ENCOURAGING LEARNERS TO EXPLORE WEBSITES: HYPERLINKS AS INVITATIONS

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ABSTRACT

We applied a user interface (UI) design approach based on a constructivist perspective for web-based learning that conceptualizes interactions between learners and websites as conversations. Hyperlinks on the UI of a distributed interactive learning environment were treated as invitations for interaction to encourage learners' active exploration. An experiment for examining the effects of two UI features, namely, additional cues attached to hyperlinks and indication of the website owner, was conducted on the basis of the literature on invitation designs for web surveys. Results reveal that, on a website owned by someone with a high-power status, learners explore further when additional cues are present on the UI. Such effects indirectly enhance learning outcomes.

Keywords: distributed learning environment, user interface, navigation, constructivist

INTRODUCTION

The focus in learning approaches has recently shifted from teacher-centered to learner-centered. Traditional learning emphasizes the transfer of teachers' knowledge and skills to learners. The focus is gradually shifting toward learners' self-exploration and self-discovery where they construct their own meanings and incorporate them into the cognitive structure of their existing knowledge and skills. Learners play an active role in such a learning approach.

Learners may not always be active in learning (Sánchez-Franco, Peral-Peral, & Villarejo-Ramos, 2014). The constructivist view of learning assumes that teachers adopt a supportive role in learners' discovery and construction of meaning. Teachers should motivate learners to explore (Duffy & Cunningham, 1996). However, teachers may not always be present to encourage such exploration, especially in the context of web-based learning. A distributed interactive learning (DIL) environment refers to the presentation of learning materials as websites, such that learners can explore them on their own time regardless of location (Khalifa & Lam, 2002). Designers and educators must design the website to encourage learners to explore the content and thus allow these learners to browse a DIL website on their own.

Researchers have been studying web-based learning with a wide range of focuses, including motivating learners (Sánchez-Franco et al., 2014), user interface (UI) design (Cho, Cheng, & Lai, 2009; Rivera-Nivar & Pomales-García, 2010), and UI design principles (Feifer & Tazbaz, 1997; Lohr, 2000). In particular, a visually appealing UI may attract students' attention. The usability of a UI enhances a learner's perception regarding the usefulness of a website, but such task is difficult.

Educators and designers seldom consider that DIL websites play a role in motivating learners' exploration. In other contexts, researchers have suggested viewing the interactions between visitors and a website as a process of communication (McKay, 2013; Nake & Grabowski, 2001; Sundar, 2007). From this perspective, the elements of the UI are messages sent to visitors. Visitors' clicks or other inputs are returned messages. This perspective can guide the development of UI designs by incorporating knowledge from the communication literature. Whether DIL websites

can send such invitations to motivate learners' self-exploration is still unclear. Studies on the invitation design for surveys may offer insights into designing invitational UI.

Researchers who use surveys as a research method have been struggling to increase their response rate (Fan & Yan, 2010). One approach for addressing the problem is focusing on the invitation design (Fan & Yan, 2010; Joinson & Reips, 2007; Kaplowitz, Lupi, Couper, & Thorp, 2012). Previous studies have examined various aspects of invitation design, such as the length of the invitations, personalization, the status of the invitation sender, and estimated completion time. Specific design recommendations have been formulated based on these findings. For example, Joinson and Reips (2007) reported that long invitations enhance the response rate. In addition, people are likely to respond to personalized invitations from a person with a high-power status. These findings are applicable to designing the UI for DIL websites.

As suggested by previous findings, hyperlinks on DIL websites are similar to invitations in terms of length. Thus, more description in the presentation may effectively inform learners what to expect, which in turn may encourage them to engage in interactions. The sender of such invitations on the UI is the website owner (often indicated on the top-left corner of each web page). This may moderate the effects of other aspects of hyperlink design, as suggested by the findings on the power of invitation senders.

In the present study, we adopted a design approach following studies on invitation design that treats learner-website interactions as conversations to enhance UI designs in DIL learning. Two features of the UI design were explored: hyperlink presentation and indication of the website owner. Based on the findings of studies on web survey invitations, we manipulated the number of cues attached to hyperlink presentations and the power status of the indicated website owner and conducted a laboratory experiment for examining the resultant designs. This study is part of a research project concerning the effects of UI in the context of DIL learning (Ho & Yao, 2018).

The rest of the paper is organized as follows. The next section introduces the theoretical background in a review of the related literature. Then, the derived hypotheses on the basis of the review are presented. The next section presents the experiment for hypothesis testing. The last section elaborates the findings and conclusions of the study.

THEORETICAL BACKGROUND AND RELEVANT LITERATURE

Constructivist View Of Learning

The constructivist view of learning focuses on the construction of meaning by learners. Unlike objectivism, no objective reality exists in constructivism that should be transferred from the instructor's mind to that of the learner (Leidner & Jarvenpaa, 1995). In the constructivist learning literature, mind as brain is a metaphorical view of the mind. One of the metaphors of the mind is mind as rhizome (MAR)(Duffy & Cunningham, 1996). A rhizome is a plant with nodes that sends out underground shoots and roots. The rhizome metaphor implies a dynamic structure with numerous points that can be connected to any other point. No inside or outside exists, but an open network exists in which points can be connected in any manner. According to this view, learning is a process involving the creation of a path to navigate and behave in the network through experiences and interactions within a learner's sociocultural context.

According to the MAR perspective, learning is mediated by tools and signs. Tools refer to technical tools involved in learning activities, such as a hammer in carpentry lessons. Duffy and Cunningham (1996) argued that the shape of a hammer influences how it should be held, along with the learner's experience of driving nails into wood and the structure of the piece of woodwork produced. The use of a tool and the tool itself transform and are transformed by learning activities.

Previous studies have investigated the effects of constructivist learning environments on students (Hsieh, Hsu, & Huang, 2016; Kwan & Wong, 2015; Nie & Lau, 2010). For example, Nie and Lau (2010) conducted a survey among 3,000 Grade 9 students in Singapore. The results suggested that constructivist instructional practices exert significantly more positive effects on students' cognition, motivation, and achievement.

According to Duffy and Cunningham (1996), computing technologies can be tools and signs that mediate learning activities. Previous researchers have pointed out that many computing technologies are suitable for constructivist learning

environments. Woo and Reeves (2007) emphasized that the constructivist perspective can be an analytical and design perspective for web-based learning environment. In an experiment involving 78 students, Baturay and Bay (2010) found that students who engaged in problem-based learning via a web-based course felt more connected with other students and performed better in post-tests than students taking a web-based course with a traditional learning approach.

Rahimi, van den Berg, & Veen, (2015) discussed how Web 2.0 technology provides possibilities for students to create personalized learning environments. Web 2.0 tools provide students with active roles as content producers, coordinators, socializers, and decision makers (Chu et al., 2017).

UI In Web-Based Learning

Santos, Boticario, & Pérez-Marín, (2014) argued that usability is a quality criterion for e-learning systems. They suggested adopting a user-centered design approach in the development of web-based educational systems to focus on learners throughout the development process. Researchers of educational technologies have focused on UI design (Cates, 2002; Perry & Schnaid, 2012; Van Aalst, Van Der Mast, & Carey, 1995). The UI of a web-based learning system influences learners' usage motivation (Cho et al., 2009; Sánchez-Franco et al., 2014). In a survey administered to university students, Cho et al. (2009) found that students who perceived the UI of e-learning to be user friendly perceive the system to be useful, thereby indirectly enhancing their intention to continue using the system. Previous researchers have also attempted to enhance the UI design of e-learning systems (e.g., Rivera-Nivar and Pomales-García, 2010). Jan, Chen, & Huang, (2016) proposed an online collaborative reading annotation system that enables readers to create, modify, filter, and discuss annotations. In one of the system's two filtering mechanisms relying on users' opening of the annotations, fuzzy functions and heuristic thresholds are found to improve students' reading comprehension.

Dialogue Between Learners And Computers

Computers may also exhibit dialogic interactions with learners. The widespread utilization of interactive technologies, such as the World Wide Web, has popularized DIL (Khalifa & Lam, 2002). In DIL, learning materials are presented as a website, i.e., a set of hyperlinked web pages. DIL enables learners to explore materials by interacting with a website. The interactive nature of websites makes such interactions similar to a conversation.

The notion of treating website-user interactions as conversations has been discussed by academics and practitioners (McKay, 2013; Nake & Grabowski, 2001; Sundar, 2007). In the field of system design, Nake and Grabowski (2001) proposed that human-computer interaction (HCI) can be treated as exchanges between two agents—specifically, between a user and a computer.

Reeves and Nass (1996) developed media equation theory on the basis of a meta-analysis on how people treat computers and media technologies in different contexts. According to the theory, people signal social responses and apply social rules to computers as if they are human, even if people are aware that they are interacting with a machine instead of other humans. In a recent study, Kim (2016) found that the same principle applies to Internet of Things devices.

A website presents a web page with content and hyperlinks that serve as a message to a visitor. The visitor responses by clicking a hyperlink. According to Sundar (2007), hyperlinks on the UI can be considered invitations for interacting with the website. In the context of a DIL website, the message exchange is a conversation-like interaction when a learner is browsing a website. Learners' interactions and experiences with a website involve signs. The UI of DIL websites presents materials and hyperlinks through various types of signs, such as icons, images, and language.

Learners on a DIL website browse the web pages through a dialogic process of message exchange. The exchange occurs through the UI, which involves various types of signs. The UI design of a DIL website can be viewed from a conversation perspective, and this idea bridges the literature on communication and UI design for the DIL environment. We drew on the literature regarding web survey invitations and conducted a laboratory experiment focusing on two UI features: the number of cues in hyperlink presentation and an indication of the website owner.

INVITATION TO INTERACT

A DIL website is a type of site that enables learners to explore (Khalifa & Lam, 2002). In most scenarios involving a DIL environment, learners

Table 1. Number Of Web Pages Visited By Participants In The Four Conditions

Power Status	Additional Cues	Mean	Standard Deviation
High	With	21.29	10.20
High	Without	13.44	4.68
Neutral	With	18.47	7.43
Neutral	Without	22.35	8.08

visit and interact with a website in the absence of an instructor. When viewing learner-website interactions as a conversation, DIL website design should encourage exploration. The hyperlinks on the UI of DIL websites can be considered invitations to explore (Sundar, 2007) that can appear in the form of a textual label, an image, or a summary. They are cues concerning the hyperlinked web page. Thus, the current study is focused on designing a hyperlink presentation to encourage learners' further exploration.

Designing invitations has attracted much interest from researchers, especially in the context of web surveys (Fan & Yan, 2010). Increasing survey response rate has been a major challenge for researchers. One key focus to address is the invitation design. Kaplowitz et al. (2012) conducted an institution-wide study to examine the effects of several design features of web survey invitations on the response rate. Long invitations are found to yield high response rates for staff and faculty samples. Their data revealed a similar trend among students, but the effect is insignificant. The authors suggested that this result may be due to the fact that long invitations effectively inform receivers, and receivers may clearly understand the survey in this way and may therefore respond to the invitations.

In a three-experiment study, Joinson and Reips (2007) sent email invitations to students of a UK university. By varying the greeting in the invitations, they found that a personalized salutation exerts a positive effect on the response rate. In their final experiment, the authors varied the greeting (personalized versus impersonal) and the sender's status (high status versus neutral). The sender's status was found to insignificantly affect the student response rate. However, the personalized salutation in an invitation from a sender with a high status was found in their sample to be the most effective.

The invitation design involves numerous design aspects. This condition also applies in UI design for DIL websites. In this study, we specifically focused on cues attached to hyperlinks and the website owner.

Number Of Cues For A Hyperlink And Website Owner

Regarding the presentation of hyperlinks on a website's UI, many design alternatives are available, such as images, text, and animation. We adopted the analogy of "a hyperlink as an invitation" to improve website design in a manner that prompts learners to respond to the invitation to interact, thereby encouraging them to explore further. As suggested by Kaplowitz et al. (2012), long invitations effectively inform receivers, thereby increasing the likelihood of a response. By considering this in the hyperlink design, the length of the invitation in hyperlink presentation is similar to the number of cues attached to hyperlinks. The cues provide additional descriptions of the content of the hyperlinked web pages through the hyperlink labels. Additional UI cues may effectively attract the attention of learners, and they may respond to the hyperlinks and thus explore further.

H1: Learners will explore more web pages when additional UI cues are attached to a hyperlink than when they are not.

As suggested by Joinson and Reips (2007), the sender of an invitation may influence the effects of other design aspects. In DIL websites, the sender of invitations (i.e., hyperlinks) is the website owner. On a typical website, the website owner is often indicated at the top of every web page by name or as a logo. Given that the DIL environment is online, learners are not confined to visiting DIL websites provided by their schools. They have the option to visit and explore other websites created by noneducational institutions. The current study did not focus on when and why learners select one DIL website over others; instead, we focused on whether and how website owners exert any encouraging effect through additional cues attached to hyperlinks. Joinson and Reips (2007) found that the power status of a website owner as shown on the UI may moderate the effect of hyperlinks. Specifically, a website owner with a high-power status has a positive influence on the additional cues for encouraging learners' exploration. Therefore, our second hypothesis is as follows:

H2: On a DIL website created by an organization with a high-power status, learners will explore more web pages when additional UI cues are attached to hyperlinks than when they are not.

The hypothesized interaction effect addresses learners' exploration on a DIL website. Examining whether this effect indirectly extends to learning outcomes is warranted.

RQ1: On a DIL website created by an organization with a high-power status, will additional UI cues attached to hyperlinks indirectly affect learning outcomes by affecting learners' exploration?

METHOD

We adopted a 2 (website owner power status: high versus neutral) × 2 (additional UI cues: with versus without) between-subject factorial design for our experiment, in which participants were asked to visit a website on healthy and balanced lifestyles. The participants were randomly assigned to one of the four experimental conditions.

Participants

We recruited 74 participants from a public university in Hong Kong. The participants were gifted supermarket cash coupons valued at HK$50 (approximately US$6.04) as an incentive. Informed consent was confirmed at the beginning of each session.

Stimulus Materials

The major stimulus of the experiment was a website with educational materials that addressed staying healthy, managing stress, and maintaining a social life. The website owner aspect was manipulated using different website titles, logos, and introductions. Under the high-power-status conditions, the title, logo, and introduction of the website were presented as if the university of the participants had created the website. Under the neutral-power-status conditions, the website owner was presented as a hypothetical company. We manipulated the UI cue by attaching additional textual cues to each hyperlink. The textual cues were descriptions of the hyperlinked web page. In addition to the hyperlink labels, the textual cues provided elaborated descriptions of the content of the hyperlinked web pages. Figure 1 displays the variations in the two manipulations by showing the condition with high-power status and additional UI cues and the condition with neutral power status without additional UI cues. The level of detail in the cues was not extensively high in order to keep the cues to a reasonable length.

The website contained 20 articles, each presented on a single web page. Each article provided advice on how to attain a healthy and balanced lifestyle. The website was devised with a dual-layered hierarchical information structure (Garrett, 2010). The 20 web pages were grouped under six sections. An overview page was available for each section. The home page presented an introduction and hyperlinks to the six overview pages. The website was in Chinese.

Dependent Measures

The amount of browsing by a participant was measured as the number of web pages visited. This parameter was recorded using a logging function in the software on the computer used in the experiment.

Memory recall entailed the following: After the participants visited the website, they were asked to fill in a paper questionnaire containing three open-ended questions. The three questions concerned the content in three of the six sections on the website. The participants were asked to provide responses to the three questions that were as detailed as possible. The answers were graded against the content on the experimental website by two independent graders. One grader was an undergraduate student hired as a student helper. The other grader was a research assistant who had an undergraduate qualification. We assessed interrater reliability by using a two-way mixed, consistency, average-measure intraclass correlation (ICC) (McGraw & Wong, 1996) to assess the degree to which the two graders were consistent in grading participant responses. The resulting ICC is in an excellent range (ICC = 0.96) (Cicchetti, 1994), indicating that the two graders have a high degree of agreement. This result also suggests that the responses receive similar grades from the graders and that the independent graders introduce a negligible amount of measurement error. The statistical power of the subsequent analyses is unlikely to be reduced substantially. For each participant, an average of the two scores by the two graders was considered. These scores were used in hypothesis testing.

Figure 1. (a) Home Page of the Website Under the High-Power-Status Condition with Additional UI Cues.(b) Home Page of the Website Under the Neutral-Power-Status Condition Without Additional UI Cues
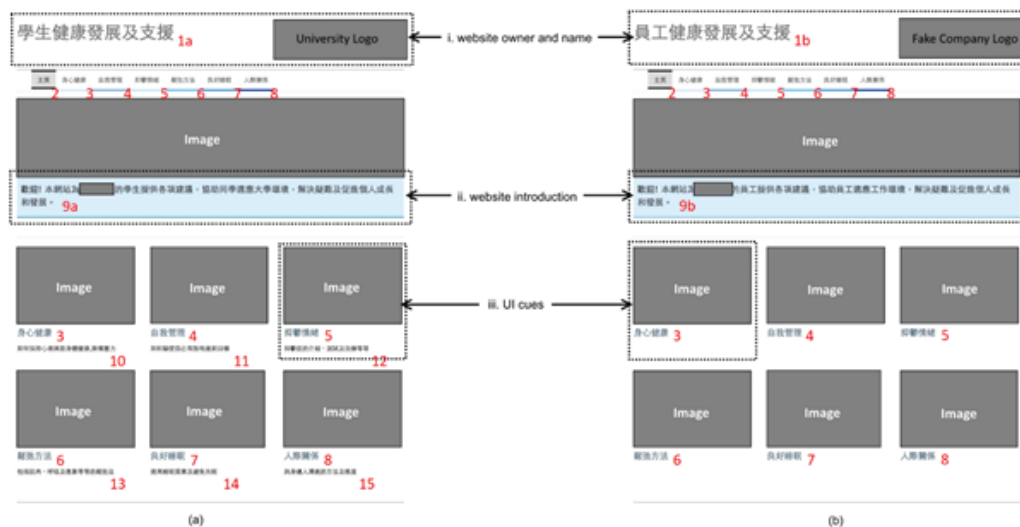
English translation of text on the figure − 1a: Student health development and support 1b: Staff health development and support 2: Homepage 3: Mental and physical health 4: Self-management 5: Depression 6: How to relax 7: Sleep well 8: Interpersonal relationships 9a: Welcome! This website offers various kinds of advice to students of [university name], to help them adapt to university environment, solve problems, and facilitate personal growth and development. 9b: Welcome! This website offers various kinds of advice to staff of [fake company name], to help them adapt to work environment, solve problems, and facilitate personal growth and development. 10: How to keep a healthy mind and body, be immune to stress 11: How to make yourself to achieve goals effectively 12: Introduction to depression, e.g., diagnosis and treatment 13: Ways to relax, including muscular, breathing, and imaginative 14: To enhance sleeping quality and avoid insomnia 15: Methods and attitudes to communicate with others

Notes:

i. The website owner logo and name were identical on every web page of the site.

ii. The website introduction appeared only on the home page.

iii. The UI cues were manipulated in every instance for this type of hyperlink appearing on the main body of a web page.

Procedure

The experiment was conducted in a laboratory setting. Upon arrival, each participant was briefed on the procedure and signed a consent form. The participant was then seated in front of a desktop computer with a 17-inch screen that displayed the instructions, which consisted of a description of the scenario (instructing them to browse a website freely) and an introduction to the website (according to the website owner conditions). Thereafter, the participant was shown the experimental website in an Internet Explorer browser window in full-screen mode. An exit hyperlink was positioned at the side margin of every web page. The participant was informed that upon completing a visit to the site, the exit hyperlink should be clicked. After the visit, he or she was administered a paper questionnaire for measuring memory recall. No time limit was set for responding to the questionnaire. Upon completing the questionnaire, the participant was debriefed.

RESULTS

We performed a two-way ANOVA on the number of pages visited. The main effect of additional UI cues was found to be insignificant (p = .28); thus, H1 was not supported. The interaction effect between additional UI cues and website owner status was found to be significant ($F_{(1, 70)}$ = 10.38, p < .005, w2 = .13). Specifically, on a website owned by an institution with a higher power status, participants visited more web pages when they were exposed exposed to additional UI cues (M = 21.29, SD = 10.20) than when the additional UI cues were absent (M = 13.44, SD = 4.68) (See Table 1 and Figure 2). On the basis of the conditional analysis detailed in Hayes (2013), the conditional effect of additional UI cues under high-power status was
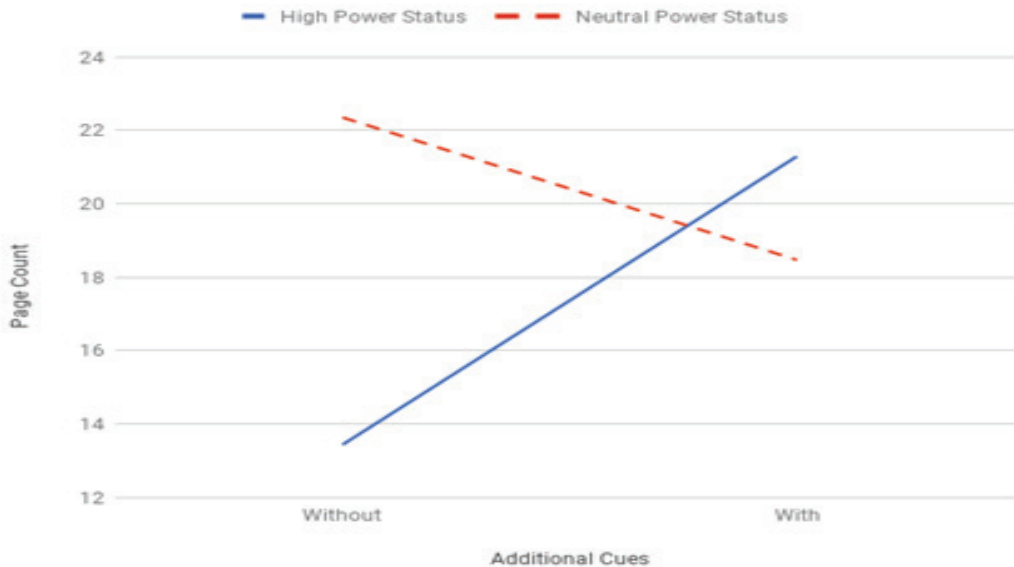
Figure 2. A Chart Showing the Interaction of Additional Cues and Power Status.

significant (p < .005) and H2 was supported. On a website owned by an institution with a neutral power status, participants visited fewer web pages when additional UI cues were present (M = 18.47, SD = 7.43) than when they were not (M = 22.35, SD = 8.08). A conditional effect of additional UI cues under neutral power status was not significant.

RQ1 addresses whether the amount of browsing mediates the effect of additional UI cues on memory recall under the moderating effect of website owner status. On the basis of the conditional process analysis detailed by Hayes (2013), we found that when the website owner has a higher power status, additional UI cues indirectly affect memory recall via its effect on the number of web pages visited. The conditional indirect effect was estimated to be 2.33, with a 95% bias-corrected confidence interval (CI), excluding zero (from .43 to 6.06), on the basis of 10,000 bootstrap samples. By adding UI cues to a website owned by an institution with a higher power status, the participants visited 7.85 more web pages on average. For each web page increase, .30 more correct answers on average were provided in the memory recall task. The conditional, indirect effect when the website owner had a neutral power status was insignificant. The conditional, indirect effect was estimated to be −1.15 with a 95% bias-corrected CI, including zero (from −3.71 to .07), on the basis of 10,000 bootstrap samples. The difference in indirect effects under different website owner conditions was estimated to be 3.48 with a 95% bias-corrected CI, excluding zero (from .71 to 8.59), on the basis of 10,000 bootstrap samples. This finding indicates that additional UI cues exert a significant indirect effect on memory recall by affecting the amount of browsing when the website owner has a higher power status. Furthermore, the power status of the website owner was found to influence such mediation effects in a statistically significant level.

DISCUSSION

This experiment aimed to examine the effect of two UI features, namely, cues attached to hyperlink presentation and the indication of the website owner, on learners' exploration and memory recall. The results reveal that additional UI cues in the presentation of hyperlinks of a DIL website enhance learners' exploration if the website is indicated to be owned by an organization with a high-power status. The status of website owners moderates the effect of additional UI cues for encouraging exploration. The enhanced exploration also increases learners' memory recall of the website content. The findings have theoretical and practical implications.

Website as Tool, Sign, and Instructor

In our study, we raised the question of how websites can be conceptualized based on constructivist learning. Websites can act as tools, signs, or even instructors. The results of our study reveal that the design of a website influences

learners' utilization (i.e., web browsing behavior) and indirectly affects their cognitive function as reflected in the learning outcome. Websites share the characteristics of tools and signs.

The interaction effect between the invitations and the power status of a website owner implies that the DIL website plays the role of an instructor. In the constructivist literature, social interactions within a cultural context are essential to learning and dialogue with the people around learners, especially instructors, is emphasized. Our results show that, even in instances of learners using a DIL website, the website design influences the dialogue (i.e., interactions) and the learning outcome. As implied by the results, how a DIL website invites learners to engage in conversation on every web page influences their exploration if the website is created by someone perceived to hold a high-power status. This finding is consistent with the view of a DIL website as an instructor. In a website-as-instructor perspective, the finding suggests that an "instructor" (a DIL website) with high-power status can encourage students to explore more and thus increase students' learning. Our results are insufficient to draw a conclusion regarding the role of the website in the constructivist framework. However, DIL websites naturally play the combined role of tools, signs, and instructors. The different natures of websites may be considered in future research.

UI of Learning Technologies

This study sheds light on UI design research for web-based learning and other learning technologies. The experimental results demonstrate that the UI of learning technologies can be conceptualized as messages sent to learners. In our particular case, the message is an invitation to interact with the website. For other technologies developed for learning in different contexts, the UI can be conceptualized for different types of messages. The automatic mathematics evaluation system by Pacheco-Venegas, López, & Andrade-Aréchiga, (2015) provides objective feedback (correct/incorrect/solved) to student on their answers to mathematics questions. If the UI is treated as an encouraging message, then certain relatively emotional phrases can be included, such as "Correct. Well done!" "Incorrect. Don't give up. Give it another try!" and "Solved. Not bad!"

Research on websites in a learning environment is multidisciplinary. In the present study, we also considered the communication perspective. We drew on the media equation theory of Reeves and Nass (1996) and the concept of message interactivity of Sundar (2007) to guide our study, which demonstrates the possibility that DIL websites should be examined from multiple perspectives with theories from different disciplines.

Hyperlink On Website UI As Motivation

The current study points to a research direction on hyperlink design for motivating students. The hyperlink design on UI is a subtle aspect of a website that may be overlooked by educators who often use the default template of a website and the attached hyperlink design. The current study demonstrates that the UI of a website can be a motivating factor to encourage students to engage themselves with web-based DIL environment in an appropriate condition. Motivating students is a challenging task, especially when students are often on their own when they visit a DIL website.

The cost of updating the hyperlink design on a website UI is relatively low when compared to printed materials. This aspect should be considered by DIL website designers and educators to motivate their target learners.

Future research should investigate different design aspects of website UI. Researchers can derive design principles for educators using DIL websites to improve the UI of their website to motivate their students.

Interactions With DIL Websites As Conversations

The current study also demonstrates that interacting with a DIL website is similar to having a conversation. The remote nature of DIL websites allows learners to access learning materials regardless of their location. The drawback is that learners are alone with the DIL websites. The current findings show that students can have a "conversation" with an agent (a DIL website) that presents learning materials when they are alone and have Internet access. Furthermore, if the hyperlink design contains sufficient information and the website owner has a high-power status, then the students can be encouraged to "converse" and expose themselves to additional learning materials.

Indication Of The Website Owner

As long as learners can connect to the Web, they obtain access to various websites that may

contain materials that warrant learning. The results reveal that indicating the website owner moderates the effect of UI cues. Whether the power status of a website owner, as indicated on the UI, increases learners' willingness to explore is still understudied. In learner-website interactions, the power status of the website owner may also play a role in such conversations. Thus, obedience to authority (Milgram, 1974; Blass, 2000) may occur in the usage of DIL websites. The power status of a website owner should be considered carefully when studying UI features for various educational purposes. This factor may moderate the effects of any feature on a UI. Our study was conducted in a laboratory setting, where participants were presented with a website instead of searching for a website according to their individual interests. Future research should examine the moderating effect of the website owner in everyday settings.

Power is an interesting aspect that is seldom discussed in constructivist learning. In a constructivist perspective, the learners play an active role. DIL environment allows them to access and explore learning materials freely. The learners have the freedom and power to browse. The effect of the website owner's power is supposedly minimal. However, the current result suggests that the indication of power status of a DIL website owner can influence the learners' exploratory behavior. Examining if this effect still exists in real-world settings where learners are by themselves without any being observed would be interesting.

Implications For UI Designers

Regarding UI designers, our study provides another example in which interactions between humans and computers can be viewed as communication. Specifically, hyperlinks on a UI can be considered invitations, which can be an innovative perspective for designing a UI. Other design aspects can also be drawn from the invitation design. For example, the estimated completion time (Kaplowitz et al., 2012) can be translated as the estimated effort and time required to finish reading a web page or watching a web-based video. Personalized invitations can become personalized messages attached to hyperlinks (Fan & Yan, 2010).

Implication For Educators

The result of our study suggests that additional UI cues encourage learners to explore web pages if the website owner is of high-power status. In an actual situation, the website owner is fixed and is typically the educational institution. To ensure that the high-power status is prominent, educators can consider presenting the image of a person with high-power status in the content such as the program director of the course the learners have enrolled in. Regarding the additional UI cues, educators can consider textual cues that elaborate the hyperlink labels. They can be a summary of content on the hyperlinked web pages or the reasons why the content might be relevant to the learners. These cues provide the learners reasons why they should click the hyperlinks and explore the content.

CONCLUSION

Our study is subject to limitations. We conducted the laboratory experiment in a controlled environment to examine the causality between the UI and exploration. However, this approach may have limited the generalization potential of the findings. Future research should focus on such relationships in everyday settings. In our experiment, only the number of cues for hyperlink presentation was manipulated to show that hyperlinks can be conceptualized as invitations. Many aspects of the invitation design can be drawn on for this design practice within the context of DIL websites in the future. We assumed that learners use desktop or laptop computers to access DIL websites. However, learners at various levels commonly use their mobile devices to access learning materials (Cheon, Lee, Crooks, & Song, 2012; Jones, Scanlon, & Clough, 2013). The UI may need to be designed for a wide range of screen sizes and devices. Learners' website interactions on mobile devices can potentially be conceptualized as conversations as well. This topic can be explored in the future.

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