

Usability of Micro-Credentialing Functionalities

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Abstract — In the last few years, micro-credentials have gained in importance and popularity as small, stockable and shareable (on social media) achievement recognitions. The beginnings have not been easy though. Micro-credentialing technologies in their infancy have shown many limitations including those related to usability, which may have even slowed down their adoption. The objective of this paper is to present some unpublished results of a study on the usability of a couple of micro-credentialing platforms from five years ago. On this basis, other studies available in literature have been searched for, analyzed, summarized and critically evaluated in order to get an insight into how usability of the given technologies has been addressed over time. Some common usability pitfalls and potentially promising approaches on how to recognize and avoid such pitfalls have been identified, analyzed and discussed. Accordingly, the results of this paper are beneficial to current and new adopters of micro-credentials, whether they are issuers, learners/candidates or technology developers.

I. INTRODUCTION

Traditional systems of assessing learners' knowledge and skills largely depend on grades and transcripts. Transcripts communicate learners' achievements and performances (e.g., points and/or grades) in specific subjects. However, conventional transcripts lack criteria that are used for awarding grades or categories for a learner's achievement as well as evidence of the learner's achievement [1][2]. Moreover, they are not shareable via digital media nor interoperable among educational platforms and tools [1]. Therefore, their effectiveness is particularly limited in communicating high-level skills such as critical thinking or collaboration [3].

Micro-credentials have been introduced to address the given shortcomings. The initial response to online credentialing has come in the form of digital badges [4]. Over time, the term micro-credential has become dominant. It is usually seen as a mini-certification or a mini-qualification typically represented with a (visual) digital badge [5]. Digital badges have emerged from the intersection of games culture, online reputation systems used in commerce, online visuals, media culture and traditional uses of badges [6][7]. To be recognized as meaningful indicators of learning and symbols of valid assessment, digital badges are linked with evidence of activities and artifacts created during those activities. This means that apart from image-based design, badges contain metadata that communicate details about the context in which the recognition is awarded and serve as justification, even validation of the badge, such as [7]:

- Issuer
- Activities undertaken and artifacts created

- Quality of the experiences, products and performances
- Standards achieved and certified

Open Badges Specification has defined some required metadata that each digital badge must contain to be open and thus portable across websites and platforms. Open Badges 1.0 was released in 2012. By 2013, over 1,450 organizations had issued Open Badges [8]. In these and following years, many learning platforms have involved some of micro-credentialing functionalities intended for learners (e.g., search for a badge opportunity, applying for a badge, submitting an evidence for meeting the badge criteria, etc.) and/or issuers, most likely teachers/educators (e.g., designing/creating a badge opportunity, issuing a badge, etc.). Moreover, new specialized platforms for micro-credentialing have emerged [9].

However, rare early utility, usability and comparative studies have shown much need for a wider and deeper usability focus [9][10][11]. Due to infancy of the technology, early adopters of micro-credentials have met various usability problems such as cumbersome and time-consuming administration, various consequences of a lack of integration or limited integration with other platforms/tools or social media, a lack of or limitations in some functionalities, etc. Therefore, they have been in doubt whether and to which platform or tool(s) to commit. In the last few years, micro-credentials have gained in importance and popularity, and the question arises as to how prospective adopters of micro-credentials find a technology that is satisfactory for their needs, easy to learn and use, and without discouraging usability problems. In general, usability evaluation before committing to an educational technology alternative ensures satisfactory learners' and teachers' experience and improves prospects for successful technology adoption [12].

There are many definitions of usability and not so many definitions of a usability problem. The well-known and well-influential ISO definition defines usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use"[13]. A usability problem has a negative impact on one or more of the usability attributes such as effectiveness, efficiency, and satisfaction. According to one of the most complete definitions of a usability problem, "it is an aspect of the system and/or a demand on the user which makes it unpleasant, inefficient, onerous or impossible for the user to achieve their goals in typical usage situations" [14]. Since the identification of usability problems in specific usage situations can be particularly beneficial to adopters of micro-credentials, this paper focuses on this usability aspect of micro-credentialing platforms.

The paper presents some unpublished results of a study that has addressed the usability of micro-credentialing functionalities of a couple of platforms available on the market. The study was conducted in 2015/2016 within the project GRASS (Grading Soft Skills), a 3-year research project with the support of the Lifelong Learning Programme (LLP) of the EU, to facilitate the selection of open badging technology for the needs of the project. From each of the four countries (Serbia, Croatia, Ireland, and Sweden), one secondary and one tertiary education institution participated in the project.

On this basis, the authors have searched for, analyzed and critically evaluated the results of usability studies available in literature in order to get an insight into how usability of the given technology has been addressed over time. The results of the paper provide a better insight into usability of micro-credentialing functionalities and/or reveal research gaps worth considering in future studies. Some common usability pitfalls and potentially promising approaches on how to recognize and avoid such pitfalls have been identified, analyzed and discussed. Accordingly, the results of this paper are beneficial to current and new adopters of micro-credentials, whether they are issuers, learners/candidates or technology developers.

II. RESEARCH QUESTIONS

The objective of the paper is to critically evaluate how usability of micro-credentialing functionalities has been addressed over time. The paper is based on the following research questions:

RQ1: How has the usability of micro-credentialing functionalities been addressed in studies described in literature in comparison to the introduced exploratory study from five years ago in terms of purpose, participants and methods?

RQ2: Which platforms or tools have been studied in studies on usability of micro-credentialing functionalities?

RQ3: Have results of studies on usability of micro-credentialing functionalities revealed some specific usability problems?

III. METHODOLOGY

In order to answer the research questions, a 2-step approach has been used: an exploratory study of the usability of early micro-credentialing platforms, followed by a comparative analysis of the results presented in other studies.

A. Exploratory study

The platforms have been preselected based on the publicly available data and applied in a pilot phase of the project. The study has been based on mixed method research, which encompasses both quantitative and qualitative methods [15].

The study has been based on an innovative framework for perceived usability evaluation of micro-credentialing platforms for the selection purposes. As Figure 1 shows, the framework triangulates quantitative and qualitative data from the following sources:

- a standardized (perceived) usability questionnaire
- the custom-developed questionnaires with focus on perceived usability of micro-credentialing

functionalities from both the learners' and teachers' perspectives

- reported usability problems/perceptions

The framework recommends the use of a standardized perceived usability questionnaire such as SUS [16] and CSUQ [17], since their validity and reliability have been confirmed in a variety of contexts including the educational contexts.

The framework has also included the custom-developed questionnaires with focus on perceived usability of micro-credentialing functionalities. Since functionalities for students and teachers differ, two questionnaires have been developed to comprise both the learners' and teachers' perspectives. The analysis of micro-credentialing functionalities of state-of-the-art platforms, as well as consultations with the project participants, have preceded the development of the questionnaires.

The custom-developed questionnaires have been used not only to collect quantitative data for calculating perceived usability metrics, but also to elicit usability problems/perceptions from users (learners and teachers) noted in the pilot phase. Moreover, the usability problems/perceptions have been collected from the learners, noted and reported diligently by the teachers during the project and used to evaluate the framework at the end of the project.

Therefore, the study has applied questionnaires as a technique for collecting subjective data on usability. The well-known System Usability Scale - SUS has been selected from the set of standardized questionnaires. SUS and the custom-developed questionnaires have been filled by learners and teachers who have participated in the GRASS project. A minimum of 20 and a maximum of 50 participants have completed each questionnaire. Students under the age of 16 have not participated in the study. A number of the teachers who have participated in the project, the lack of incentives for learners, and the fact that most of the participants have used only one of the platforms, have limited the number of completed questionnaires per platform. Yet, such limitations are expected for the context of educational technology selection that the proposed framework addresses. The mixed-method research has been chosen as a way to overcome the limitations.

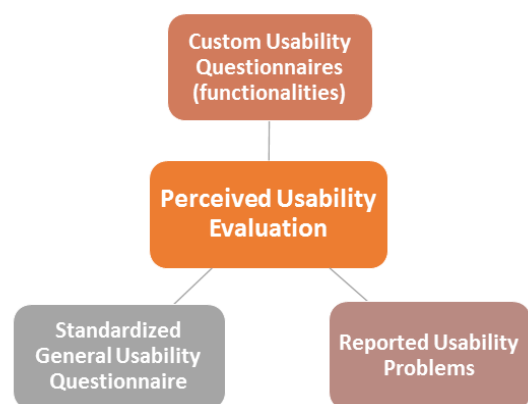


Figure 1. GRASS framework for perceived usability evaluation of micro-credentialing platforms in the context of technology selection

Based on the data from the SUS questionnaire, the SUS scores have been calculated. Furthermore, a statistical analysis has been performed. In addition to the descriptive statistics, the validity and reliability of the SUS questionnaire in the given context have been examined by using Exploratory Factor Analysis (EFA) and standard internal consistency tests “Cronbach’s α ” and “McDonald’s ω ”. Likewise, the usability scores for the identified functionalities and the same statistical analysis methods have been applied to the data collected via the custom-developed questionnaires. In addition to the analysis of the quantitative data, an analysis, classification and sorting of the qualitative data collected via the given questionnaires have been conducted.

B. Other studies

A search for studies described in literature by using the libraries known for good quality papers, Web of Science (WOS), and a wide range of papers, Google Scholar, has been conducted. The search terms have included terms such as “micro-credentials”, “micro-credentialing”, “digital badges”, “badging” and “usability”. The following criteria for the paper selection have been defined:

- the paper has the primary or secondary focus on usability evaluation of micro-credentialing functionalities
- the applied usability methods and results have been adequately presented
- the papers have been written in English

In the selection phase over 300 papers have been reviewed according to the selection criteria. First, the abstract, methodology and results have been read. The papers that have met the criteria have been then read in full to verify the quality of the papers and to extract relevant data. Although a considerable number of papers indicate the importance of usability of micro-credentialing platforms (e.g., [10][18][19]), seven papers have met the selection criteria. The papers were published from 2015 to 2020.

Finally, the relevant data extracted from the papers have been analyzed, summarized, compared with the results of the GRASS study, and critically evaluated according to the research questions.

IV. RESULTS

The results of the GRASS exploratory usability study are followed by the comparative analysis of the results presented in the reviewed studies.

A. Exploratory study

The application of the SUS and custom-developed questionnaires for evaluation of perceived usability of micro-credentialing functionalities in the exploratory study from five years ago have successfully differentiated the early versions of the following platforms: BadgeOS, Credly¹ and Moodle. The mean SUS score of 73.5 has indicated that Credly has had the good to excellent perceived usability. On the other hand, with the mean SUS scores of 67.5 and 55, the perceived usability of the other

two platforms has only been acceptable. Therefore, these scores suggest that Moodle and especially BadgeOS have had certain usability issues. However, based on the SUS results alone, it is not possible to conclude what these problems are.

This is why custom questionnaires targeting specific functionalities for both learners and teachers have been developed. The results have shown differences in the perceived usability of the specific functionalities of BadgeOS and Credly. For instance, the users of BadgeOS in the role of learners have given the highest mean score to “applying for a badge” and the lowest mean score to “reviewing of other learners’ badges”. At the same time the users of Credly in the same role have given the highest mean score to “sharing of badges” and the lowest mean score to “discovering of badge opportunities”. The perceived usability of Moodle has not been assessed by a sufficient number of its users in this way. In addition, the qualitative analysis has revealed the most and least satisfying functionalities. Moreover, a comparison of the quantitative and qualitative results from the learner perspective has shown that they are well consistent.

On the other hand, most of the teachers have assessed the perceived usability of the specific functionalities of BadgeOS. Thereby, they have given the highest mean score to “awarding of badges” and the lowest mean score to “monitoring of learner progress”. The teachers have proved to be much more willing to answer a set of open-ended questions. Therefore, a much richer set of qualitative data has been collected on usability issues from the teacher perspective. The analysis of these data has revealed a number of usability problems related to a limited support for “differentiation in learning”, i.e., insufficient or inadequate support for pedagogical practices related to task assignment, assessment of task results and awarding of badges. This includes unsatisfactory support for creating badge hierarchies and badge paths. These usability problems may have a negative influence on the pedagogical effectiveness of envisioned badging/micro-credentialing systems depending on the context of their application. Another group of the identified usability problems/perceptions, which has been characterized as primarily technological, has involved: inability to assign badges to a group of learners, limitations in the notification system when issuing/earning badges, difficulties in administration of users/learners, lack of intuitive design, and poor navigability. These usability problems do not stop teachers from performing their tasks, but require more effort and time than platforms without such problems.

The results have shown that the usability of specific functionalities can have a significant impact on the pedagogical effectiveness and adoption of micro-credentialing technology.

B. Comparative analysis of the reviewed studies

Table 1 shows an overview of the results of the usability studies selected from literature. More specifically, the table highlights the general purpose, i.e., context of a study, participants in a usability evaluation, usability evaluation methods applied in a study (RQ1), micro-credentialing platforms used (RQ2), as well as the Yes/No mark to indicate whether the study has identified some specific usability problems (RQ3).

¹ The free edition of the original Credly platform has been used. As of September 1, 2020, Credly has been consolidated with a newer platform to a unified platform: Credly’s Acclaim platform.

TABLE I.
AN OVERVIEW OF THE RESULTS OF THE REVIEWED STUDIES

Study Reference	Purpose / Context	Participants	Usability methods	Platforms	Usability problems identified?
Davis & Klein (2015)	To investigate the students' perceptions of the use of digital badges	high school students	- focus groups, - usability tests	custom system	Yes
Rodgers & Puterbaugh (2017)	To implement the university library's information literacy badging program	- faculty, - university students	users' feedback	- Credly + LearnDash, migration to - D2L's Brightspace with Awards tool	Yes
Beilstein et al. (2018)	To investigate Open Badges via a pilot study for the accreditation of media-related competences in higher education	- faculty - university students	- questionnaire, - observation, - structured interviews (faculty)	Open Badge Factory + Open Badge Passport	Yes
Homer, Hew, & Tan (2018)	To compare the impact of a use of digital badges and a non-digital conventional classroom token system on elementary school students' classroom behavior and English learning	- elementary school students, - teacher	- survey, - teacher written reflection	ClassDojo	No
Stefaniak & Carey (2019)	To investigate theme consistency, similarities, and differences across three digital badge programs at the course level, the department level, and the university level	- faculty - university students	- questionnaire, - interviews (faculty)	- custom system (case study 1) - Credly + Wordpress (case study 2) - custom system (case study 3)	Yes
Hanbidge et al. (2020)	To investigate the use of digital badges for acknowledging academic integrity	- university students	- pilot users' feedback - questionnaire	CanCred Factory + CanCred Passport	Yes
Hurrell, Ruddock, & Pival (2020)	To investigate the integration of Open Badges into the institutional repository of research articles to be issued if the article complies with a national funders' open access policy	researchers	usability tests	DSpace plugin	Yes

Although the studies have applied different usability evaluation approaches, most of them have identified some usability problems specific to the use of a micro-credentialing platform in a given context.

The high-school students who have participated in the study of Davis & Klein (2015) [11] have expressed needs for an improved and autonomous (without asking a teacher) progress monitoring, as well as for visualizations of pathways to success. Moreover, the students have found some shortcomings in looking at peers' profiles.

Thanks to the users' feedback, Rodgers & Puterbaugh (2017) [20] have identified certain usability problems in the use of both technological combinations. For instance, the lack of a confirmation email after receiving a badge, as well as the lack of more robust reporting in the integration of Credly and LearnDash have provoked dissatisfaction of university students and teachers. In addition, some administration shortcomings have been noted. The migration to D2L's Brightspace with the Awards tool has brought mostly satisfaction with more robust reporting, but also some dissatisfaction with initial administration.

Beilstein et al. (2018) [21] have elicited the university students' and teachers' usability perceptions regarding the

use of two complementary platforms, Open Badge Factory (used by teachers/badge issuers) and Open Badge Passport (used by learners), by applying a questionnaire, participatory observation of the students and structured interviews with the faculty. The elicited usability problems have been discussed in more detail than in the first two studies most likely due to the stronger usability focus and applied approach. For instance, the study has reported users' complaints about some unnecessary entries, missing helpful explanations when claiming, saving and sharing badges, a confusing expiry date option, the lack of feedback from the system regarding the status of issuing a badge, etc.

Homer, Hew, & Tan (2018) [22] have applied a part of an impact assessment survey and a teacher-written reflection to assess the usability of ClassDojo in an elementary school badging program. The authors have investigated whether students have liked ClassDojo and whether it has helped them participate more. Specific usability problems have not been reported.

Stefaniak & Carey (2019) [23] have conducted a qualitative multi-case study to compare three badging programs. The study has also included usability evaluation of three different technological solutions: an integration of

Credly and Wordpress, and two custom technological solutions. For each of the technological solutions, some specific usability issues have been elicited from university students and teachers via a questionnaire and interviews with the faculty. Some of the reported usability problems are: unspecified problems that have increased faculty workload (case study 1), navigation issues (case study 2), some shortcomings in badge-assignment management (case study 2), problems with permission settings (case study 3), the lack of a notification to the instructor on resubmissions (case study 3), etc. In all 3 case studies, much of the users' frustration has originated from the usability problems caused by the lack of integration between the badging platform and the learning management system.

In the study of Hanbidge et al. (2020) [24] two complementary platforms, CanCred Factory (used by teachers/badge issuers) and CanCred Passport (used by learners) have been applied. CanCred Factory/Passport is an in-house deployment of Open Badge Factory/ Passport, which is an open-source technology. However, by using a pilot users' feedback and a questionnaire, only students' usability perceptions have been elicited. In addition to the usability problems (e.g., some shortcomings when sharing badges, the lack of support for Asian languages, etc.), the study has also reported some explicit users' recommendations such as some improvement suggestions for sharing of badges, integration of the platform with the university's learning management system, enhancement of image quality, etc.

Hurrell, Ruddock, & Pival (2020) [25] have found a number of low-level usability problems of DSpace plugin by applying user testing. The user testing report has included problems such as: a lack of clarity between a label, description and information request; long and unwieldy drop-down lists; and buttons or descriptions without a clear call to action, etc.

V. DISCUSSION AND CONCLUSIONS

The GRASS usability study, as well as all studies selected from literature have investigated usability within broader research initiatives with specific objectives. Whereas the GRASS project has implemented several badging programs for soft skills assessment and acknowledgement, other research initiatives have developed badging programs for promotion of information literacy, accreditation of media-related competences, English learning support, etc. The purpose of the GRASS usability evaluation framework is to facilitate the selection of a micro-credentialing platform for an application case. Other usability studies have aimed at investigation/verification of the usability of a selected/available or newly-developed platform/tool or at comparing usability of a couple of platforms.

When it comes to participants, only the GRASS study has involved participants from both secondary and tertiary education institutions. Five of the reviewed studies have had participants from tertiary education. Participants from primary and secondary education have been involved in one of the studies each. As in the GRASS study, both students and teachers have participated in four of the reviewed studies. Only students have participated in two of the reviewed usability studies. Interestingly, researchers have been participants in one of the studies since they

have been end-users of the micro-credentialing platform in the proposed application case.

Various methods and techniques have been applied in the analyzed studies including questionnaires, interviews, users' feedback, observation, usability tests, etc. Whereas the GRASS study has been based on mixed-method research, most of the studies have been qualitative. Even usability tests in the study of Davis & Klein (2015) have been qualitative; only students' impressions have been noted. On the other hand, Hurrell, Ruddock, & Pival (2020) have recorded 'time to complete a task' in addition to researchers' impressions.

With regard to micro-credentialing platforms or tools, most of the studies have used well-known vendors' platforms and tools. Custom systems have been applied in three cases, two of which are reported in the same paper. Most of the reviewed studies address only one platform/tool or a technological combination (i.e., two complementary platforms).

All but one of the studies have revealed some usability problems of the micro-credentialing functionalities specific to the platform/tool and the application case. The granularity level of the reported problems has varied across the studies depending on the study focus and usability approach. Usability problems that are common to multiple studies, including the GRASS study, are related to the poor or missing integration with social networking sites. These problems have significantly limited the usability of sharing badges. In addition, the lack of integration with learning management systems has caused much dissatisfaction and most likely increased workload in several studies. Other usability problems that have been identified in the GRASS study and at least one of the reviewed studies are: the lack of visualizations of pathways to success (i.e., badge pathways), poor progress monitoring, limitations in the notification system when issuing/earning badges, shortcomings in badge assignment management, unsatisfactory navigability, etc. No other study categorizes usability problems as those affecting pedagogical effectiveness and those affecting efficiency as the GRASS study.

This paper reveals efforts of researchers and adopters of micro-credentials/digital badges in several research initiatives to identify and overcome usability issues. Regardless of different platforms and tools, as well as the time difference in when the studies have been conducted, usability problems causing users' dissatisfaction, limitations in pedagogical effectiveness and/or decreased efficiency have been reported. The paper points to different usability evaluation approaches that can be applied in order to evaluate usability of a micro-credentialing platform/tool when choosing to commit. Depending on the approach, the scope and granularity of usability results may significantly vary. However, any usability approach is most likely better than no approach at all. The price of not recognizing or ignoring usability problems at early phases of technological alternative selection or adoption overcomes the price of usability evaluation efforts.

The paper also recognizes the importance of sharing others' usability experiences on a larger scale. Early adopters of some educational technology often cannot count on the experiences of the colleagues they personally know. Even if the technology is mature, the experiences of

the colleagues might not be relevant to a specific application case. Therefore, allowing and encouraging educational technology adopters to share relevant usability experience in a searchable and systematic way would be of great help to the community.

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