Exploring the Validity of an Instrument to Measure the Perceived Quality in Use of Web 2.0 Applications with Educational Potential

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Abstract. The aim of the work presented in this paper was to examine to what extent the subjective measuring instrument supports the assessment of all relevant facets of the quality in use in the context of Web 2.0 applications. For that purpose, two scenario-based studies were conducted. In both studies users were observed during their interactions with two Web 2.0 applications that are widely used in educational settings. Data analysis has verified the validity of the post-use questionnaire at various levels of the conceptual model. Findings of empirical studies together with implications for researchers and practitioners are presented and discussed.

Keywords: Web 2.0 Applications, Perceived Quality in Use, Post-use Questionnaire, Empirical Findings.

1 Introduction

Web 2.0 [19] refers to the novel generation of web applications which enable users to actively participate in the development of online resources. The support for different kinds of interaction among users has found its application in numerous fields including education. Under the influence of social and technological trends, the traditional forms of computer-supported learning have evolved into e-learning 2.0 [6]. The implementation of Web 2.0 applications into educational ecosystem brings lots of advantages for both teachers (in terms of enhanced communication with students and facilitated monitoring of their progress) and students (through the development of personal learning environments and educational artefacts that are adapted to their learning styles) [14]. Drawing on harnessing the power of the crowd and network effects, Web 2.0 applications encourage the development of innovative pedagogical

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approaches that have the potential to improve students' educational experiences [22]. In addition, Bennett et al. [1] stated that content creation and sharing by means of Web 2.0 applications results in learning benefits for students. Finally, Den Exter et al. [5] emphasized that Web 2.0 applications due to their flexibility and ease of use offer various learning opportunities for distance education students. In order to gain benefits from the implementation of technology into learning process, special attention should be paid to finding and selecting applications with sufficient level of educational potential. In that respect, Orehovački et al. [15] developed a taxonomy of Web 2.0 applications which consist of following three dimensions: the type of Web 2.0 application, their function, and cognitive processes that are part of the revised Bloom's taxonomy. Although Web 2.0 applications are widely employed in various fields of education, sound measuring instrument meant for subjective assessment of their quality in use is still not available. The set forth motivated us to initiate a research on the development of a post-use questionnaire that would enable the evaluation of the perceived quality in use of Web 2.0 applications. The remainder of the paper is structured as follows. Next section offers a brief literature review together with the description of an enhanced version of the conceptual model. Details on employed research methodology are provided in the third section. Findings of two experimental studies are presented in the fourth section. Conclusions and future research directions are contained in the last section.

2 Background to the Research

2.1 Literature Review

Recent research related to the assessment of Web 2.0 applications was predominantly focused on exploring diverse aspects of quality, usability, quality in use, and adoption. For instance, Bubaš et al. [2] created a post-use questionnaire meant for evaluating navigability, ease of use, understandability, and reliability of Web 2.0 applications with educational potential. Sassano et al. [21] suggested the extension of the software quality model that was introduced in international standard ISO/IEC 25010 [10] with a characteristic that would enable the assessment of content accuracy, suitability, accessibility, and legal compliance. As a result of an in-depth literature review on website evaluation, Pang et al. [20] proposed a set of five first-order and twenty-five second-order dimensions meant for measuring the quality of Web 2.0 applications. Orehovački and Žajdela Hrustek [18] designed an online questionnaire that enables the assessment of six technical and five pedagogical usability aspects of educational artifacts created with Web 2.0 applications. García-Martín and García-Sánchez [8] found that gender, educational level, and age define patterns of Web 2.0 applications use. Hartshorne and Ajjan [9] revealed that students' attitudes and subjective norms significantly influence their decisions to adopt Web 2.0 applications. Finally, Dwivedi et al. [7] discovered that usefulness and ease of use are strong predictors of users' intentions to adopt Web 2.0 applications. Our journey to the comprehensive methodology that would enable the evaluation of all relevant aspects of the quality in use of Web 2.0 applications started with the initial set of attributes

which significantly contribute to the success of Web 2.0 applications [13]. As a follow up, a conceptual model and measuring instruments that support the assessment of Web 2.0 applications from both subjective and objective perspective were developed [11]. The psychometric characteristics of the aforementioned model and measuring instruments were validated on the representative sample of Web 2.0 applications meant for collaborative writing [12], mind mapping [17], and diagramming [16]. Since the outcomes of the set forth studies have suggested that the model and the post-use questionnaire do not encompass all relevant dimensions of the quality in use of Web 2.0 applications, they were both revised.

2.2 Novel Categorization of Quality in Use Attributes

The enhanced version of the conceptual model is comprised of six categories which are further decomposed into 43 quality in use attributes. System quality refers to attributes that measure the extent to which Web 2.0 application: provides various navigation mechanisms (navigability); has uniform interface structure, design, and terminology (consistency); is similar to previously used applications (familiarity); can be customized to meet users' needs (customizability); has implemented mechanisms that protect created artefacts from unauthorized use (security); operates properly with different types of devices and among different environments (compatibility); can exchange files with other applications and use files that were exchanged (interoperability); offers accurate and efficient internal search engine (searchability). Service quality relates to attributes aimed for evaluating the degree to which Web 2.0 application: provides various forms of help to users (helpfulness); is available every time users need it (availability); facilitates management of created artefacts (artefacts management); contains mechanisms that prevent errors to emerge (error prevention); is dependable, stable, and bug-free (reliability); can quickly recover from errors and operational interruptions (recoverability); notifies users with appropriate and useful messages (feedback); supports teamwork and data sharing (collaborativity); enables different types of communication among users (communicativity).

Content quality consists of attributes meant for the assessment of the extent to which artefacts created by means of the Web 2.0 application are: error-free, valid, and precise (correctness); complete, displayed clearly, and appropriately represented (coverage); unbiased, trustworthy, and verifiable (credibility); supplementable, modifiable, and updatable (timeliness); advantageous and impact users' decisions (value-added). Performance refers to attributes that measure the extent to which the use of Web 2.0 application: enables users to execute tasks accurately and completely (effectiveness); enables users to quickly perform tasks (efficiency); responds promptly to users' actions (responsiveness); is capable to operate under an increased or expanding workload (scalability); is usable within and beyond initially intended contexts of use (context coverage).

Effort relates to attributes dealing with the evaluation of the degree to which: the interaction with Web 2.0 application requires small amount of keyboard and mouse usage (minimal action); the use of Web 2.0 application requires small amount of mental and perceptive activities (minimal memory load); Web 2.0 application is

usable to people with the widest range of characteristics and capabilities (accessibility); users have full freedom in executing tasks by means of the Web 2.0 application (controllability); is simple to operate the Web 2.0 application (ease of use); is easy to become proficient in interacting with the Web 2.0 application (learnability); is simple to memorize how the Web 2.0 application is used (memorability); the interaction with Web 2.0 application is unambiguous (understandability). Acceptability refers to attributes meant for measuring the extent to which: the Web 2.0 application has visually appealing user interface (aesthetics); the Web 2.0 application is beneficial in the context of tasks execution (usefulness); the interaction with the Web 2.0 application holds the users' attention and stimulates their imagination (playfulness); users have positive perception about the use of Web 2.0 application (attitude towards use); the Web 2.0 application has met users' expectations (satisfaction); the Web 2.0 application arouses users' emotional responses (pleasure); the Web 2.0 application is distinctive among applications with the same purpose (uniqueness); users have the intention to continue to use the Web 2.0 application and recommend it to others (loyalty).

3 Methodology

The aim of this paper is to examine the validity of the enhanced version of subjective measuring instrument. For that purpose, two studies were carried out. In the first study, the participants were observed during their interactions with two Web 2.0 applications aimed for collaborative writing (Zoho Writer and Microsoft Word Web App), and in the second with two Web 2.0 applications meant for mind mapping (Mindomo and Wise Mapping). The reason why we have selected these two types of Web 2.0 applications as a representative sample in our research relies on the fact that there are a number of examples how they can be employed in educational settings (for more information see e.g. [3], [15], and [23]). Research subjects in both studies were students from three Croatian higher education institutions. Both studies adopted a repeated measures design comparing evaluated Web 2.0 applications that have the same purpose. Studies were conducted during winter semester of the academic year 2012/2013. To ensure accuracy of the collected data, students were given detailed oral and written instructions related to the implementation of the study in which they were involved. Firstly, students had to complete predefined scenario that was composed of representative assignments (45 in the case of Web 2.0 applications meant for collaborative writing and 43 in the context of Web 2.0 applications aimed for mind mapping). After students have completed the scenario with both Web 2.0 applications, they were asked to fill out the post-use questionnaire and in that way evaluate diverse facets of their quality in use. The questionnaire consisted of 244 statements where each quality in use attribute was assessed with between 3 reflective items and 16 formative indicators. The responses were modulated on a five-point Likert scale (1 – strongly agree, 5 – strongly disagree). A sum of responses yielded a single number that represents a composite measure of the perceived quality in use of evaluated Web 2.0 applications at different levels of granularity in the conceptual

model. The findings extracted from the conducted empirical studies are presented and discussed in more detail in the following section.

4 Results

In order to examine differences between evaluated Web 2.0 applications, Wilcoxon Signed-Rank Tests were applied. The reason why we have employed this non-parametric equivalent of the dependent t-test is because results of Shapiro-Wilk Tests revealed that at least one of the variables in a pairwise comparison significantly deviates from a normal distribution ($p < .05$). Consequently, all the reported results are expressed as the median values.

4.1 First study

Participants. A total of 209 respondents were involved in the first study. The sample was composed of 62.68% male and 37.32% female participants. Most of them (44.98%) were students at Polytechnic of Rijeka, 43.54% were enrolled in Faculty of Organization and Informatics in Varaždin while 11.48% of them studied at Faculty of Economics in Split. At the time when the study was carried out, the majority of participants (45%) were first-year undergraduate students. They ranged in age from 18 to 30 years ($M = 20.18$, $SD = 1.594$). More than half of respondents (62.68%) had at least good knowledge of using Web 2.0 applications. All study participants had been loyal users of the social networking site Facebook and video podcasting service YouTube (73.21% and 67.47%, respectively, used those applications at least between once to twice a day).

Findings. The participants perceived the overall quality in use of Zoho Writer ($Mdn = 587$) as significantly higher ($Z = -4.934$, $p = .000$, $r = -.24$) than those of Microsoft Word Web App ($Mdn = 622$). More specifically, it appeared that Microsoft Word Web App ($Mdn = 159$) has significantly lower level of the perceived system quality ($Z = -2.290$, $p < .05$, $r = -.11$) than Zoho Writer ($Mdn = 152$). The analysis of collected data also revealed that Zoho Writer ($Mdn = 32$) has significantly better navigation mechanisms ($Z = -2.336$, $p < .05$, $r = -.11$) than Microsoft Word Web App ($Mdn = 34$). On the other hand, results of the analysis indicate that Microsoft Word Web App ($Mdn = 11$) has significantly less consistent structure and design of interface elements ($Z = -2.210$, $p < .05$, $r = -.11$) than Zoho Writer ($Mdn = 10$). Pairwise comparisons discovered that users perceived interaction with Microsoft Word Web App ($Mdn = 10$) as significantly more similar to previously used applications ($Z = -2.834$, $p < .01$, $r = -.14$) than interaction with Zoho Writer ($Mdn = 11$). Wilcoxon signed ranks test implies that Zoho Writer ($Mdn = 27$) can be customized to suit users' needs to the significantly higher degree ($Z = -2.725$, $p < .01$, $r = -.13$) than Microsoft Word Web App ($Mdn = 28$). Compared to Zoho Writer ($Mdn = 40$), Microsoft Word Web App ($Mdn = 39$) has significantly better mechanisms aimed for protecting created artefacts from unauthorized use ($Z = -4.651$, $p < .001$,

r = -.23). The evaluated Web 2.0 applications (Mdn = 12) do not differ significantly (Z = -.915, p = .360) in terms of their operating in diverse browsers and at different devices. However, Wilcoxon signed ranks test indicates that search engine implemented in Microsoft Word Web App (Mdn = 13) is significantly less accurate and efficient (Z = -3.698, p = .000, r = -.18) than those integrated in Zoho Writer (Mdn = 11). Concerning the quality of artefacts being exchanged with other desktop, web, or mobile applications, Zoho Writer (Mdn = 8) presents significantly better solution (Z = -7.875, p = .000, r = -.39) than Microsoft Word Web App (Mdn = 11).

The perceived service quality of Zoho Writer (Mdn = 141) is significantly higher (Z = -7.110, p = .000, r = -.35) than those of Microsoft Word Web App (Mdn = 153). According to the results of data analysis, the quality of help resources provided by Microsoft Word Web App (Mdn = 18) is significantly lower (Z = -3.735, p < .001, r = -.18) than those offered by Zoho Writer (Mdn = 16). In addition, it appeared that Zoho Writer (Mdn = 14) is significantly more readily available to users (Z = -5.629, p = .000, r = -.28) than Microsoft Word Web App (Mdn = 16). Microsoft Word Web App (Mdn = 40) provides significantly less functionalities that facilitate management of created artefacts (Z = -4.907, p = .000, r = -.24) than Zoho Writer (Mdn = 38) offers. There was no significant difference between Web 2.0 applications meant for collaborative writing (Mdn = 9) in terms of the quality of mechanisms that prevent users from committing errors (Z = -.264, p = .792). On contrary, Zoho Writer (Mdn = 9) has significantly less bugs (Z = -2.518, p < .05, r = -.12) than Microsoft Word Web App (Mdn = 10). Furthermore, Microsoft Word Web App (Mdn = 11) is significantly less successful in recovering from errors (Z = -3.294, p = .001, r = -.16) than Zoho Writer (Mdn = 10). Nevertheless, the quality of displayed messages was not significantly affected by the Web 2.0 application (Mdn = 20) that was used while performing steps of the scenario (Z = -1.180, p = .238). Finally, Zoho Writer (Mdn = 18 and 8, respectively) offers significantly better support for teamwork (Z = -5.133, p = .000, r = -.25) and communication (Z = -7.586, p = .000, r = -.37) among users than Microsoft Word Web App (Mdn = 19 and 9, respectively) does.

According to the results of data analysis, quality of artefacts created with Zoho Writer (Mdn = 50) is significantly higher (Z = -3.025, p < .005, r = -.15) than quality of artefacts generated by means of Microsoft Word Web App (Mdn = 50). Artefacts created by employing Microsoft Word Web App (Mdn = 13) are significantly less accurate (Z = -2.141, p < .05, r = -.10) than artefacts derived from the use of Zoho Writer (Mdn = 13). However, there was no significant difference between evaluated Web 2.0 applications (Mdn = 8 and 13, respectively) in terms of completeness (Z = -1.485, p = .137) and credibility (Z = -1.042, p = .298) of generated artefacts. The quality of user interface functionalities for altering created artefacts was significantly higher (Z = -2.175, p < .05, r = -.11) in the case of Zoho Writer (Mdn = 4) than in the context of Microsoft Word Web App (Mdn = 5). Finally, artefacts created by means of Microsoft Word Web App (Mdn = 10) are significantly less advantageous (Z = -2.207, p < .05, r = -.11) than artefacts generated with Zoho Writer (Mdn = 10).

Results of the analysis indicate that interaction with Microsoft Word Web App (Mdn = 54) enhances users' performance in executing task to significantly lower extent (Z = -5.077, p = .000, r = -.25) than the use of Zoho Writer (Mdn = 50) does.

Namely, when interacting with Zoho Writer (Mdn = 12), users are significantly more effective in executing tasks (Z = -6.584, p = .000, r = -.32) than when they are using Microsoft Word Web App (Mdn = 15). On the other hand, results of data analysis imply that evaluated Web 2.0 applications for collaborative writing (Mdn = 10) do not differ significantly from the perspective of users' efficiency in completing the scenario (Z = -.006, p = .238). Microsoft Word Web App (Mdn = 10) is significantly slower in responding to users' actions (Z = -3.348, p = .001, r = -.16) than Zoho Writer (Mdn = 9). In addition, Zoho Writer (Mdn = 9) has significantly higher level of scalability (Z = -5.419, p = .000, r = -.27) than Microsoft Word Web App (Mdn = 11). Finally, there is no significant difference (Z = -.941, p = .346) between Zoho Writer (Mdn = 9) and Microsoft Word Web App (Mdn = 10) regarding the flexibility in the scope of their use.

The analysis of collected data suggests that Zoho Writer (Mdn = 80) and Microsoft Word Web App (Mdn = 81) do not differ significantly in terms of the overall perceived effort needed for the completion of the scenario steps (Z = -1.480, p = .139). Although there was no significant difference between evaluated Web 2.0 applications (Mdn = 12) in terms of the amount of mental effort required to execute steps of the scenario (Z = -1.910, p = .056), users reported that they had to invest significantly more physical effort to complete the scenario (Z = -2.044, p < .05, r = -.10) when they used Microsoft Word Web App (Mdn = 10) than when they applied Zoho Writer (Mdn = 10). Results of data analysis also revealed that Zoho Writer (Mdn = 17) is significantly more accessible to users with different capabilities and characteristics (Z = -2.676, p < .01, r = -.13) than Microsoft Word Web App (Mdn = 18). Furthermore, it was discovered that users have significantly less freedom (Z = -2.084, p < .005, r = -.10) in interaction with Microsoft Word Web App (Mdn = 7) than when they use Zoho Writer (Mdn = 6). Besides, it is significantly easier to memorize (Z = -2.944, p < .005, r = -.14) how to use Microsoft Word Web App (Mdn = 6) than to remember where interface functionalities of Zoho Writer (Mdn = 6) are located. Nevertheless, there is no significant difference between Zoho Writer (Mdn = 11, 8, and 8, respectively) and Microsoft Word Web App (Mdn = 10, 8, and 8, respectively) in terms of their ease of use (Z = -.927, p = .354), learnability (Z = -.796, p = .354), and understandability (Z = -1.086, p = .278). According to the results of gathered data, Zoho Writer (Mdn = 113) has significantly higher level of perceived acceptability (Z = -3.539, p = .000, r = -.17) than Microsoft Word Web App (Mdn = 117). No significant difference was found between evaluated Web 2.0 applications (Mdn = 11) in terms of the user interface attractiveness (Z = -.093, p = .926). However, Microsoft Word Web App (Mdn = 14) was perceived by users as less beneficial Web 2.0 application for completion of scenario tasks (Z = -4.998, p = .000, r = -.24) than Zoho Writer (Mdn = 13). In addition, there was no significant difference between Web 2.0 applications aimed for collaborative writing (Mdn = 18) in terms of their playfulness (Z = -1.540, p = .124). It was also found that users have a significantly more positive attitude (Z = -3.558, p = .000, r = -.17) towards using Zoho Writer (Mdn = 11) than towards the interaction with Microsoft Word Web App (Mdn = 12). Besides, participants reported that Zoho Writer (Mdn = 12) made significantly better impression on them (Z = -4.601, p = .000, r = -.23) than Microsoft

Word Web App (Mdn = 14) did. However, the level of pleasure perceived by respondents do not differ significantly between evaluated Web 2.0 applications for collaborative writing (Mdn = 12, Z = -1.507, p = .132). Results of data analysis also uncovered that Microsoft Word Web App (Mdn = 12) is significantly less distinctive among web application with the same purpose (Z = -3.067, p < .005, r = -.15) than Zoho Writer (Mdn = 12). Finally, significantly more participants (Z = -2.826, p = .005, r = -.14) is willing to continue to use Zoho Writer (Mdn = 20) than to employ Microsoft Word Web App (Mdn = 22) regularly.

4.2 Second Study

Participants. A total of 213 respondents (61.03% male, 38.97% female), aged 20.18 years (SD = 1.627) on average, took part in the second study. All of them had been using Facebook and YouTube on a regular basis (75.58% and 70.42%, respectively, had been using those popular Web 2.0 applications at least between once and twice a day). More than half of students (62.91%) reported that they have at least good knowledge of using Web 2.0 applications. At the time the study took place, the majority of participants (44.60%) were first-year undergraduate students. Most of them (45.07%) studied at Polytechnic of Rijeka, 42.72% were enrolled in Faculty of Organization and Informatics in Varaždin while 12.21% of them were students at Faculty of Economics in Split.

Findings. According to the results of data analysis, Mindomo (Mdn = 552) has significantly higher (Z = -11.812, p = .000, r = -.57) level of the perceived quality in use than Wise Mapping (Mdn = 635). More specifically, it appeared that the system quality of Wise Mapping (Mdn = 170) was perceived as significantly lower (Z = -9.948, p = .000, r = -.48) than those of Mindomo (Mdn = 155). It was also found that navigational mechanisms offered by Mindomo (Mdn = 32) are significantly better organized and deployed (Z = -7.309, p = .000, r = -.35) than those provided by Wise Mapping (Mdn = 34). Moreover, participants reported that Wise Mapping (Mdn = 11) employs significantly less uniform interface functionalities, design, and terminology (Z = -6.036, p = .000, r = -.29) than Mindomo (Mdn = 10) does. In addition, data analysis uncovered that Mindomo (Mdn = 11) is significantly more similar to web applications respondents normally use (Z = -4.031, p = .000, r = -.20) than Wise Mapping (Mdn = 12). Besides, Wise Mapping (Mdn = 30) is significantly less customizable (Z = -10.158, p = .000, r = -.49) than Mindomo (Mdn = 26). However, Web 2.0 applications meant for mind mapping (Mdn = 42) do not differ significantly in terms of the quality of mechanisms that protect security of created artefacts (Z = -.699, p = .485). Results of data analysis indicate that Mindomo (Mdn = 13) is significantly more compatible with diverse web browsers and devices that can be connected to the Internet (Z = -4.920, p = .000, r = -.24) than Wise Mapping (Mdn = 13). In the context of the support for the exchange of created artefacts and quality of artefacts that have been exchanged, Mindomo (Mdn = 8) presents significantly better solution (Z = -5.111, p = .000, r = -.25) than Wise Mapping (Mdn = 10). Search

results provided by internal search engine implemented in Wise Mapping (Mdn = 15) are significantly less accurate and relevant (Z = -7.751, p = .000, r = -.38) than those of internal search engine integrated in Mindomo (Mdn = 11).

Results of data analysis suggest that Mindomo (Mdn = 137) has significantly higher degree of perceived service quality (Z = -11.554, p = .000, r = -.56) than Wise Mapping (Mdn = 160). Namely, help resources that are implemented in Wise Mapping (Mdn = 21) are of significantly lower quality (Z = -9.135, p = .000, r = -.44) than those integrated in Mindomo (Mdn = 16). In addition, Mindomo (Mdn = 14) has significantly higher level of perceived availability (Z = -6.994, p = .000, r = -.34) than Wise Mapping (Mdn = 16). On the other hand, Wise Mapping (Mdn = 41) contains significantly less functionalities meant for artefacts management (Z = -8.692, p = .000, r = -.42) than Mindomo (Mdn = 36). The quality of functionalities that disable users from committing errors is significantly higher (Z = -4.856, p = .000, r = -.24) in the case of Mindomo (Mdn = 8) than in the context of Wise Mapping (Mdn = 9). Drawing on the results of data analysis, Wise Mapping (Mdn = 9) is significantly less dependable and stable mind mapping Web 2.0 application (Z = -3.779, p = .000, r = -.18) than Mindomo (Mdn = 8). It was also discovered that Mindomo (Mdn = 8) is significantly more efficient and effective in recovering from errors and operational interruptions (Z = -5.320, p = .000, r = -.26) than Wise Mapping (Mdn = 9). Besides, messages displayed by Wise Mapping (Mdn = 22) are significantly less useful and precise (Z = -5.791, p = .000, r = -.28) than messages shown by Mindomo (Mdn = 20). Finally, analysis of collected data revealed that Mindomo (Mdn = 17 and 8, respectively) provides better support for collaboration (Z = -8.413, p = .000, r = -.41) and communication (Z = -9.876, p = .000, r = -.48) among users than Wise Mapping (Mdn = 19 and 12, respectively) does. The quality of mind maps created by means of Mindomo (Mdn = 48) is significantly better (Z = -7.628, p = .000, r = -.22) than quality of mind maps generated with Wise Mapping (Mdn = 51). Artefacts derived from the use of Wise Mapping (Mdn = 13, 8, 13, 4, and 10, respectively) are significantly less correct (Z = -4.591, p = .000, r = -.22), complete (Z = -6.413, p = .000, r = -.31), trustworthy (Z = -5.106, p = .000, r = -.25), modifiable (Z = -3.426, p = .001, r = -.17), and beneficial (Z = -5.311, p = .000, r = -.26) than those generated by means of Mindomo (Mdn = 12, 8, 12, 4, and 10, respectively).

Results of data analysis indicate that users' performance in completing tasks is significantly lower (Z = -6.699, p = .000, r = -.32) when they use Wise Mapping (Mdn = 52) than when they employ Mindomo (Mdn = 48) for the same purpose. It was also found that interaction with Mindomo (Mdn = 10) enhances users' effectiveness in generating mind maps to significantly greater extent (Z = -7.167, p = .000, r = -.37) than the use of Wise Mapping (Mdn = 12) does. When interacting with Mindomo (Mdn = 9), users can complete tasks significantly much quicker (Z = -5.052, p = .000, r = -.24) than when they apply Wise Mapping (Mdn = 10). The perceived responsiveness of Wise Mapping (Mdn = 9) to users' actions is significantly lower (Z = -2.822, p = .005, r = -.14) than those of Mindomo (Mdn = 8). Nevertheless, Web 2.0 applications (Mdn = 11) aimed for mind mapping do not differ significantly in terms of their capability to retain performance under an increased workload (Z = -1.332, p = .183). Finally, the analysis of collected data revealed that

Mindomo (Mdn = 10) has significantly wider range of uses (Z = -5.529, p = .000, r = -.27) than Wise Mapping (Mdn = 10). Perceived overall effort needed for executing tasks is significantly higher (Z = -11.509, p = .000, r = -.56) in the case of Wise Mapping (Mdn = 83) than in the context of Mindomo (Mdn = 72). There was no significant difference between evaluated mind mapping Web 2.0 applications (Mdn = 10 and 12, respectively) in terms of perceived amount of physical (Z = -1.922, p = .055) and mental (Z = -.234, p = .815) effort needed to complete the scenario steps. On the other hand, it was found that Mindomo (Mdn = 15) is significantly more usable to users with diverse capabilities and characteristics (Z = -9.858, p = .000, r = -.48) than Wise Mapping (Mdn = 18). Furthermore, users stated that the way of carrying out tasks by means of Wise Mapping (Mdn = 7) is significantly less flexible (Z = -6.138, p = .000, r = -.30) than using Mindomo (Mdn = 6) for the same purpose. Results of data analysis also indicate that is significantly easier for users to operate (Z = -11.915, p = .000, r = -.58) Mindomo (Mdn = 8) than to execute tasks by means of Wise Mapping (Mdn = 11). Users reported that is significantly harder (Z = -4.453, p = .000, r = -.22) to become proficient in using Wise Mapping (Mdn = 8) than to learn how to use Mindomo (Mdn = 8). Besides, the analysis of collected data uncovered that is significantly easier (Z = -4.443, p = .000, r = -.22) to memorize how Mindomo (Mdn = 6) is used than to remember how to interact with Wise Mapping (Mdn = 6). Finally, interface functionalities provided by Wise Mapping (Mdn = 8) are significantly less comprehensible (Z = -5.504, p = .000, r = -.27) than those offered by Mindomo (Mdn = 8). Considering results of data analysis, Mindomo (Mdn = 96) is significantly better accepted by users (Z = -10.710, p = .000, r = -.52) than Wise Mapping (Mdn = 120). More specifically, interface design of Mindomo (Mdn = 9) is significantly more pleasant to the eye (Z = -10.537, p = .000, r = -.51) than those of Wise Mapping (Mdn = 15). Moreover, users believe that Wise Mapping (Mdn = 13) is significantly less advantageous in the context of creating mind maps (Z = -7.171, p = .000, r = -.35) than Mindomo (Mdn = 10). Respondents reported that using Mindomo (Mdn = 16) can successfully hold their attention for significantly longer period of time (Z = -7.380, p = .000, r = -.36) than interaction with Wise Mapping (Mdn = 18). Results of the analysis also imply that users have significantly less positive attitude (Z = -8.484, p = .000, r = -.41) towards using Wise Mapping (Mdn = 13) than towards interaction with Mindomo (Mdn = 11). Besides, Wise Mapping (Mdn = 14) has met users' expectations to significantly lower degree (Z = -8.387, p = .000, r = -.41) than Mindomo (Mdn = 10) has. Furthermore, users reported that they had significantly less fun (Z = -7.605, p = .000, r = -.37) when they have been creating mind maps with Wise Mapping (Mdn = 12) than when they have been using Mindomo (Mdn = 10) for the same purpose. Mindomo (Mdn = 9) is also significantly more unique among applications meant for mind mapping (Z = -8.980, p = .000, r = -.44) than Wise Mapping (Mdn = 12). Finally, significantly more respondents are willing to use Mindomo (Mdn = 17) frequently (Z = -8.040, p = .000, r = -.39) than to employ Wise Mapping (Mdn = 23) on regular basis.

5 Concluding Remarks

With an objective to examine the validity of the post-use questionnaire aimed for evaluating the quality in use of Web 2.0 applications, two empirical studies were carried out. The analysis of collected data uncovered statistically significant differences between evaluated Web 2.0 applications in both conducted studies. More specifically, composite measures which represent a sum of responses at different levels of granularity in the conceptual model have shown small (.10), medium (.30), and large (.50) effects in size (as proposed in [3]) which indicate that post-use questionnaire has a high level of validity and can be therefore employed for the assessment of all relevant aspects of the perceived quality in use of Web 2.0 applications. In that respect, the work presented in this paper provides implications for both researchers and practitioners. Given that proposed enhancement of the conceptual model adds to the current body of knowledge, researcher can use it as a framework for future advances in the context of evaluating the quality in use of Web 2.0 applications. On the other hand, practitioners can apply the post-use questionnaire to measure and improve the quality in use of Web 2.0 applications. Taking into account that reported findings are a constituent part of an ongoing research, our future work will be focused on the assessment of psychometric characteristics of the conceptual model that will reflect interplay among specified quality in use attributes.

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