to make a decision, it is assumed that this task or activity will support the development of higher-order thinking skills.

属于高阶思维能力的表现：解决问题，设计真实的产品，做决定

3 Research on WebQuests in teacher education

The use of WebQuests can serve as a powerful and an efficient tool for teacher professional development (Johnson and Zufall 2004). WebQuests focus on learner-centered principles and when teachers implement well-designed WebQuests, they can acquire in-process professional development, directing them towards more learning-centered practices (March 2003–2004). Teacher professional development with WebQuests provides the opportunity for teachers to develop higher-order thinking skills, enhance their creativity, and also presents an alternative route to assessing student learning (Halat 2008a). In addition, it is believed that teachers can gain technology integration skills by designing WebQuests (Wang and Hannafin 2008). All these benefits elevate WebQuests to the apex of professional development resources for teacher educators.

Research has shown the effectiveness of WebQuests on teacher outcomes. Allan and Street (2007) investigated whether WebQuests have the potential to promote teacher training students' higher-order learning. For use in an initial teacher training module, the researchers modified the typical WebQuest steps by adding a "knowledge pooling" stage into the model. The purpose of this stage was to guide students to discuss the topic and stimulate critical reflection in particular. The results indicated that WebQuests could be effective instructional tools to engage teacher training students in higher-order

learning. Halat (2008b) investigated the effects of designing WebQuests on preservice elementary school teachers' motivation in mathematics. The experimental study showed that designing WebQuests had positive effects on preservice teachers' motivation. The teachers who designed WebQuests demonstrated more positive attitudes towards the mathematics course compared to those who completed the regular course. However, researchers did not always attain positive teacher professional outcomes by using WebQuests. King (2003) examined the outcomes expectancy and computer efficacy of preservice elementary teachers after developing and delivering instruction with WebQuests. This experimental study showed that preservice teachers, who were in the experimental group, demonstrated a decrease in outcomes expectancy compared to those in the control group.

Researchers also studied perceptions regarding WebQuests. Gulbahar et al. (2008) examined preservice teachers' thoughts about the process of creating their WebQuests using a dynamic WebQuest tool. This was an interactive platform designed to create and manage WebQuest projects. After experiencing the dynamic tool while creating their WebQuests, preservice teachers' perceptions were collected through open-ended questions and analyzed qualitatively. The results of the study showed that most participants felt positively toward using WebQuests in their teaching. However, they also had difficulty using the dynamic WebQuest tool, suggesting modifications to improve the system. Zheng et al. (2005) aimed to identify the factors perceived by learners as critical to learning with WebQuests. The study participants were undergraduate and graduate students in the Department or Colleges of Education. The researchers identified three constructs, constructivist problem solving, social interaction, and scaffolded learning, which differed from the constructs derived from the literature. They cautioned that the underlying constructs could facilitate a better understanding of the essential elements of WebQuests rather than imposing uniform standards for WebQuest design and development.

Recognizing the need for appropriate support for WebQuest design activities, Wang and Hannafin (2008) reviewed the scaffolding research to present guidance for preservice teachers. They identified four types of scaffolds—procedural, conceptual, metacognitive, and strategic—which could be both fixed (static in nature) and dynamic (adaptive to individual learning needs). Similarly, Menchaca and McVicker (2003) proposed a set of strategies for supporting master's level and experienced teachers' WebQuest design activities. Also called scaffolds, these strategies included brainstorming ideas, diagramming concepts, narrowing an area of focus, facilitating group work, providing grade-appropriate Internet search strategies, building Web-pages, assessing student learning and collecting feedback data, and evaluating and modifying the WebQuest. However, the researchers did not evaluate the effectiveness of the use of these strategies (scaffolds). This line of research highlighted the need for carefully designed experiences for teachers when they undertake the task of creating their own WebQuests.

4 Research problem

The potential of WebQuests as powerful teacher professional development tools has long been recognized (Johnson and Zufall 2004; March 2003–2004; Halat 2008a).

WebQuests are Web-based activities that engage students to think at higher levels. Teachers should be able to design WebQuests in order to make use of valuable resources on the Web and support their students' higher-order thinking. Furthermore, teaching of technological and pedagogical skills can be embedded into the WebQuest design, which could be used as an effective teacher professional development module. However, research also suggest that teachers' WebQuest design experiences need to be carefully planned (Menchaca and McVicker 2003; Wang and Hannafin 2008). Most research on WebQuest use in teacher education has focused on preservice teachers (Allan and Street 2007; Gulbahar et al. 2008; Halat 2008b; King 2003; Wang and Hannafin 2009; Zheng et al. 2005). This study is designed to fill a gap by providing an inservice teacher professional development module that was built around designing WebQuests. The effectiveness of this module is also examined by answering the following questions*: How did the WebQuest training help teachers develop (a) technological skills; that is, Web searching and Web evaluating skills; and (b) pedagogical skills; that is, adopting a working definition for higher-order thinking and developing WebQuest tasks to improve such skills?*

5 Research design and context

This study is designed as an exploratory case study (Yin 2003) to investigate the effectiveness of a teacher professional development module built around developing WebQuests. Although a single case was investigated—a specific inservice teacher professional development context—the case involved more than one unit of analysis (i.e., six teachers). Thus, it represents an embedded single-case design (ibid.).

Six inservice teachers volunteered to participate in this study (five female and one male). Table 2 provides some demographic data about the participants (names are pseudonyms).

Prior to the WebQuest training, interviews and performance assessments of Web skills (Web searching and evaluating) were conducted with the teachers. Teachers then participated in the WebQuest training, which took approximately 20 h. During the WebQuest training, teachers kept a diary for each of the three training days, and designed their WebQuests. After the training, interviews and post-training performance assessments for Web skills were again conducted with the teachers. To summarize, the

Table 2 Demographic data about participants

Name	Institution type	Area	Age	Grade level taught	Work experience
Eylem	Private	English	29	university -prep school	5 years in private schools and a university.
Cemile	Private	English	34	high school	12 years in private schools.
Sermin	Public	Chemistry	41	high school	17 years in public schools.
Levent	Private	Chemistry	41	high school	18 years in private schools.
Mine	Private	Math	39	high school	8 years in private schools.
Zulal	Private	Math	30	high school	6 years in private schools.

multiple sources of data in this case study included pre- and post-training interviews, pre- and post-training performance assessments for Web skills, teachers' WebQuests, and teachers' journals. In what follows, the steps and processes of the WebQuest professional development module are described and each of the data collection instruments used in this study are explained.

5.1 The WebQuest professional development

The WebQuest training[3] involved the following sessions (summarized in Table 3):

1. *Introduction:* The training started with a whole-class discussion on teachers' problems with Internet use in their classes. The researchers (authors) listened closely to teachers' problems. They also provided a brief overview of the training and explained the specific approach taken. More specifically, they emphasized that teachers' active participation and work was the central component of this training.
2. *Investigating WebQuests:* At the beginning, the researchers provided several examples of high quality WebQuests in teachers' areas. Teachers were invited to examine them all and generate a description of WebQuests that identified their common characteristics. That is, the researchers did not provide a definition of WebQuests initially, but rather asked the teachers to come up with a description of them. First the teachers worked alone and then in pairs with another teacher in the same area. Following these activities, there was a whole-class discussion in which teachers had the opportunity to share their thoughts on WebQuests.
3. *Understanding sections of WebQuests:* In this session, the researchers invited teachers to look at the sections of the WebQuest examples more closely, examining each section and focusing on their purposes. Only after the teachers derived the functions of these sections did the researchers provide a formal presentation of these sections and their purposes.
4. *Start developing your WebQuest:* In the next session, teachers started developing their own WebQuests, working on the first draft of their introduction and task sections. First, they discussed these sections in pairs. Then they all presented their work in class and received feedback from the other teachers.
5. *Higher-order thinking:* The teachers had developed their tasks in the session prior to the one in which they were introduced to the ITM model, so that they would realize the need for it. This session started by describing the ITM model and comparing it with Bloom's taxonomy (Bloom et al. 1956) of learning objectives, with which teachers were more familiar. The researchers introduced the idea that higher-order thinking can be modeled as an interactive system, as opposed to a collection of separate skills. They presented sample WebQuest tasks that engage students in problem solving, designing, and decision making (the three major processes of complex thinking in the ITM model). Then teachers were asked to revise their tasks in light of this model. After working on their tasks individually, teachers presented their revised task sections and received feedback.

[3] The term "training" is used to avoid repetition, yet it is used without its connation associated with traditional forms of teacher professional development models.

Table 3 The WebQuest training plan webquest培训流程

Session	Agenda	Instructional techniques
Introduction	-Discuss problems with Internet use in instruction -Understand the purpose of the WebQuest training	-Whole class discussion
Investigating WebQuests	-Examine several examples of WebQuests -Identify aspects of a WebQuest activity -Define a WebQuest activity	-Individual work -Group-work -Whole class discussion
Understanding WebQuests	-Investigate sections of a WebQuest, underlying ideas, and types of WebQuests	-Pair-work -Whole class discussion
Start developing your WebQuest	-Write the introduction and task sections of your WebQuest -Present your introduction and task sections in class -Provide and receive feedback	-Individual work -Pair discussion -Presentation -Whole class discussion
Higher-Order Thinking, The ITM Model: The task section	-Define higher-order thinking skills in terms of the ITM model -Write the task of your WebQuest and present in class -Provide and receive feedback	-Lecture -Whole class discussion -Presentation
Scaffolding the WebQuest task: The process section	-Understand different types of scaffolds -Write the process section of your WebQuest and present in class -Provide and receive feedback	-Lecture -Whole class discussion -Presentation
Searching the Web: Resources section Writing the conclusion	-Web searching strategies -Evaluating Web resources -Find and evaluate Web resources for your WebQuest -Write the conclusion section of your WebQuest and present in class	-Lecture -Demonstration -Individual work -Individual work -Presentation
Putting it all together: Build your WebQuest	-Build your WebQuest by modifying a WebQuest template	-Demonstration -Individual work
Evaluation	-Present your WebQuest in class -Provide and receive feedback	-Presentation -Whole group discussion

6. *Scaffolding the task:* In this section of the training, teachers met with the notion of "scaffolding" and types of different scaffolds that could be used when designing a WebQuest (Dodge 1997, 2001). They examined the process sections of a variety of WebQuests, evaluating different scaffolds and discussing these as a group. Teachers then worked alone to write the process sections of their WebQuests, which help students accomplish the task. Finally, they presented their work and received feedback.
7. *Searching the Web:* Finding relevant and reliable resources is the core factor in designing a WebQuest. As researching Web resources would only be meaningful in the context of scaffolding a WebQuest task (at least in the present case), the researchers presented Web skills as tools for scaffolding student work. As discussed above, the focus was on two major Web skills: (1) accessing the needed

information from the Web, and (2) evaluating such information. In this step of the training, the researchers introduced the Web searching strategies that were summarized in Table 1. They also presented a decision flowchart to evaluate the credibility of Web content (Fig. 1).

The researchers used lectures and demonstrations as the main instructional strategies in this session. However, it is worth noting that they provided this information in the context of locating the Web resources that teachers needed to use in designing their WebQuests. Therefore, this content was made relevant for teachers, as it was something they could use in the service of designing a WebQuest activity. Teachers immediately made use of this information to access the websites they needed for their resources sections and to evaluate the credibility of these resources.

8. *Writing the conclusion:* Finally, teachers wrote the conclusion section of their WebQuests, focusing on possible extensions of their WebQuest activity. They presented their conclusion sections and received feedback.
9. *Putting it all together:* When the sections of WebQuests were completed, teachers put them together by modifying a word processor-based WebQuest template. They saved their files as HTML pages, readying them for Web publication.
10. *Evaluation:* Each teacher presented their final work in class and received further feedback on their final product as a whole from other teachers and the researchers.

6 Data collection

6.1 Interviews 对webquest培训前后进行访谈

Before and after the WebQuest training, semi-structured interviews were conducted with each participant individually. Thus, although there was an interview protocol, some questions arose naturally during the interviews (Gillham 2000). The first interview conducted before the training aimed to reveal (a) whether teachers had used the Web for teaching purposes, and if so, how; (b) their views about effective use of the Web in instruction; (c) whether they had heard about WebQuests before; (d) whether they could define higher-order thinking skills, give examples, and describe what they do in class to develop these skills. In the second interview, teachers were asked about (a) their general opinions about the training; (b) their views about effective use of the Web in instruction; (c) whether they could define higher-order thinking skills, give examples of them, and explain what they could do in class to develop these skills (see Appendix 1 for the interview protocols). The interviews were audiotaped and transcribed.

6.2 Web searching skills performance (WSSP) assessment

In order to assess teachers' Web searching skills, teachers were given two equivalent forms of performance assessment (order of items changed in the implementation) before and after the training (see Appendix 2). These assessments included nine tasks

focusing on the Web searching skills defined above (Table 1); additionally, teachers were expected to use the advanced search options of a search engine to search for images, videos, or animations, as well as to customize image searches according to image size, image type, or image color. As the teachers performed these tasks, their computer screens were recorded using a screen-capture program.

6.3 Web evaluating skills performance (WESP) assessment

In order to evaluate their development of Web evaluating skills, teachers were given a performance assessment focusing on Web evaluating skills before and after the training (see Appendix 2). In each assessment, teachers were given some websites related to their area and were asked to examine them. They were asked if they found the website content reliable and credible, and further, whether they could use the given website in their teaching, providing a rationale for their answers. Before the training, teachers were given two websites to examine: a blog and a large university research center website. After the training, in addition to the same type of two sets of websites, teachers were also given blogs created by experts in related content areas (domain names not associated with any institutions).

6.4 Teacher journals 教师反思日志

Teachers were also asked to keep a journal throughout the training. In order to help teachers to reflect on the training day, three questions were asked: (1) What did you learn today that was new? (2) When did you have difficulty? (3) Which skills or information were the most useful for you? 学到了什么？
还有什么困难？
对你而言什么技能和信息是最有用的？

7 Data analysis

The data were analyzed using a combination of quantitative and qualitative procedures to address the research questions as described below. More detail on how the data were analyzed follows.

RQ1. How did the WebQuest training help teachers develop Web searching and Web evaluating skills? In order to answer this research question, the WSSP and WESP assessments were investigated and compared before and after the training. After all screen recordings were transcribed, teachers' screen activities were written down. All strategies the teachers used on the computer and what they wrote on the assessment sheets were classified and counted. For instance, if a teacher was not able to use the *site:* operator or the search box within a site to perform a search on a specific website, this teacher was considered as not demonstrating the associated web searching skill. Thus a '−' mark was assigned to that teacher (Table 4). As a checklist was created, these data were initially analyzed quantitatively. Regarding the web evaluating skills, we looked at whether teachers expressed a specific set of criteria (that relate to authority, reliability, and coverage) when asked about the credibility of a website on their WESP assessment sheets. Thus, these data were analyzed qualitatively, focusing on what kind of evidence teachers used when evaluating a website. Furthermore, the pre- and post-training interviews and journal entries were also qualitatively examined in order to support the performance

Table 4 Progression of teachers' Web searching skills before and after the training

Web searching skills/Participants		Eylem	Cemile	Sermin	Levent	Mine	Zulal
Use of dash (-)	Before	−	−	−	+	−	−
	After	+	+	+	+	+	+
Use of asterisks (*)	Before	−	−	−	−	−	−
	After	+	+	−	+	+	−
Use of quotation marks ("")	Before	−	−	+	+	+	+
	After	+	+	+	+	+	+
Use of advanced search options (for video and animation search)	Before	+	−	−	−	−	−
	After	+	+	+	+	+	+
Use of advanced search options (for image search)	Before	−	−	−	+	−	−
	After	+	+	+	+	+	−
Use of *filetype:*	Before	−	−	−	+	−	−
	After	+	+	+	+	+	+
Use of *site:*	Before	−	−	−	−	−	−
	After	+	+	+	+	+	+
Use of appropriate keywords	Before	+	+	−	+	+	+
	After	+	+	+	+	+	+
Use of academic databases	Before	+	+	−	−	−	+
	After	+	+	+	+	+	+

indicators determined in the WSSP and WESP assessments. More specifically, the interview and journal data were divided into meaningful units (Merriam 1998) organized around the questions asked in interviews and for journal entries. A meaningful unit may be composed of two or three sentences or a large paragraph, and conveys information relevant to the research questions. Instances in which teachers talked about the development of their Web searching and Web evaluating skills were examined. Common themes were identified across the data, looking for evidence of convergence with teachers' performances and statements on the WSSP and WESP tasks.

RQ2. How did the WebQuest training help teachers develop pedagogical skills; that is, adopt a working definition for higher-order thinking and develop WebQuest tasks to improve such skills? The data for the second research question come from interview records, teachers' journals kept during the training, and teachers' WebQuests prepared during the training program. For the first part of this research question, we paid attention to the ways in which teachers talked about higher order thinking skills; not only whether they could name them, but also whether they could clearly articulate what they could do in their classrooms to develop these skills. After the data relevant to the second research question were carefully divided into meaningful units (Merriam 1998), descriptive words or sentences were assigned to them. Then as the coding proceeded, these initial codes turned into themes responding to the research questions. For the second part, teachers' WebQuests (the task parts) were examined and evaluated with respect to the ITM thinking processes to see if they were designed to improve students' higher-order thinking skills. Below the findings are presented to answer these research questions.

8 Development of technological skills: Web searching

Table 4 provides a summary of teachers' performance before and after the training in terms of the Web searching skills. One can see that most of the skills introduced in the training were new to the teachers. More specifically, none of the teachers knew how to use the asterisks (*) and *site:* operators before the training. Also, only one teacher knew how to use advanced search options for video, animation and image, and use of *filetype:* prior to the training. However, after the training all the teachers were able to use the dash (-), *site:*, and *filetype:* operators, and to search for videos and animations using advanced search options. In addition, all teachers were able to search academic databases and use appropriate keywords and quotation marks after the training. All teachers but Zulal were able to customize their image search by size and type. And Eylem, Cemile, Levent, and Mine started using asterisks (*) in their searches in the post-training WSSP assessment.

In addition to these performance indicators, teachers stated that they developed their Web searching skills significantly throughout the training. The data supporting this claim come from pre- and post- training interviews and journal entries. All of the teachers indicated that the WebQuest training helped them develop their Web searching skills. Some quotes from teachers' journals related to their Web searching skills are provided below:

> Web searching strategies that we learned during the WebQuest training provided us information that we could use for a lifetime. (Eylem, Journal Entry, May 12)

> Learning to search for different formats such as animations was also useful. (Zulal, Journal Entry, May 12)

> I noticed that I do not even use the Ctrl+F shortcut while examining a website. I think I got faster at doing a quick overview of text that is too long. (Mine, post-training interview)

Comparing the results of the pre- and post-WSSP assessments, and considering teachers' journal entries and interview records, it can be concluded that the WebQuest training helped teachers improve their Web searching skills. Below, further data are presented to discuss how teachers' Web evaluating skills improved after the WebQuest training.

8.1 Development of technological skills: Web evaluating

In order to evaluate the development of teachers' Web evaluating skills, pre- and post-training WESP assessments, teachers' journals, and interview records were examined. As mentioned above, for the first WESP assessment conducted before the training, teachers were given two websites related to their areas to investigate. The first set of websites consisted of blogs with instructional materials created by nonexperts in the respective areas. Five of the teachers stated that they would not use these blogs, providing the following rationales:

> It is not reliable since it is a blog. The appearance seems complex and it does not have adequate content. I would not use it. (Levent, pre-training WESP assessment)

I might not use it because it is a blog page. (Mine, pre-training WESP assessment)

The information on this page does not seem sufficient. I would not use it (Zulal, pre-training WESP assessment)

I would not use it, as I found this website very boring. (Cemile, pre-training WESP assessment)

I would never use this website. It seems like all the content is created by registered users. The content is limited, and the language is not correct either. (Eylem, pre-training WESP assessment)

Levent and Mine stated that they would not use these Web pages since they were blog pages. Levent, along with Zulal and Eylem, also talked about the content of the website. However, it seems as though Levent and Mine considered blog websites as unreliable in general, and thus believed that they should not be used at all. The rationale for Cemile's decision was based only on the visual aspects of the website. Only Sermin stated that she could use the website in her teaching.

The second set of websites given to the teachers belonged to a large university's research center. Teachers were asked if they could use these websites in their classes. While all of the teachers stated that they could use them as resources for different reasons (they had a wide range of information, they included animations, they gave general information etc.), only two teachers indicated that they would use these websites because they were university pages with an .edu extension.

Considering the results of the first WESP assessment, it could be argued that before the WebQuest training, teachers' decisions about the credibility of a website were based on intuition rather than on an explicit set of criteria. For this reason, in the training, teachers were provided with a decision flow chart for quickly checking the credibility of Web content (Fig. 1).

In the post-training WESP assessment, along with sets of websites similar to those used in the first assessment, one other type of website was also used (i.e., an expert blog). As in the pre-training assessment, teachers were asked to explain if the website content was reliable and credible, and whether they could use a given website in their teaching, providing a rationale for their answers.

After the WebQuest training, it was expected that teachers would look first at the URLs of the given websites and evaluate their content accordingly. When examining an educational website associated with a large university, five of the six teachers stated that they found it reliable. The rationales they provided show that they first considered the URL's extension. Some representative quotes from interviews and journals follow:

I think this website is reliable because it has an .edu extension. And the references given on the website are academic papers. (Cemile, post-training WESP assessment)

I would use it because it is a university website and is prepared by a faculty member. (Levent, post-training WESP assessment)

Another expectation was that teachers would also consider the author of the website when evaluating the content. In the post-training WESP assessment, when evaluating

blogs created by anonymous authors, all of the teachers stated that they did not find the website content credible, as the authors were unknown. Some representative quotes:

> There is no clear information about this blog. Who created it? Who contributed? (Zulal, post-training WESP assessment)

> I would not use this website, as there is no information about the owner of the blog. (Sermin, post-training WESP assessment)

When evaluating a blog prepared by area experts, teachers were still able to use the suggested criteria in the post- training WESP assessment. Four of the teachers stated that the website content was credible, as it was created by area experts. After checking the author's credibility, teachers were also expected to consider the appropriateness of the content for the grade level they taught. Two teachers said that they would not be using these websites, as the content was not suitable for their students' level. Some representative quotes:

> I would use this website since there is information about the blogger, and he is an educated person in his field. Also, there is research-based information on the website. (Levent, post-training WESP assessment)

> I would use this website since references were given. In addition, when I look at the contact page, I can find formal information about the blogger. (Sermin, post-training WESP assessment)

> I would not use this website since I did not find the content appropriate for the level of my students. (Cemile, post-training WESP assessment)

When the teachers' answers to the WESP assessment tasks were compared, it can be argued that teachers had begun to use a clear set of criteria when evaluating the credibility of website content, thus making progress with respect to their Web evaluating skills. This finding was corroborated by the post-training interview data. Teachers stated that after the training, they started viewing Web content in a different way. A representative quote follows:

> One of the most important things I learned in the WebQuest training was checking the credibility of websites that we can recommend to students. I learned a lot of tips on the trustworthiness of information. I need to skim all this information. I remember getting excited while learning. For example, in the past, when I looked at a website I could disapprove it due to strange ads and a wide variety of content on many different disciplines. But now I have different criteria to evaluate Web resources. (Mine, post-training interview)

Considering the evidence in the data—that is, comparing the teachers' responses to the WSSP and WSEP assessments before and after the training, interview records, and journal entries—it can be concluded that the WebQuest training helped teachers to develop their Web searching and evaluation skills. More specifically, teachers improved

in their ability to access information efficiently on the Web using a variety of strategies, and in their ability to evaluate Web content based on a clear set of criteria.

8.2 Developing pedagogical skills: Higher-order thinking

One of the most definitive characteristics of a WebQuest is the availability of a higher-level task. Thus, a teacher who developed WebQuest skills would define higher-order thinking skills operationally and design a WebQuest with a higher-level task in it. For this reason, the aim was to develop teachers' pedagogical skills, focusing on the concept of higher-order thinking and the design of WebQuest tasks that would develop students' higher-order thinking, in turn. The effectiveness of the WebQuest training was examined in terms of developing pedagogical skills by analyzing pre- and post-training interview data, teachers' journal entries, and teachers' WebQuests. In the interviews, teachers responded to a set of questions related to higher-order thinking and the role of the Web in developing such skills. Teachers' responses to these questions before and after the training are discussed below.

8.3 Views about higher-order thinking skills before the training

在培训前问教师对于高阶思维能力的认识

In order to reveal teachers' prior knowledge about higher-order thinking skills, teachers were asked to define what higher-order thinking skills were. All of the teachers had difficulty answering this question, taking a long time before responding. Moreover, two of the teachers, Zulal and Eylem, repeated the question without answering it. The remaining four teachers who answered this question suggested various definitions:

> Higher-order thinking skills are linking to other things based on a sentence or an opinion by analyzing and synthesizing. It is a brainstorming in itself. (Levent, pre-training interview)

> In what aspects do you ask? Higher-order thinking skills relevant to my lesson are developing different points of view, for instance. Indeed, I want to teach my students not to give up. (Mine, pre-training interview)

> For instance, higher-order thinking skills are creativity, critical thinking, or discussion. (Sermin, pre-training interview)

> For higher-order thinking skills, you need to ask students to make analysis and synthesis. In addition to this, it is the ability to read the subtext. For my literature lesson, for instance, when I teach a lesson about rhetorical language within a Shakespeare unit, and students are asked what the meaning of the metaphor is, all of them know what a metaphor is. However, understanding what it means, reading the subtext, while using this metaphor are higher-order thinking skills to me. (Cemile, pre-training interview)

The teachers presented a variety of definitions of higher-order thinking skills in these representative quotes. In order to better understand their thinking, they were asked

about the kinds of activities they were doing in their classes in order to develop their students' higher-order thinking skills. Two of the teachers stated that they did not have any time to do such activities, as there was a heavy curriculum they needed to teach. Furthermore, they said that they needed to prepare their students for standardized tests. One of these teachers said:

> We don't worry much about teaching for higher-order thinking skills. For instance, there is a two-hour lesson for 9th graders, and we have a heavy curriculum. While we are making an effort to cover the curriculum, we do not have enough time to do anything extra. (Levent, pre-training interview)

It appears that for these teachers, higher-order thinking skills were not part of the curriculum. Rather, they were a separate subject, which would require extra effort on the part of the teacher and be of secondary importance.

One of the other teachers who answered this question stated that she considers learning styles in order to develop students' higher-order thinking skills. Another teacher, whose content area was English, said that she planned paraphrasing activities. The explanations of higher-order thinking skills given by the other two teachers were inconsistent with the actions stated in their descriptions. The following conversation took place in the pre-training interview:

> Sermin, pre-training interview
> Interviewer: What are higher-order thinking skills?
> Sermin: Higher-order thinking skills… creativity, critical thinking, discussion, for instance.
> Interviewer: Could you give an example? What do you do in your lessons in order to develop these skills?
> Sermin: I worked on peer learning. I have dyads work on peer learning.

Sermin considered creativity and critical thinking to describe higher-order thinking skills. She talked about using peer learning activities in order to teach these skills. However, she was not able to clearly exemplify an activity that would develop students' creativity and critical thinking skills in peer learning.

Zulal was one of the teachers who was not able to answer the question. When asked to define higher-order thinking skills, she said: "That [question] sounded strange. What are they?" (pre-training interview).

When teachers' responses to these questions are considered, it can be argued that they did not have a clear idea about higher-order thinking skills before the training, as their definitions were not clearly articulated. In other words, the teachers were not able to explain any activities that could be used to develop such skills.

8.4 Views about higher-order thinking skills after the training 培训后问教师对于高阶思维能力的认识

After the training, the teachers were asked the same questions again. In answering the first question, all the teachers listed at least one of the higher-order thinking processes introduced in the training (i.e., problem solving, designing, and decision making). One other difference worth noting in the post-training interview data was that the teachers

were able to answer the question much more easily, and articulate their answers more clearly. For instance, one of the teachers said:

> In order for an activity to include any higher-order thinking skills, it needs to encourage students to use at least one of these skills: to make a decision, solve a problem, or design something new. Actually, there are not clear differences between them. I think they all mesh into each other (Levent, post-training interview).

In the pre-training interview, Sermin described higher-order thinking skills as "creativity, critical thinking, and discussion." Then she talked about peer learning, without articulating the details, as an activity that would develop higher-order thinking skills, as mentioned above. After the training, Sermin defined higher-order thinking as designing a new product, and exemplified this definition with an activity in which students work to develop a new method for recycling batteries.

> Sermin, post-training interview
> Interviewer: What do higher-order thinking skills mean?
> Sermin: Higher-order thinking skills are… when a student creates an authentic product and creates something new by taking a different approach is a form of higher-order thinking skill to me.
> Interviewer: Could you please give an example? What can you do in your lessons in order to develop these skills?
> Sermin: For example, a student can suggest a new method for separating waste batteries from other waste and for recycling and reusing them. [By doing that] the student creates a new thing, which also has a connection to real life.

When asked about types of higher-order thinking activities for the classroom, the teachers sounded clearer this time. Zulal, who was not able to answer the question regarding higher-order thinking skills in the pre-training interview, listed designing and problem solving as processes requiring higher-order thinking skills. Furthermore, she talked about an activity in which such skills could be developed, namely creating wallpaper patterns using knowledge of geometric shapes and their properties.

> Zulal, post-training interview
> Researcher: What do higher-order thinking skills mean?
> Zulal: Previously, we knew about the Bloom. But now designing a new product and problem solving skills. These are higher-order thinking skills as far as I remember. From the model we call the Integrated Thinking Model.
> Researcher: Could you please give an example? What could you do in your lessons in order to develop these skills?
> Zulal: For example, using circumcircles and properties of squares and rectangles, and creating decorative models and products, wallpaper patterns for instance. In this way, students can develop higher-order thinking skills such as creating a new product, and design.

Considering teachers' responses to the interview questions about higher-order thinking skills and activities, it can be argued that they adopted working definitions of

higher-order thinking skills. More essentially, they started imagining and describing activities that could help students develop such skills.

Towards the end of the training, teachers wrote in their journals that learning about higher-order thinking skills was valuable for them. More importantly, they emphasized the importance of teaching these skills as a teacher. Below is a representative excerpt from a teacher's journal:

> What should a good WebQuest be like? It was essential for me to learn that I should place importance on higher-order thinking skills. In addition to this, the activities dealing with higher-order thinking skills and how one can develop these skills used in the training were very helpful. (Zulal, Journal Entry, May 05)

Teachers were also asked in the interviews, both before and after the training, whether they thought the Web could be used to develop students' higher-order thinking skills. In the pre-training interviews, one of the teachers was not able to answer the question, while the others said that it would be possible to use the Internet for this purpose. However, when asked about how that could be done, none of the teachers was able to give a clear explanation.

In the post-training interviews, the same question was asked again. Five of the teachers stated that by using the WebQuests, they could develop students' higher-order thinking skills and benefit from Web resources. Below is a representative quote:

> WebQuest is a very good example of how to do it. There are many kinds of resources on the Web like visual, audial, and such. In the classroom it is difficulty to use them all. However, in order for students to increase their cognitive level, we need to use a wide variety of resources. All of these resources already exist on the Web. For instance, in the WebQuest that I prepared during the training, before students make a decision, they need to achieve the required cognitive level on the subject. So, this is a process which needs to be supported with different resources. The visual and audial resources which I found on the Web helped me a lot. (Eylem, post-training interview)

8.5 Teachers' WebQuests

In addition to what teachers said in the interviews and wrote in their journals, the tasks in teachers' WebQuests were examined to evaluate whether they could put theoretical ideas into practice. Based on the ITM, teachers were introduced to three major higher-order thinking processes, including designing, decision making, and problem solving, the essential core of higher-order thinking (Iowa Department of Education 1989). When examining their WebQuests, the focus was on whether the tasks designed by the teachers addressed at least one of these processes. The Table 5 below provides teachers' WebQuest titles, their tasks, and which major higher thinking process they address. As can be seen in the table, all teachers were able to create WebQuest tasks that could be used to develop their students' higher-order thinking skills in their classes.

As can be seen, teachers improved their knowledge of higher-order thinking skills, showing evidence of understanding what the concept means and designing appropriate

Table 5 Teachers' WebQuests

Teacher	Area	Title of WebQuest	Task	Process addressed
Eylem	English	Shall we light up the coliseums?	You believe that death penalty should never be applied under any circumstances. You need to write a report stating your arguments and refuting possible counter-arguments.	Decision making
Cemile	English	The media unit	To create the most successful advertising campaign to present Everlasting Chewing Gum in media. This campaign will consist of preparing a print ad and then shooting the commercial, which will be shown on many national TV Channels.	Designing
Sermin	Chemistry	What will happen to the waste batteries?	Prepare a presentation that includes the environmental impact of waste batteries, make suggestions to minimize these negative effects, and suggest method(s) that will eliminate waste batteries from garbage.	Problem solving
Levent	Chemistry	Separating solid waste	Designing a Solid Waste Center 1. Modeling the solid waste center 2. Designing a poster to introduce the center.	Designing
Mine	Math	Fairground arrangement	Create plans for the arrangement of a new fairground.	Designing
Zulal	Math	How many people will live in our city in the future?	Research the population of our city and come up with outstanding and effective solutions to decrease or stop immigration. Prepare a presentation and write a report on it.	Problem solving

tasks for their classrooms to develop their students' higher-order thinking skills within the framework introduced in the training.

9 Discussion

This study proposed a teacher professional development module underlined by the learning technology by design approach. Six teachers, who volunteered for the study, designed WebQuests as the major and guiding activity throughout the training. Technological and pedagogical skills were introduced in the context of this design activity. The effectiveness of this module was investigated by focusing on the development of not only teachers' technological skills, but also pedagogical skills. Our findings suggest that all the participating teachers showed improvement in their Web searching and evaluating skills. Furthermore, they adopted a working definition for higher-order thinking skills, and using Web resources, they designed higher-level WebQuest tasks to promote students' higher-order thinking.

The premise of using authentic design activities in teacher education, rather than teaching technological skills independently, is that teachers have the chance to develop effective professional skills (Koehler and Mishra 2005). Traditionally, technology training for teachers usually emphasized developing computer skills at the *mechanical* level while providing little support at the *instructional* level (Ertmer 1999, emphasis in the original). This approach may be considered as "technocentric" (Papert 1987) as it begins with the affordances and constraints of technologies and the skills necessary to use them. Only later are the ways in which these technologies can be successfully integrated into classrooms given consideration (Harris et al. 2009). The consequence of this approach is that although teachers complete technology training courses, they end up not knowing how to create or implement meaningful technology-based activities (Moersch 1995, as cited in Ertmer 1999). The learning technology by design approach highlights the idea that knowledge about technology cannot be treated as context-free. Thus, good teaching requires an understanding of how technology relates to pedagogy and content (Mishra and Koehler 2006). This view implies that teachers can develop such knowledge through designing authentic learning activities to be used in their classrooms using technology. Therefore, this study provided evidence for the effectiveness of design-based activities for inservice teacher professional development, as the teachers in this study developed both their technological and pedagogical skills.

研究结论

Although one can find several studies exploiting the potential of WebQuests in preservice teacher education, studies that introduce WebQuests in inservice teacher professional development are rare. In this study, an inservice teacher professional development module built around designing WebQuests was put forward. This module, which was effective in our context, can be considered as an operationalization of the learning technology by design approach for inservice teachers. While design activities are usually lengthy and time-consuming, participation in the suggested professional development only takes about 20 h. Hence, it can be more easily completed by inservice teachers without committing an entire semester, which is typically the case (i.e., see Koehler et al. 2007). Thus, in addition to being effective, this module also proves efficient. In this regard, the findings of this study are significant given the growing need for effective (and efficient) inservice teacher professional development models.

The study, however, also had some limitations. Although data from multiple sources (i.e., interviews, journals, performance assessments regarding Web searching and evaluating) were collected and analyzed, we did not observe the participating teachers in their classrooms. Further research might investigate the extent in which these teachers adopt the WebQuest model in their teaching. In addition, all the teachers who participated in this study were volunteers. Although they were busy professionals with families who were asked to dedicate three full days, all of the teachers attended all the training sessions. This suggested that these six teachers were ready to improve their teaching, and accept and apply new ideas. Thus, their gains might be also due to their personal and professional characteristics in addition to the characteristics of the WebQuest training itself. Therefore, more research is needed to examine the effectiveness of the module along the dimensions defined in different contexts, particularly in contexts in which teachers do not voluntarily participate.

缺陷1

缺陷2

Although the WebQuest training module helped the participating inservice teachers to develop their technological and pedagogical skills, the findings of the study are not necessarily generalizable to the larger population or other contexts. This, however, should not be perceived as a limitation of this study. Flyvbjerg (2006) identifies misunderstandings about case study methodology deriving from the conventional wisdom. One of these misunderstandings is that one cannot generalize on the basis of an individual case, and that therefore the case study cannot contribute to the scientific development. Citing Bourdieu (1977) and Dreyfus and Dreyfus (1986), Flyvbjerg argues for the value of concrete and context-dependent knowledge gained by studying cases, in comparison to universal knowledge, for the development of scientific knowledge. He points out that not only were carefully chosen experiments, cases, and experiences critical in the works of social scientists such as Marx and Freud; but also for those of hard scientists such as Newton, Einstein, Bohr, and Darwin. Qualitative methodologies, as case studies, have their own epistemological foundations. One can generalize from cases, yet this would be different in nature. Stake (1978) proposed the term *naturalistic generalizations* to capture the type of generalization case study research allows. In this type of generalization, findings from a single case would generalize to another *similar* case, rather than to the population and then to particular situations. For that reason, describing the particulars of the case is crucial (Lincoln and Guba 1985). Some important aspects that are particular to the WebQuest module are discussed below for those who wish to apply the module.

It is crucial to pay utmost attention to how new technological and pedagogical knowledge presented to teachers during the training. Teachers were provided with new knowledge only when such a need was created within their WebQuest design activity. Therefore, the knowledge of technology and pedagogy were not presented independently or as irrelevant to the immediate context. The sessions were structured in a way that such need would arise, and such knowledge would be useful to advance the work currently being undertaken. In addition, those who wish to implement the module should keep in mind that introducing WebQuests with their underlying principles and providing a useful higher-order thinking model (such as ITM) are equally essential. It is much easier to design WebQuests as worksheets with URLs (Dodge 2001) that limit students' experiences with them to information search and rote memorization (Zheng et al. 2005) rather than engaging in higher-order thinking. Teachers should be carefully guided towards designing high-quality WebQuests by providing operational definitions and examples for higher-order thinking.

10 Conclusion

The ubiquitous institutional pressure to teach more effectively with technology creates many challenges for teachers, particularly experienced ones. Design-based activities, such as the one proposed in this study, may help inservice teachers to develop effective professional knowledge and skills to undertake such a challenge. Training modules focusing on designing authentic activities, such as WebQuests, provide the context for teachers to develop both technological and pedagogical

skills. Such modules can be integrated into a large-scale teacher professional development endeavor, such as the one in the FATIH Project in Turkey (MNE 2012). In addition, WebQuests can be presented to teachers in a way that addresses their practical needs, that is, as an alternative to students' research assignments, in which students tend to simply copy and paste from the Internet. This way the appeal of WebQuests can be increased.

Although the 20-hour training can be considered feasible for inservice teachers, we recognize the ongoing professional support needs of teachers. The changes we identified before and after the training may not become part of the usual practices of these teachers immediately, or even after a while. Therefore, continuous professional development needs to be sustained (Demetriadis et al. 2003). Furthermore, considering the time-consuming nature of WebQuest design, a locally produced WebQuest portal where teachers can upload and share their work with other teachers can significantly support WebQuest use in the classroom.

Appendixes

Appendix 1

The Pre-Training Interview Protocol

1. Do you use the Web for teaching purposes?
    - How do you use the Web? Could you please give an example?
    - Could you please describe a lesson in which you used the Web?
    - Do you think that you used the Web effectively this way?
2. Do you think there could be other ways to use the Web effectively?
    - What can they be?
3. Are you familiar with WebQuests? What do you know about them?
    - If the answer is yes, what are they?
    - What kind of advantages do these Web-based activities have?
4. What kind of problems do you encounter when using the Web for teaching purposes?
5. What is meant by higher-order thinking skills?
    - Could you please give an example?
6. What do you do in your lessons in order to develop these skills?
7. Can these skills be developed using the Web?
    - How? Could you explain? Could you give me an example?

The Post-Training Interview Protocol

1. How did you find the training? What is your sincere opinion about it?
2. What are the methods of using the Web effectively?
3. What is meant by higher-order thinking skills?
   - Could you please give an example?
4. What could you do in your lessons in order to develop these skills?
5. Can these skills be developed using the Web?
   - How? Could you explain? Could you give me an example?

Appendix 2

The Pre-Training WSSP Assessment

Questions	Targeted skills
1. Assume that a student of yours is searching for "space travel" on the Web. However, every time she conducts a Web search, she comes across "space games" or "space stories." She has asked for your help. What would you suggest as a search strategy so that she would access information just about space travel? Please indicate what you would type in the search box.	-use of dash (−)
2. How would you search the Web if you wanted to access information about libraries, librarians, or librarianship? Please indicate what you would type in the search box.	-use of asterisks (*)
3. You want to access websites that include both your given name and surname. Please indicate what you would type in the search box.	-use of quotation marks ("")
4. Please find a video or an animation about one of the topics given below. You may use any strategies with your search. a) water cycle b) measuring angles c) farm animals in English	- use of advanced search options (video or animations)
5. Search the Web and find a) a comic about one of these topics: i) probability; ii) homogenous—heterogeneous compounds; iii) reported speech b) a picture with large dimensions to use as a background about one of the topics: i) mole; ii) number Pi; iii) house	-use of advanced search options (image)
6. Please find a worksheet about one of the topics given below in Acrobat Reader (PDF) format: a) Periodic table b) Trigonometric functions c) Active vs. passive voice	-use of *filetype:*
7. Please respond to one of the following questions by searching www.tubitak.gov.tr/. a) Who found the Arf number?	-use of *site:*

b) Who discovered the atom? c) What does OEDC mean?	
8. Please search the Web to find an answer to the following question: What language do the natives who live in Madagascar speak?	-use of appropriate keyword
9. Please find an academic article about one of the topics given below a) Particulate nature of matter b) Students' reading development c) Geometry software	-use of academic databases

The Pre-Training WESP Assessment

Questions	Targeted skills
1. Please answer one of the following. a) You are looking for information about pronouns in your English class. Would you use the following website? Please explain your answer by providing a rationale. http://lisenotlari.blogspot.com/search/label/%C4%B0ngilizce b) You are looking for information about "vectors" in your Geometry class. Would you use the following website? Please explain your answer by providing a rationale. http://lisenotlari.blogspot.com/2011/01/vektorler-geometri.html c) You are looking for information about "atom models" in your Chemistry class. Would you use the following website? Please explain your answer by providing a rationale. http://lisenotlari.blogspot.com/search/label/Kimya	-Web evaluating based on authority, reliability, and coverage
2. Would you use the information given on the websites (pick one to answer) to use in your classes or advise for student use? Please explain your answer by providing a rationale. a) Salts and solubility (http://phet.colorado.edu/tr/simulation/soluble-salts) b) Probability (http://phet.colorado.edu/tr/simulation/plinko-probability) c) A short story about dinosaurs (http://static.ehe.osu.edu/sites/beyond/penguins/downloads/feature-stories/dinosaurs-in-the-dark-45-text.pdf)	-Web evaluating based on authority, reliability, and coverage

The Post-Training WSSP Assessment

Questions	Targeted skills
1. You are searching for information about historical monuments in Istanbul, yet you are not interested in the Byzantine era. What would you type in the search box?	-use of dash (−)
2. You need to access information about the recent draft laws accepted by the Grand National Assembly Committees. How would you search for … committee accepted the … draft law?	-use of asterisks (*)
3. Who said: "It is not good to be consumers. Let us be producers."	-use of quotation marks ("")
4. Pelase find a video or animation about one of the topics given below: d) Gas pressure e) Symmety f) Demonstratives (that, this)	-use of advanced search options (video or animations)
1. Search the Web and find a) a comic about studying	-use of advanced search options (image)

b) a scene picture with large dimensions to be used as your desktop	
2. You need a document about children and sports in Acrobat Reader (PDF) format. In order to access more websites satisfying these criteria, what should you type in the search box?	- use of *filetype:*
3. You need the contact information of one of the music teachers at Bahcesehir High School. When you looked at the school website (http://www.bahcesehir.k12.tr/) you realized that it has no site search boxes. How would you look for the contact information of a music teacher who works there?	-use of *site:*
4. Living in a certain country brings you luck. Which country is it? Search the Web and find an answer.	-use of appropriate keyword
5. Please find an academic article that is related to both neoliberalism and educational policy.	-use of academic databases

The Post-Training WESP Assessment

Questions	Targeted skills
1. Would you use the information given on the websites (pick one to answer) in your classes or recommend them for student use? Please explain your answer by providing a rationale. a) Math: http://concretenonsense.wordpress.com/category/algebraic-geometry/ b) Chemistry: http://blog.khymos.org/molecular-gastronomy/definitions/ c) English: http://meaningandthinking.blogspot.com/	-Web evaluating based on authority, reliability, and coverage
2. Would you use the information given on the websites (pick one to answer) in your classes or recommend them for student use? Please explain your answer by providing a rationale. a) Math: http://www.uvm.edu/~dhowell/StatPages/StatHomePage.html b) Chemistry: http://www2.aku.edu.tr/~evcin/chemistry/mk1/atom.pdf c) English: http://www.buowl.boun.edu.tr/teachers/fDefining%20Academic%20Writing.htm	-Web evaluating based on authority, reliability, and coverage
3. Would you use the information given on the websites (pick one to answer) in your classes or recommend them for student use? Please explain your answer by providing a rationale. a) Math: http://matematikk.blogcu.com/ b) Chemistry: http://blog-cenneti.tr.gg/kimya.htm c) English: http://esmus.blogcu.com/en-sik-kullanilan-en-cok-kullanilan-ingilizce-kelimeler-1-a/5615929	-Web evaluating based on authority, reliability, and coverage

References

Alexander, J. E., & Tate, M. (1999). *Web wisdom: How to evaluate and create information quality on the Web*. Mahwah: Lawrence Erlbaum Associates.

Allan, J., & Street, M. (2007). The quest for deeper learning: an investigation into the impact of a knowledge-pooling WebQuest in primary initial teacher training. *British Journal of Educational Technology, 38*(6), 1102–1112.

Barker, J. (2007a). *Recommended search strategy: Analyze your topic & search with peripheral vision*. Berkeley: The Library of University of California. Retrieved March 11, 2013, from http://www.lib.berkeley.edu/TeachingLib/Guides/Internet/Strategies.html.

Barker, J. (2007b). *Evaluating web pages: Techniques to apply & questions to ask*. Berkeley: The Library of University of California. Retrieved March 11, 2013, from http://www.lib.berkeley.edu/TeachingLib/Guides/Internet/Evaluate.html.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook 1: Cognitive domain*. New York: Sage.

Bourdieu, P. (1977). *Outline of a theory of practice*. Cambridge: Cambridge University Press.

Crawford, C. M., & Brown, E. (2002). Focusing upon higher order thinking skills: WebQuests and the learner-centered mathematical learning environment. (ERIC Document Reproduction Service No. ED474086).

Demetriadis, S., Barbas, A., Molohides, A., Palaigeorgiou, G., Psillos, D., Vlahavas, I., Tsoukalas, I., & Pombortsis, A. (2003). "Culture in negotiation": teachers' acceptance/resistance attitudes considering the infusion of technology into schools. *Computers & Education, 41*, 19–37.

Dodge, B. (1997). *Some thoughts about WebQuests*. Retrieved March 11, 2013, from http://webquest.sdsu.edu/about_webquests.html.

Dodge, B. (2001). FOCUS: five rules for writing a great WebQuest. *Learning and Leading with Technology, 28*(8), 6–9.

Dreyfus, H., & Dreyfus, S. (1986). *Mind over machine: The power of human intuition and expertise in the era of the computer*. New York: Free Press.

Ertmer, P. A. (1999). Addressing first- and second-order barriers to change: strategies for technology integration. *Educational Technology Research and Development, 47*(4), 47–61.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative Inquiry, 12*(2), 219–245.

Gillham, B. (2000). *The research interview*. New York: Continuum Press.

Gohagan, D. (1999). Computer facilitated instructional strategies for education: designing WebQuests. *Journal of Technology in Human Services, 16*(2/3), 145–159.

Grassian, E. (1995). *Thinking critically about world wide web*. Retrieved March 11, 2013, from http://www.sscnet.ucla.edu/library/modules/Judge/CLThinkwwwResources.pdf.

Gulbahar, Y., Kalelioglu, F., & Madran, O. (2008). Using dynamic WebQuest approach in teacher education to promote project-based learning. *Proceedings of the 8th International Educational Technology Conference*, (pp. 1156–1159). Eskisehir, Turkey.

Halat, E. (2008a). A good teaching technique: WebQuests. *Clearing House, 81*(3), 109–112.

Halat, E. (2008b). The effects of designing WebQuests on the motivation of pre-service elementary school teachers. *International Journal of Mathematical Education in Science and Technology, 39*(6), 793–802.

Harris, R. (2010). *Evaluating internet research sources*. Retrieved March 11, 2013, from http://www.virtualsalt.com/evalu8it.htm.

Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' technological pedagogical content knowledge and learning activity types: curriculum-based technology integration reframed. *Journal of Research on Technology in Education, 41*(4), 393–416.

Iowa Department of Education (1989). *A guide to developing higher-order thinking across the curriculum.* Des Moines, IA: Department of Education. (ERIC Document Reproduction Service No. ED 306 550).

Johns Hopkins University (JHU) Library Guides. (2012). *Evaluating internet resources*. Retrieved March 11, 2013, from http://guides.library.jhu.edu/content.php?pid=198142&sid=1665954.

Johnson, D., & Zufall, L. (2004, March/April). Web watch – Not just for kids anymore: WebQuests for professional development. *Reading Online, 7*(5). Retrieved March 15, 2014, from http://www.readingonline.org/electronic/elec_index.asp?HREF=webwatch/webquests/index.html.

Jonassen, D. (1996). *Computers as mindtools for schools: Engaging critical thinking*. New Jersey: Prentice Hall.

Kabakci, I., Fırat, M., Izmirli, S., & Kuzu, E. B. (2010). Opinions of teachers on using internet searching strategies: an elementary school case in turkey. *Turkish Online Journal of Qualitative Inquiry, 1*(1), 49–61.

King, K. P. (2003). The WebQuest as a means of enhancing computer efficacy. (ERIC Document Reproduction Service No. ED474439).

Koehler, M. J., & Mishra, P. (2005). What happens when teachers design educational technology? The development of technological pedagogical content knowledge. *Journal of Educational Computing Research, 32*(2), 131–152.

Koehler, M. J., Mishra, P., & Yahya, K. (2007). Tracing the development of teacher knowledge in a design seminar: Integrating content, pedagogy, & technology. *Computers and Education, 49*(3), 740–762.

Kuiper, E., Volman, M., & Terwel, J. (2008). Students' use of web literacy skills and strategies: searching, reading and evaluating web information. *Information Research: An International Electronic Journal, 13*(3).

Kurbanoglu, S. (2002). Www bilgi kaynaklarının değerlendirilmesi. *Hacettepe Üniversitesi Edebiyat Fakültesi Dergisi, 19*(1), 11–25.

Lim, J., Reiser, R. A., & Olina, Z. (2009). The effects of part-task and whole-task instructional approaches on acquisition and transfer of a complex cognitive skill. *Educational Technology Research and Development, 57*(1), 61–77.

Lima, M., Koehler, M. J., & Spiro, R. J. (2004). Collaborative interactivity and integrated thinking in Brazilian business schools using cognitive flexibility hypertexts: the panteon project. *Journal of Educational Computing Research, 31*(4), 371–406.

Lincoln, Y., & Guba, E. (1985). *Naturalistic inquiry*. Newbury Park: Sage.

MacGregor, S., & Lou, Y. (2004–2005). Web-based learning: how task scaffolding and web site design support knowledge acquisition. *Journal of Research on Technology in Education, 37*(2), 161–175.

March, T. (1998). *Why WebQuests?* Retrieved March 11, 2013, from http://tommarch.com/writings/why-webquests/.

March, T. (2003–2004). The learning power of WebQuests. *Educational Leadership, 61*(4), 42–47.

Mathew, R., & Lally, J. (2010). *The thinking teacher's toolkit: Critical thinking, thinking skills and global perspective*. London: Continuum International Publishing.

Menchaca, M., & McVicker, B. (2003). Scaffolding WebQuest creation for experienced teachers. In C. Crawford et al. (Eds.), *Proceedings of society for information technology & teacher education international conference 2003* (pp. 1025–1032). Chesapeake, VA: AACE.

Merriam, S. B. (1998). *Qualitative research and case study applications in education: Revised and expanded from case study research in education*. San Francisco: Jossey-Bass.

Metzger, M. J., Flanagin, A. J., Eyal, K., Lemus, D., & McCann, R. M. (2003). Bringing the concept of credibility for the 21st century: Integrating perspectives on source, message, and media credibility in the contemporary media environment. In P. Kalbfleish (Ed.), *Communication yearbook* (Erlbaum, Vol. 27, pp. 293–335). NJ: Mahwah.

Ministry of National Education, Turkey (MNE). (2012). *Fatih Projesi*. Retrieved March 11, 2013, from http://fatihprojesi.meb.gov.tr/tr/english.php.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: a framework for teacher knowledge. *Teachers College Record, 108*(6), 1017–1054.

Moersch, C. (1995). Levels of technology implementation (LoTi): a framework for measuring classroom technology use. *Learning and Leading with Technology, 23*(3), 40–41.

Noruzi, A. (2005). Google scholar: the new generation of citation indexes. *LIBRI, 55*(4), 170–180.

Olcay, N. E. (2003). Analysis of search strategies of turkish search engine users': Case of arabul. Unpublished Doctoral Dissertation, Hacettepe University, Ankara, Turkey.

Papert, S. (1987). *A critique of technocentrism in thinking about the school of the future*. Retrieved March 15, 2014, from http://www.papert.org/articles/ACritiqueofTechnocentrism.html.

Perkins, R., & McKnight, M. L. (2005). Teachers' attitudes toward WebQuests as a method of teaching. *Computers in the Schools, 22*(1–2), 123–133.

Polly, D., & Ausband, L. (2009). Developing higher-order thinking skills through WebQuests. *Journal of Computing in Teacher Education, 26*(1), 29–34.

Stake, R. E. (1978). The case study method in social inquiry. *Educational Researcher, 7*(2), 5–8.

Vidoni, K. L., & Maddux, C. D. (2002). WebQuests: can they be used to improve critical thinking skills in students? *Computers in the Schools, 19*(1–2), 101–117.

Wang, F., & Hannafin, M. J. (2008). Integrating WebQuests in preservice teacher education. *Educational Media International, 45*(1), 59–73.

Yin, R. K. (2003). *Case study research: Design and methods* (3rd ed.). Thousand Oaks: Sage.

Young, D., &Wilson, B. (2002).WebQuests for reflection and conceptual change: Variations on a popular model for guided inquiry. *World Conference on Educational Multimedia, Hypermedia and Telecommunications, 2002*, *1*, 2116–2121.

Zheng, R., Stucky, B., McAlack, M., Menchana, M., & Stoddart, S. (2005). WebQuest learning as perceived by higher education learners. *TechTrends, 49*(4), 4149.