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ABSTRACT

The use of open badges in teacher professional development is an extension to traditional teacher professional development initiatives. Existing teacher ICT Skills frameworks set a clear baseline for developing skills criteria and professional development goals for teachers globally. At the same time, badges support self-directed learning and micro certification through validation of existing skills. Previous projects focusing on validating existing teacher ICT skills have been executed and researched in Finland, offering a good contextual basis for this similar research that focuses on Rwanda.

The objective of this research is to test the badging approach and further examine the triggers that lead to learning / teachers' motivation to apply for badges. The research was conducted during a project targeting a group of teachers in Rwanda during the spring of 2020 as part of a longer cooperation between the researchers and the Rwanda Education Board. The research covers a badge-driven teacher professional development process that focused on skills validation. Quantitative data collection was undertaken through surveys prior, during and after the project. The results show a positive perception of a badge driven professional development programme by the participants and suggests promise of further badging initiatives.

Keywords:

Open-badges, professional development, teachers, competencies, teachers, Rwanda, Sub-Saharan Africa, UNESCO ICT competency framework

CONTENTS

1 INTRODUCTION

Since their development in 2011 (‘About Open Badges’, 2016), Open badges have influenced the certification landscape, where formal institutions like Universities are seen as certifying bodies, by offering a previously unavailable digital solution for the micro credentialing rewarding of skills, participation or accomplishment by many actors (schools, employers, hobbies) under a unified standard (OpenBadgeFactory, 2019). The differences between recognizing participation, completion or skill in formal education or in informal settings (work, hobbies, personal interest) are becoming more narrow and the paradigm is shifting to a more holistic view on competence. While more traditional education focuses skills to be attained after completion of a course, in the future, badges allow professional development schemes to also look back and merge existing and future skills (Diaz, Finkelstein, & Manning, 2015). Badges combine data on a simple digital form (picture with metadata). While pushing users to a new approach in skills validation, the badging system also reaches to the more traditional world of education by i.e. offering the opportunity to download badges in pdf form that can be printed on paper (Diaz, Finkelstein, & Manning, 2015).

New technologies have also changed the opportunities educators have in developing new and innovative programs. Open badges play a role in providing a digital tool for skills validation and digital micro-certification (Diaz, Finkelstein, & Manning, 2015). While teacher professional education has largely been implemented via traditional courses, badges allow for learning of a narrow, focused micro skill, at a time convenient to the end user. Instead of larger courses, the approach allows the building of individual skill constellations according to need and interest, which is harder to do in traditional learning. This narrowing of the skills to a micro-level and micro-certification as the authors aimed to do in this research also leads to increased motivation (Dyjur & Lindstrom, 2017). There are other technologies than open badges for micro-certification, but open badges have become an unofficial standard (Jirgensons & Kapenieks, 2018).

The use of open badges in professional development is a new and mostly unexplored area, with key research conducted by Dyjur & Lindstrom; Brauer, Ruhalahti, & Hallikainen; the Digital Credentials Consortium and DiSalvio. None of the sources for this research had been conducted on the use of open badges in Africa. Overall only limited research on the validity of the badges approach exists at this stage globally, let alone in

the African continent. It still remains unclear if the badging approach fits the teacher professional development scheme in Rwanda or in Africa, since not much work with open badges has not been conducted at any larger scale or scope on the continent.

Teacher professional development is one of the critical strategic objectives in Rwanda (Mineduc, 2016), one valuable strategic element that can ensure the country is able to reach its objective in becoming a knowledge economy and harness the opportunities of the 4th industrial revolution.

Teacher professional development is ongoing and widely studied. The focus of this research is examining a more novel approach to continuous professional development (CPD) of teachers in Rwanda focusing specifically on the learning triggers in open badge driven teacher ICT skills validation. This research aims to understand the motivational factors that drive teachers' motivation in taking part in professional development as well as the triggers that spark action throughout the process. This research is filling a gap in literature on badge-driven professional development initiatives in the African continent. It is expected to support further developments regarding the quality of education in Rwanda that gives context to this research, and through that to a limited extent, Africa in general.

2 LITERATURE REVIEW

To ground the research question, it is needed to understand key elements affecting the research. Those include understanding teacher continuous professional development (CPD), motivational factors in teacher participation in CPD and triggers that activate teachers to progress in a badge-driven process. The Rwandan context is also described below in order to outline the strategic goals Rwanda has set for teacher ICT skills development (Mineduc 2016).

2.1 Continuous Professional Development (CPD) of Teachers

The Organization of Economic Co-operation and Development (OECD) remarks that few clear connections exist between teachers' initial education, induction, and professional development, resulting in learning and development systems of teachers not being interconnected (OECD, 2005). The lack of information on the varying models of teacher training (Kennedy, 2005) results in a "blurred and incomplete picture of what effective CPD looks like" (Whitehouse, 2011). However, teacher professional development has been internationally widely studied (Kempen & Steyn, 2016, Kennedy, 2005, OECD, 2005, Whitehouse, 2011).

The multidimensional competence model of teaching (MAP model) developed as part of the "Student Selection to Teacher Education in Finland – Anticipatory Work for Future" (DOORS; 2017-2020) project is a recent attempt in describing and categorizing teacher competences in light of the needs of today's education in Finland (Metsäpelto et al., 2020). The research presents a multidimensional process model of key knowledge and skills for teaching. The MAP model gives insight to how the skills requirements in the teaching profession are classified today in light of skills teachers need when looking forward from year 2020 (Metsäpelto et al., 2020). The competence dimensions of MAP, as well as more traditional competence classifications are presented in Table 1.

Table 1. Definitions of teacher competence areas (Järvinen, 2020)

Schulman (1987)	DigiCompEdu (2017)	UNESCO (2018)	DOORS (2020)
1. Content knowledge 2. General pedagogic knowledge 3. Curriculum knowledge 4. Pedagogical content knowledge 5. Learners and their characteristics 6. Educational contexts 7. Knowledge of educational purposes.	1. Professional engagement, 2. Digital Resources 3. Teaching and Learning 4. Assessment 5. Empowering Learners 6. Facilitating learners' digital competence.	1. Understanding ICT in Education Policy 2. Curriculum and Assessment 3. Pedagogy 4. Application of Digital Skills 5. Organization and Administration 6. Teacher Professional Learning.	• Knowledge base for teaching and learning (8): • Cognitive thinking skills (9): • Social skills (10): • Relational skills Personal orientations (11): • Professional well-being (12):

It is notable how even in the more recent teacher competence classifications like MAP, ICT skills are not presented. The Ministry of Education and Culture in Finland created a vision for future teacher competences in 2016 that mentions digital skills as part of a teacher's "ability to co-create and deploy new innovations in teaching." (Opetus- ja kulttuuriministeriö, 2016), which places digital skills and a teacher's ability to use ICT tools, as not a standard practice but rather as something to strive for.

Perhaps the most common frameworks used in teacher ICT skills classifications is the UNESCO Teacher ICT competency frameworks (UNESCO, 2011 & UNESCO, 2018) and the Digital Competence Framework for Educators (DigiCompEdu) by the European Union (Redecker C., Punie Y., 2017). The first UNESCO framework was published in 2008 with updated versions published in 2011 and 2018 (UNESCO, 2011 & UNESCO, 2018).

Both of the ICT competence frameworks discuss, in addition to purely technical skills, the overall competencies of teachers. Instead of focusing on technical skills, they look at how ICT impacts the overall work of teachers from policy level to everyday practice. DigiCompEdu proposes 22 elementary competences organised in six areas (Redecker C., Punie Y., 2017). UNESCO categorizes teachers' professional practice in 6 categories and three competency levels (UNESCO, 2011 & 2018).

Becoming a professional teacher is an activity that continues throughout the years of working as a teacher. This activity is mediated, influenced, and shaped by individual understandings and values as well as external constraints and expectations (Appleby, Pilkington, 2014). The transformation from a new, starting teacher to a competent professional has an impact in their ability to facilitate the students' motivation to learn and their individual learning processes (Oon-Seng, Woon-Chia , 2015).

Kennedy (2005) proposes a categorization of 9 models of teacher CPD. Training, award-bearing, deficit, cascade, standards-based, coaching/mentoring, action research and transformative. Appleby & Pilkington (2014) propose three main groups of theories that investigate teacher professional development: the knowledge model, the career path model, the "doing and becoming" model. Teacher CPD in developing countries has a tendency of focusing on traditional training and train-the-trainer initiatives fitting the training and cascade models of teacher development. (Hassler et al., 2018; Kennedy, 2005; Ono & Ferreira, 2020)

Teacher development can also be defined more broadly, i.e. as a result of the series of myriad values based solutions a teacher has to make on a daily basis, decisions that are based on the teacher's conscious and unconscious values (Syrjäläinen, Jyrhämä & Haverinen, 2008). Reflection has become a fundamental component in professional learning and education processes. The ongoing development of professionals is often associated with the concept of reflective practice (Appleby, Pilkington, 2014).

In spite of the frameworks outlined above that categorize areas to be targeted with CPD, the issue of how to measure a CPD programme's effectiveness remains fragmented (Whitehouse, 2011). The OECD (2005) comparative review on teachers defines efficiency broadly:

> "Effective professional development is on-going, includes training, practice and feedback, and provides adequate time and follow-up support. Successful programmes involve teachers in learning activities that are similar to ones they will use with their students, and encourage the development of teachers' learning communities"
> (OECD, 2005).

The notion of competence can be interpreted in various ways, most seeing competences as units of human capital (van Halsema, 2016). Competence can be defined as a combination of knowledge, skills, and attitudes (Baartman & de Bruijn, 2011). The Finnish National Agency of Education adds to the element of "will" to the otherwise identical transversal competence description used in basic education (Finnish National Agency for Education, 2016). Competence is seen in this research from a behavioural perspective where an individual "acts responsibly and effectively according to given standards of performance" (van Halsema, 2016).

2.2 Motivation and Triggers in teacher CPD

Understanding the motivational factors of teachers taking part in professional development as well as the triggers that initiate action (applying for badges) helps us gain a wide understanding of the factors impacting the teacher motivation and triggers in this particular badging project.

The process of competence development combined with reflective practice is concerned with the daily activities teachers engage in with their students, making professional development a complex process. Fullan (cited in Dean, 1991) states that teacher professional development is a process where breakthroughs occur when teachers start to cognitively understand the underlying conception and rationale they are being introduced to and how new ways of working are more beneficial to them. For this to occur, teachers need feedback and support from their organisations and their peers (Dean, 1991).

Dean (1991) proposes eight factors that can impact teachers' motivation to take part in professional learning. These are:

- children and young people developing and learning
- enthusiasm for subject matter
- recognition, interest, praise and encouragement
- a chance to contribute and to shine
- a chance to take responsibility
- a challenge to professional skill
- the inspiration of others
- career prospects

Iliya & Ifeoma (2015) note that professional development programs can have a positive impact in teacher motivation in developing countries, especially when combined with school reforms that lead to enhanced learning outcomes of students. Teachers in developing countries can have more motivational challenges due to the generally more difficult working conditions and low ability to impact their work (Iliya & Ifeoma, 2015).

Triggers in can be described as an “action that pushes a student to perform an action at a specific moment or an initial stimulus that ensures that students enjoy learning”. (Brauer, Ruhalahti, & Hallikainen, 2018). In their study, Brauer et al. drew on a

conception of triggers that combined triggers with gamification. Muntean argues that when motivation, ability and triggers are present at the same time, learning results in the targeted behaviour (Muntean 2011). In this research, triggers are viewed as the stimulus leading to action and also to look at the motivations and enabling conditions of the participating teachers.

Professional development with badges in general and especially with teachers has not been widely studied, but existing research indicates a similar pattern where badges have a positive impact on motivation to take part in professional development (Diaz, Finkelstein, & Manning, 2015; Bauer, 2019).

2.1 Rwanda Context

The Rwandan government has placed quality education and ICT as one of the key actions driving the country forward. The Rwanda vision 2020 had focus on "Skilled human capital, including education, health and information technology*"* (World Bank, 2018). The new Rwanda vision 2050 lists universal access to quality education as one factor in its first focal area: "Quality life" (Gatete, 2016). It is seen as essential to achieve the highest possible quality of education that imparts skills that are necessary to enable all citizens of Rwanda to build the advanced country that is envisioned in the Vision 2050 (World Bank, 2018).

Equally the Rwanda growth strategy sees skilled Human Capital as one of the six growth drivers for the country (World Bank, 2018). These visions come through equally in the ICT for Education Policy from 2016 that has a vision:

> "To harness the innovative and cost-effective potential of world-class educational technology tools and resources, for knowledge creation and deepening, to push out the boundaries of education: improve quality, increase access, enhance diversity of learning methods and materials, include new categories of learners, foster both communication and collaboration skills, and build capacity of all those involved in providing education" (Republic of Rwanda, Ministry of Education, 2016).

The strategic goals of the policy are:

- "Strategic Objective 1: Develop a competent & relevant ICT professional base to meet industry needs.
- Strategic Objective 2: Increase ICT penetration and usage at all educational levels.
- Strategic Objective 3: Develop Education leadership and teachers' capacity and capability in and through ICT.

- Strategic Objective 4: Enhance teaching, learning & research through ICT integration in HLIs (Republic of Rwanda, Ministry of Education, 2016)."

The Strategic Objective 3 of the policy focuses on teacher capacity, seeing them as key to the successful implementation of the policy. For that purpose, teachers are required to complete yearly courses in ICT integration, also laptops have been made available. The policy calls for training of teachers as well as providing them with the tools necessary to integrate ICT tools in their education (Republic of Rwanda, Ministry of Education, 2016).

The Rwandan government has put great emphasis on teacher training. The education statistics from 2018 indicate that 98,6% of primary school teachers are qualified. Also, 75,5% of all primary schools are equipped with computers for students, with a 1:10 ratio (Republic of Rwanda Ministry of Education, 2019). This research is conducted in the Rwandan context due to the government focus on teacher ICT skills that is aligned with the scope of this research.

2.2 Open badges: definition and types

Open badges are already used globally in professional development (PD) by a wide range of educational institutions from small institutions like Cambridge Assessment English in the UK (Cambridge Assessment English, n.d.) and medium sized institutions like Oulu University of Applied Sciences in Finland (Open Badge Factory Ltd., n.d.) all the way to giant global corporations such as Microsoft's Education Center (Microsoft, n.d.).

Despite other technologies existing for micro-certification answering the need of online credentialing, Open badges have become an unofficial standard due to their open nature (Jirgensons & Kapenieks, 2018). Some of the developed technologies like Blockcert and Ethereum can be seen as attempts to exercise credentialing in a blockchain solution, whereas open badges are more dependent on third party hosting. Block chain solutions are showing promise but are still largely under development (Jirgensons & Kapenieks, 2018).

An open badge is a digital credential, "a digital representation of a skill, learning achievement or experience" ("Badges/FAQs - MozillaWiki," 2014). Each badge contains

within its metadata: the criteria required to earn it, the evidence provided by the applicant to earn it, the issuer, the badge's lifespan and more.

> "This supporting data contained within the badge reduces the risk of abusing the system (e.g., illegitimately copying badges and putting them on your site) and builds in an implicit validation system"
> ("Badges/FAQs - MozillaWiki," 2014).

Depending on the criteria required to earn it, badges can be one of many types, not all open badges are created equal. A badge can vary greatly from another in terms of image, necessary criteria, required evidence, lifespan and more ("Badges/FAQs - MozillaWiki," 2014) but these are just technical differences. More important is the purpose of the badge and how they are applied to the needs of the programme they are being applied to. These are separated by Mozilla into 7 types ("Badges/FAQs - MozillaWiki," 2014):

- "Smaller".
- "Larger".
- Basic or foundational.
- Intermediate and expert level.
- "Stealth assessment".
- "meta badges".
- Life-long learner badges.

In this pilot, only two badge purposes were used to ensure there would be no confusion between the types of badges: "Larger badges", referred to as simply "badges" within this article, and "Stealth assessment badges", referred to as "meta-badges".

"Stealth assessment badges" are referred to as "meta-badges" within this article due to the technical nomenclature within the Open Badge Factory (OBF) badging service. In the OBF both "Stealth assessment badges" and Mozilla's definition of "meta-badges" are created in the same area and are automatically delivered to applicants based on either a number of regular badges earned, or when a set of specific badges have been earned.

Badges were used as credentials for each of the 20 skills to be proven by the Rwandan pilot teacher. With clearly defined criteria and required evidence, they were the core type of earnable badges in the pilot. 5 meta badges were created for the Rwandan pilot marking milestones of 1, 5, 10, 15 and 20 badges earned.

2.3 Badge use cases

The Digital Credentials consortium that was founded in 2018 by some leading global universities (among others Harvard University, Tecnológico De Monterrey, Massachusetts Institute of Technology) has a mission to create a trusted, distributed, and shared infrastructure that becomes the standard for issuing, storing, displaying, and verifying digital academic credentials ("University-led Digital Credentials Consortium explores technology for digital academic credentials | Open Learning," 2020).

The consortium views digital credentials to have three broad areas of benefit:

- "It increases the efficiency of exchanging and evaluating credentials.
- It provides more reliable ways to protect and verify the credentials, thereby reducing the opportunity for fraud.
- It expands learners' control over their credentials, enabling a verifiable history of lifelong learning" (Digital Credentials Consortium, n.d).

DiSalvio equally highlights the role of digital credentialing in allowing students to have more control over their credentials. He also sees as a benefit the widening scope of assessment from grades to also including a number of other competences gained along the learning journey (DiSalvio, 2018).

3 RESEARCH METHODOLOGY

The Rwanda Education Board has initiated a number of activities in response to the ICT in Education Policy. As one of the responses to the ICT policy they have developed an online learning course on their Moodle platform that teaches basic and advanced skills in ICT integration (S.Järvinen, personal communication, 4 December, 2019). The courses are based on a localised adaptation of the UNESCO ICT Competency Framework for teachers. (Rwanda, Ministry of Education, 2016)

This research builds on the earlier work done by the Rwanda Education Board by investigating if the skills requirements set in the localised UNESCO framework could be validated independently but supported by the existing course content (S.Järvinen, personal communication, 4 December, 2019). The core objective of the research has been to investigate the learning triggers in Open Badge driven skills validation, to examine if the badging approach could serve as a viable addition or alternative to more traditional online learning programmes offered. Through this, the approach is aligned with the ICT in Education policy and helps to reinforce its objectives, especially strategic objective 3: “Teacher preparation and development” (Republic of Rwanda, Ministry of Education, 2016).

This project is the first attempt to use open badges as a tool in teacher skills validation in Rwanda and the authors’ second project in teacher skills validation in the African continent. The authors were not able to find studies from academic journals and databases of studies that would have touched on using open badges in Africa for any skills validation. However, outside academic research, open badges have been used on the continent for skills validation by HPass, an organisation focusing on professional development in the humanitarian sector (HPass, 2019, Presant, n.d.).

This research examines open badges in teacher ICT skills validation through looking at the motivations of teachers to take part in a badge driven professional development and triggers leading to teachers applying for badges during the badge driven learning process. The authors developed 20 individual badges and 5 meta badges for this pilot project. Each badge corresponded to a particular category in the Level 1 UNESCO framework. The UNESCO framework was remade in 2018, however the REB localised version was aligned with the previous version so this project’s badges and research is

also aligned with the UNESCO framework's initial version from 2011 (UNESCO, 2011). This research does not examine the thematic area of these badges but focuses on researching the approach.

Each meta badge was awarded automatically upon successfully earning a specific number of badges: 1, 5, 10, 15 and 20 (the maximum number of available badges). The purpose of the meta badges was to encourage pilot teachers to continue their progress by informing them when they hit these milestones.

The Rwanda Education Board offered a list of 33 teachers that were invited to take part in the pilot project. From the initial group of teachers invited, 20 teachers took up the invitation and took part in the pilot project. During the course of the project more teachers joined, making the total number of participating teachers, and therefore the sample size, rise to 27. Out of all the teachers in the project, only one participant had not gained a single badge at the end.

For some teachers, their participation in the project was impacted by the COVID-19 outbreak and sudden closure of schools. All teachers did not have the capacity to continue with the project without a computer and stable internet connection.

The pilot project was open for 15 days (4-20 March 2020), during which the participants could access the project site (described below) and apply for the badges.

3.1 Data Collection

Research data in the project was collected through three surveys:

- Pre-pilot survey for basic information on participants.
- During-pilot survey to measure triggers, motivation levels during the badging process, perceived challenge levels, time consumption and order of applying for badges.
- Post-pilot survey to measure overall feedback and motivation and to collect information on how the process could be improved in the future.

The data collected from the pre, during and post pilot were analysed separately in the research. In each response instance, the email address of the responder was recorded to be able to associate the data to the same person. Any participant that did not complete

both the pre-pilot survey, the post-pilot survey and at least one during-pilot survey have been omitted to focus research on those individuals that allowed us to examine their progress in a holistic way from beginning to end.

The omission filtered teachers that did not take part in all aspects of the badging project (i.e. if they had not applied for any badges) so that the pre and post-pilot survey responses would not include non-participatory teachers. On the other side of this, any teachers who applied for badges but did not complete the post-pilot survey, were also filtered out so that the data included only teachers who gave post-pilot validation to their responses given during the pilot.

3.2 Project Tools

The project required five tools to be used:

- Google Sites - The website introducing the teachers to the pilot and then providing them the necessary resources.
- Open Badge Factory - The badge delivery service where badge applications were processed and successful applications were awarded.
- WhatsApp - The instant messaging service for quick communication with the pilot teachers.
- Google Drive - The hosting service for the embedding the progress tracking charts and other visual media on the website and the Google site itself.
- YouTube - The largest video hosting service in the world, for hosting the guidance videos embedded on the site.

3.2.1 Google Sites

The late permissions to begin the pilot created a short time frame in which to create the environment that would provide the pilot teachers with the necessary resources. The authors selected Google Sites due to the familiarity and simplicity of the tool.

The site served many roles and included:

- Introductory and guidance videos on how the badge applications should proceed.
- A demo badge for pilot teachers to familiarise themselves with a guaranteed successful application.

- The constellation of badges, listed alongside their evidence criteria.
- Optional reading resources if the badge subject was new to the applying teacher (Järvinen & Stockley, 2020).

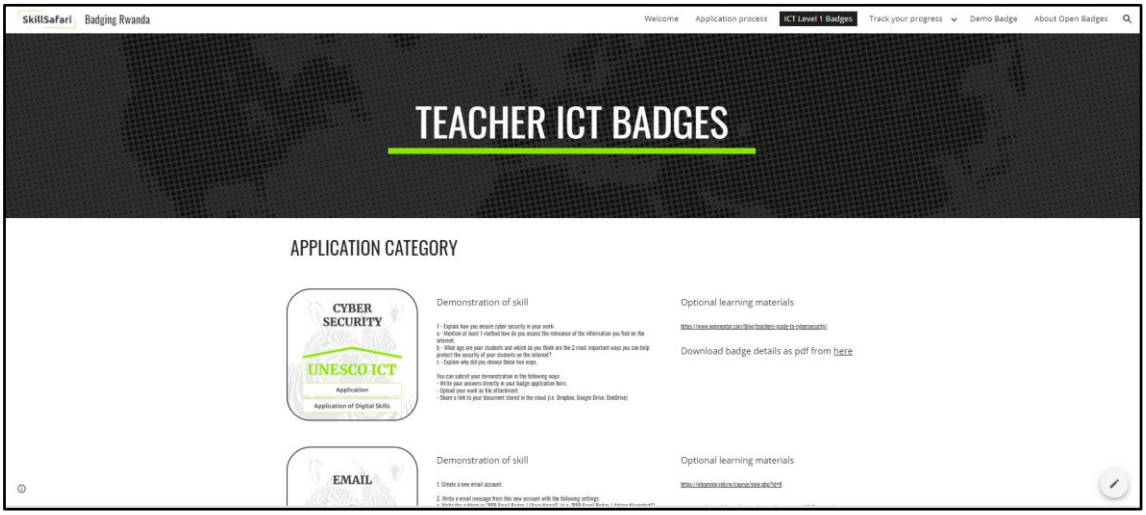

Figure 1. The first two badges listed on the site.

The badges were listed first by their category as stated in the UNESCO ICT Competency Framework for Teachers (UNESCO, 2011), and then alphabetically by their badge name. The order of the badges becomes a relevant factor when the research looks at the order in which the pilot teachers applied for them.

One key addition to the pilot site, not yet available in the open badge tools used by the authors, was the tool for pilot teachers to visually track their own progress: An online chart displaying all the possible pilot badges. Each teacher had their own personal chart. Every badge was 65% transparent and upon each successful application, the image of the badge was manually made fully opaque by the author who assessed and awarded the badge. This enabled the teachers to see what badges they had received and more importantly, the badges still left to apply for.

The charts were made publicly available on the project site so that there would be no negative issues with accessing and viewing them. They were titled using the first three characters of the pilot teachers first name and surname to ensure anonymity (Järvinen & Stockley, 2020).

Figure 2. An example tracking chart where 5 badges and 2 meta badges have been earned.

3.2.2 Open Badge Factory

The Open Badge Factory (OBF) is an open badge hosting and deployment tool. The tool was developed by the Finnish Oulu-based Discendum Ltd which in 2019 separated into its own company, Open Badge Factory Ltd.

The authors have been using the Open Badge Factory and the accompanying Open Badge Passport in private and publicly funded projects since 2013 and have been key figures in the development of these projects.

Open Badge Factory was not the only badging deployment tool considered for the pilot. The Rwanda Education Board have been using Moodle, a free, open-source learning management system which can also function as a badge deployment tool (S. Järvinen, personal communication, December 4, 2019). Moodle can host and deploy badges since version 4.5 (Moodle, 2014) which has been available since 2012 (Moodle, 2014) and is already a familiar online environment for the Rwandan pilot teachers. However, the Open Badge Factory has many functions that lend credibility to the services that adopt it, which is why it was chosen as the primary tool for this project.

The functions offered by Open Badge Factory include verification of the badge authors, public partnerships with other badge developers, advanced reporting features and

compatibility with many of the world's most used badge storage and display tools such as the Mozilla Backpack, LinkedIn and the Open Badge Passport (OBP).

The compatibility between both Open Badge Factory and Open Badge Passport services allow the authors' solution to remove a step from the end users' process (that of transferring the badge into a badge storage service) and that time saving and removal of work from the end user is an advantage even without the other previously mentioned features.

The Open Badge Factory tool began to provide a brand new feature in December 2019 (Open Badge Factory Ltd, 2019) that was very successful in the pilot, providing a PDF version of the badge to the receiver. This paper version is an alternative storage method to the digital version of the badge and includes all the necessary data to verify the PDF belongs to a legitimately earned open badge.

3.2.3 WhatsApp

WhatsApp was suggested as a communication tool between all project stakeholders and approved by the Rwanda Education Board. Participants were invited to a mutual group via invitation link and later added manually upon being accepted in the programme. This instant communication method was accepted so as to minimise response times between the authors and pilot teachers and also to ensure that negative motivation triggers would not be influenced from the communication; for example, slow or no responses to questions.

3.2.4 Google Drive

Google Drive was selected for cost reasons and the range of available tools within it. Primarily the authors found this to be the most flexible ecosystem for:

- Hosting the Google Site.
- Survey form creations using Google Forms and data storage in Google Sheet spreadsheets.
- Data analysis using Google Sheet tools with integrated charting tools that would automatically update as more data was received.

3.2.5 YouTube

A welcome video, two guidance videos related to the badge application process and a video guide on how to download PDF versions of earned badges were made. These are embedded on the site for the pilot teachers to access when needed. Each video was made using a greenscreen and chroma key technology to enable an author to visually clarify the process and maintain a human element in the instructions.

These videos were uploaded to YouTube to remain within the Google ecosystem and enable simple embedding of these videos into the Google Site.

3.3 Limitations

This study focused on a limited number of teachers taking part in a short-term development programme. For that reason, the results of this research can be considered as a pilot. Due to the overall lack of research done on badges in skills recognition, further and more extensive research is required before more certain conclusions can be drawn. The sample size of the survey (27 responses in both the pre-pilot and post-pilot surveys plus an additional 330 responses for the during-pilot survey) was limited and even though the participating teachers represented all geographical areas of Rwanda they did not represent all education levels or give an overall image of all teachers in Rwanda.

To further validate the findings, the teacher's motivations were analysed both during and after the pilot and the results were compared to each other. Each participating teacher was asked to summarise their experience in the post-pilot survey, this data was used to validate their responses from the during-pilot survey.

The unexpected spread of the COVID-19 virus in spring 2020 also impacted on the project by closing schools and changing the teachers focus from classroom education to online learning in a very short time period. This had an impact on all teachers retaining access to the devices and connectivity required for the pilot. The school closures occurred in the last week of the project so it had limited, minimised impact on the research outcomes.

4 RESULTS

A total number of 297 badges were issued to participants over the course of the study. Five users were able to gain all badges during the pilot, while the average number of badges earned was 12.6. The lowest number of earned badges was 1, by a single pilot teacher.

The participants were invited to answer a short survey after every badge application, asking them about triggers, time consumption, perceived challenge level and motivation-level to apply for more badges. The survey collected data on the reasons for selecting the specific badge participants had applied for, the time the badge application had taken as well as the participants' motivation levels going forward.

Throughout the project, the motivation levels of teachers remained high (figure 11). Interestingly, the motivation to keep advancing in the process of gaining badges was not affected by the perceived challenge level of the badge or the time spent in collecting the evidence required to demonstrate competence. Also, the time spent applying for the badge did not correlate with the perceived challenge level of the badge. The time spent in applying for different badges varied significantly. The time participants invested in applying for less challenging badges was on average 23.4 minutes. while the most challenging badges took just over half an hour longer with an average of 60.4 minutes spent on the application.

The order in which the participants were allowed to gain badges was kept free so each teacher was able to advance at their own pace and in an order that suited them best. Despite this, many users advance in a similar order during the first nine badges with the selected badges after this, becoming more scattered. Cyber security was the most common choice with 15 / 27 badge earners choosing it as their first badge to apply for.

When looking at the triggers, when participants indicated their decision making, the most common choice was "I wanted to test if I have the skills required to achieve this badge." There was no significant difference between the top 4 badge triggers, with the slight exception of the first badge issued. Figure 3 shows a breakdown of the triggers indicated by the participants.

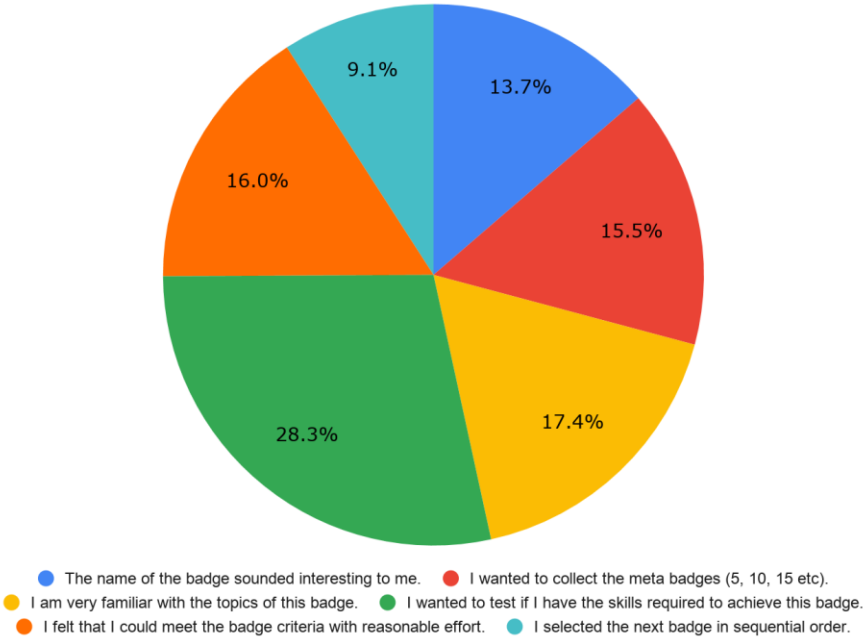

Figure 3. Overall triggers

After the data collection phase, when badges were applied for and issued, had concluded, the participants were asked to take part in a post-pilot survey. The purpose of the survey was to allow them to reflect on the overall experience, give feedback on the badging approach and make recommendations on possible improvement areas. All participants responded to the survey, giving us a reliable view on their comments.

In the post-pilot survey, a Likert scale from 1 to 5 and a 4 step scale measuring agreement on statements was applied. The overall rating of the approach was high, 4.45 / 5 and the suitability rating of the badging approach was valued equally high at 4.5 / 5.

In the open-ended question asking for recommendations, the most common point made by teachers was a request for airtime (internet connection) to facilitate the online learning process. Also many hoped for the time given to go through the badging process to be longer. The positive ratings of the post survey were very much aligned with the high motivation level measured during the project, indicating that the approach was appreciated by the participating teachers.

Challenges that remain for similar projects are related to occasional lack of devices with which to participate. Some teachers have access to computers in their schools and with the school closure due to COVID-19 their participation suffered. Similarly, the cost of internet usage pilot teachers had to purchase for their homes to work on the pilot caused

worry to some participants which was expressed in the WhatsApp discussions and post-pilot survey. The last concern made from teachers was the expected gain they can expect by participating in the badging programme and having their skills validated.

4.1 Pre-pilot survey

The pre-pilot survey was designed to gain a basic understanding of the pilot teacher group including the geographic, gender and demographics. Additionally, the pilot teachers were asked for how long they had been teaching to see how this might affect their participation in the pilot.

This data was used to create a geographical map of the teacher locations and also to create a set of teacher personas that would be useful when designing badging CPD projects in Rwanda in the future.

4.2 During-pilot survey

After each application for a badge, the pilot teacher was requested to answer a short survey on how motivated they were to apply for another badge and how their recent application experience went. Specifically they were asked which badge they applied for, how long it took to create the evidence for that badge and how challenging they felt creating that evidence once. The goal was to gain an understanding of each teacher's motivation levels as they progressed through the pilot.

Figure 4 displays which badges were applied for on each day of the data collection phase of the pilot. There is a heavy focus on applying for the Cyber Security badge early on in the pilot. This is reinforced by the data in figure 5 which shows it as the 1st badge applied for by 15 of the 27 pilot teachers.

This is further reinforced when it can be seen that badges for Email, Graphics Software and Internet in Education also have higher numbers of applications early on.

The weekend (7-8 March) brings with it a strong decline in the number of badges applied for, which is true for both the weekend periods in the pilot.

After the first weekend, shift of applications towards badges relating to office tools such as Presentation Software, Spreadsheets and Text Processing can be seen. Unsurprisingly there is a slight increase in the application for the Social Media badge which is located adjacent to the badges for office tools in the badge list on the website.

The rise in the number of applications for the YouTube badge was to be expected as it is listed immediately below the badges for office tools on the website but it was surprising to see it rise to become the most applied for badge within a single day.

Towards the end of the pilot there is a change from applications for badges that require evidence related to technical skills, towards badges that require evidence related to understanding frameworks or policy. These include Peer2Peer Networks, Professional Communities / Networks, Managing ICT for Project Based Learning, ICT & Policy, SAMR and Lesson Planning with ICT.

The early assumption was that this was due to pilot teachers continuing to work down the list of badges on the site but the order of the badges the pilot teachers applied for, does not exactly match the badges within the Application category on the site. Figures 4 and 5 below display two methods of viewing the order in which teachers applied for each badge.

BADGE NAME																		
CYBER SECURITY	1	4	6	1			2	2	1	1			1	2		2	1	24
EMAIL	1	2	2		2	2	2	3	2	2			1	1		1	1	22
GRAPHICS SOFTWARE		2	2		2	1		3		4				2	1	2	1	20
ICT & CURRICULUM		1	1			1	1				1			1	1	1	2	10
ICT & POLICY			1			1		1			1			1	2	2	3	12
ICT TO SUPPORT ASSESSMENT	1					2		3	3					2	3	3		17
INTERNET IN EDUCATION			4		2	4	1	4		2				2		2	2	23
LESSON PLANNING, WITH ICT			1			3	2		2	1				2		3	1	15
MAKING SMALL VIDEOS				1				2	1	2		1		3		2	1	13
MANAGING ICT FOR PROJECT-BASED LEARNING (PBL)						1					1	1		2	2	2	2	11
OER							1	1		1	1	1	1	1	1	3	1	12
PEER2PEER NETWORKS						1		1	1		1		1	2	1	4	2	14
PRESENTATION SOFTWARE		1	2	1	1	3		5	1	4				1		2		21
PROFESSIONAL COMMUNITIES /NETWORKS		1				1		2	1				2	1	1	2	5	16
RESOURCE USAGE PLAN								2	2		1			1	3		3	12
SAMR MODEL							1	1	1			2		2	1	3	1	12
SOCIAL MEDIA		2	2	1	2	2		3		1		1		2	2	1		19
SPREADSHEETS		1	1	1		2		4	1	4			1	2	1	1	1	20
TEXT PROCESSING		1	1			1	1	2	2	2			1	2		4		17
YOUTUBE		1	2			1	1	7	1	3		1		1	1	1		20
Date	Wednesday 4.3.	Thursday 5.3.	Friday 6.3.	Saturday 7.3.	Sunday 8.3.	Monday 9.3.	Tuesday 10.3.	Wednesday 11.3.	Thursday 12.3.	Friday 13.3.	Saturday 14.3.	Sunday 15.3.	Monday 16.3.	Tuesday 17.3.	Wednesday 18.3.	Thursday 19.3.	Friday 20.3.	
Sum per day (total:330)	**3**	**16**	**25**	**5**	**9**	**26**	**12**	**46**	**19**	**27**	**6**	**7**	**8**	**33**	**20**	**41**	**27**	**330**

Figure 4. Badges applied for on each day of the pilot.

BADGE NAME	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th	
CYBER SECURITY	15	4	1	0	1	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	24
EMAIL	5	9	3	2	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	22
GRAPHICS SOFTWARE	1	4	7	2	3	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	20
ICT & CURRICULUM	0	0	0	0	0	0	1	0	1	2	1	0	1	0	1	1	0	1	0	1	10
ICT & POLICY	0	0	1	0	0	0	0	1	0	0	1	0	1	1	1	0	0	3	2	1	12
ICT TO SUPPORT ASSESSMENT	1	0	0	2	1	1	0	2	1	2	2	3	0	1	1	0	0	0	0	0	17
INTERNET IN EDUCATION	1	4	1	10	1	2	1	2	0	0	0	1	0	0	0	0	0	0	0	0	23
LESSON PLANNING, WITH ICT	4	0	1	0	0	0	0	0	1	1	2	1	2	0	0	1	1	0	1	0	15
MAKING SMALL VIDEOS	0	0	0	2	3	0	0	1	0	1	1	0	0	2	0	0	1	1	0	1	13
MANAGING ICT FOR PROJECT-BASED LEARNING (PBL)	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	3	2	1	0	11
OER	0	0	0	0	1	0	0	0	1	0	2	1	1	1	2	0	1	0	1	1	12
PEER2PEER NETWORKS	0	0	0	0	0	0	0	0	1	2	2	0	2	0	3	3	1	0	0	0	14
PRESENTATION SOFTWARE	0	2	4	2	6	4	2	0	0	0	0	1	0	0	0	0	0	0	0	0	21
PROFESSIONAL COMMUNITIES /NETWORKS	0	0	0	0	1	0	0	2	0	1	2	2	1	2	0	1	2	1	0	1	16
RESOURCE USAGE PLAN	0	0	0	0	1	0	0	0	0	2	0	0	0	2	1	3	0	1	1	1	12
SAMR MODEL	0	0	1	0	0	0	0	0	0	1	0	2	0	2	1	2	0	1	2	0	12
SOCIAL MEDIA	0	2	4	1	1	8	1	0	1	0	0	0	0	0	0	0	0	0	0	1	19
SPREADSHEETS	0	0	0	2	1	3	8	2	2	0	0	0	1	0	0	0	1	0	0	0	20
TEXT PROCESSING	0	1	0	1	0	1	3	5	2	2	1	1	0	0	0	0	0	0	0	0	17
YOUTUBE	0	0	2	0	2	2	3	3	5	2	0	0	0	0	1	0	0	0	0	0	20
	27	26	25	24	23	22	21	18	17	16	15	14	13	11	11	11	10	10	9	7	330

Figure 5. The order in which pilot teachers applied for each badge.

The next assumption was that the pilot teachers were leaving what they felt were the more difficult badges for last. Some evidence to support this comes from the average amount of time used to create the evidence for each badge. The data from figure 6 shows the time required increased steadily during the pilot. However, this can be discounted when the pilot teachers reported they felt the challenge level decreasing steadily over time as shown in figure 7.

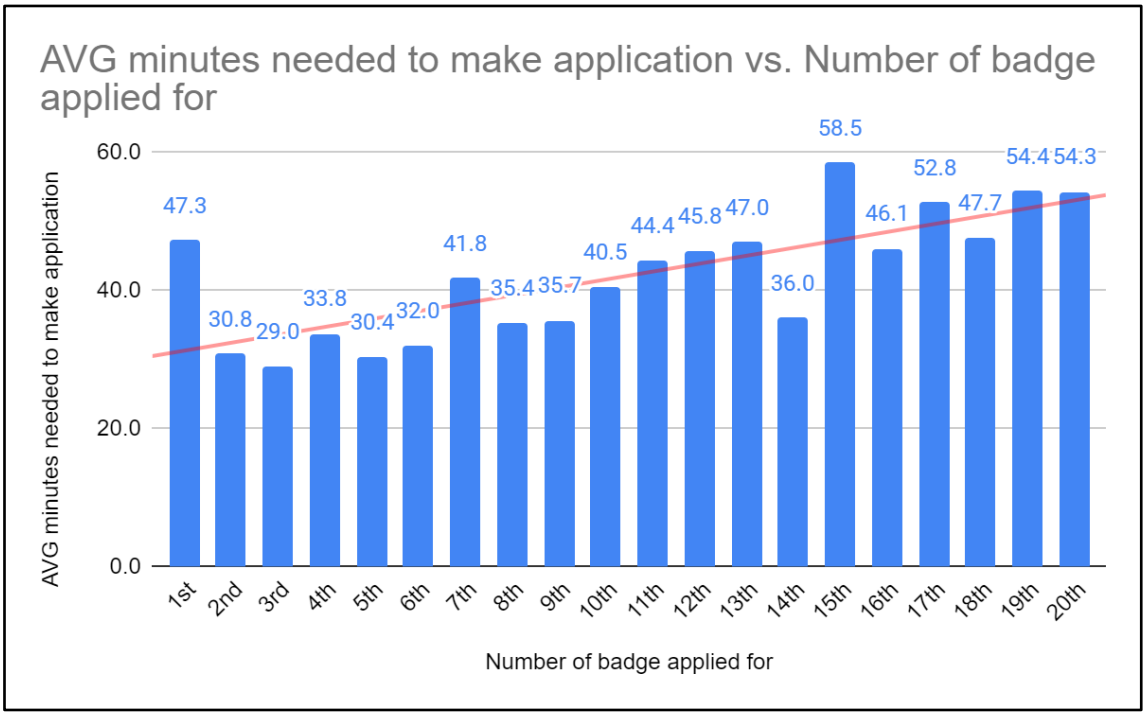

Figure 6. Average minutes needed to make an application vs. Number of badge applied for.

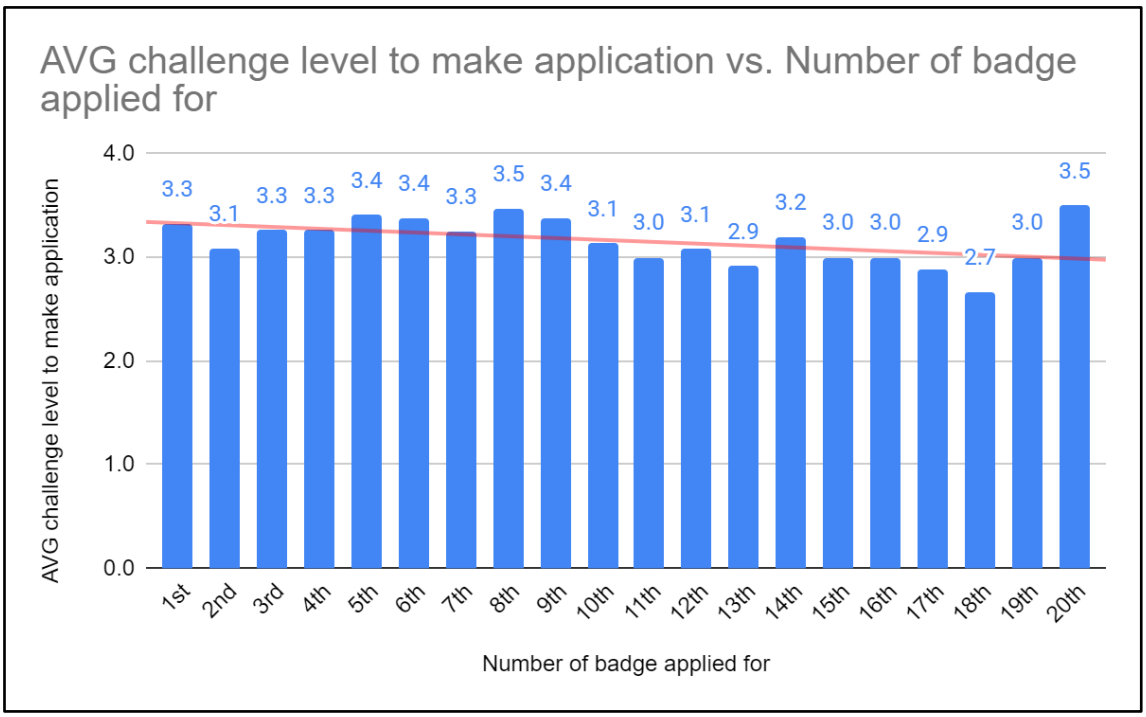

Figure 7. Average challenge level to make an application vs. Number of badge applied for

Despite the large changes in time required and small changes in challenge levels, an unexpected result were the high levels of likelihood the pilot teachers reported after each badge to make another application. Of specific note is the highest available rating from all seven teachers who completed the 20th and final badge in the badge constellation. This implies that there would be a desire to continue or begin a new badging CPD programme.

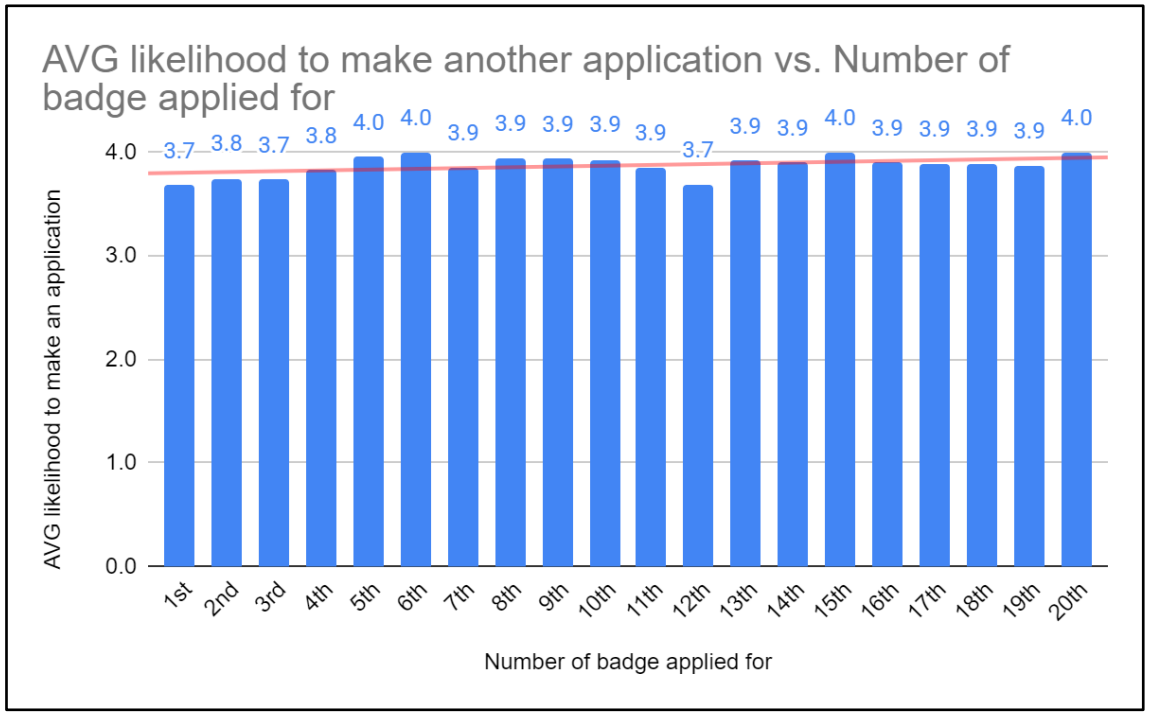

Figure 8. Average likelihood to make another application vs. Number of badge applied for.

Looking at these same averages but at specific badges instead of the number of the earned badge also helps to confirm the assumption that badges requiring technical evidence were easier for the pilot teachers. In figure 9, notably lower times required to make the application for those badges when compared to those that require understanding local policy or pedagogical models can be seen.

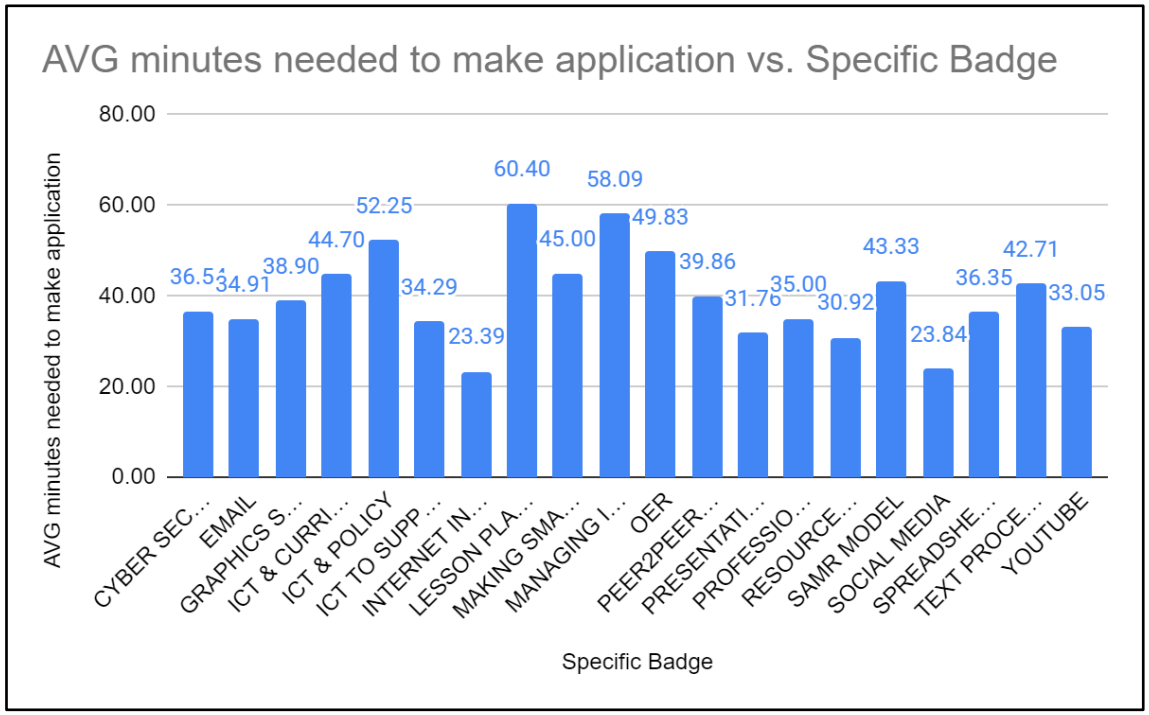

Figure 9. Average minutes needed to make an application vs. Specific Badge.

The heterogeneity of the pilot teacher responses towards challenge level and likelihood to apply for another badge are equally visible in the averages for specific badges as found in figures 10 and figure 11.

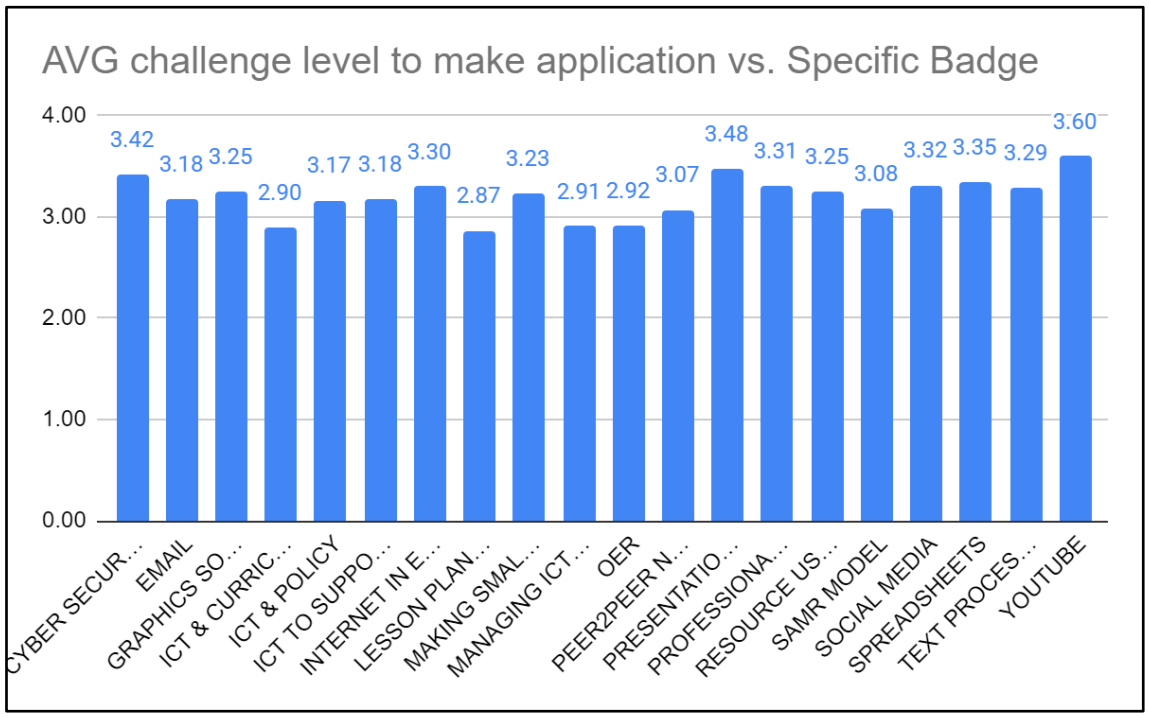

Figure 10. Average challenge level to make an application vs. Specific Badge.

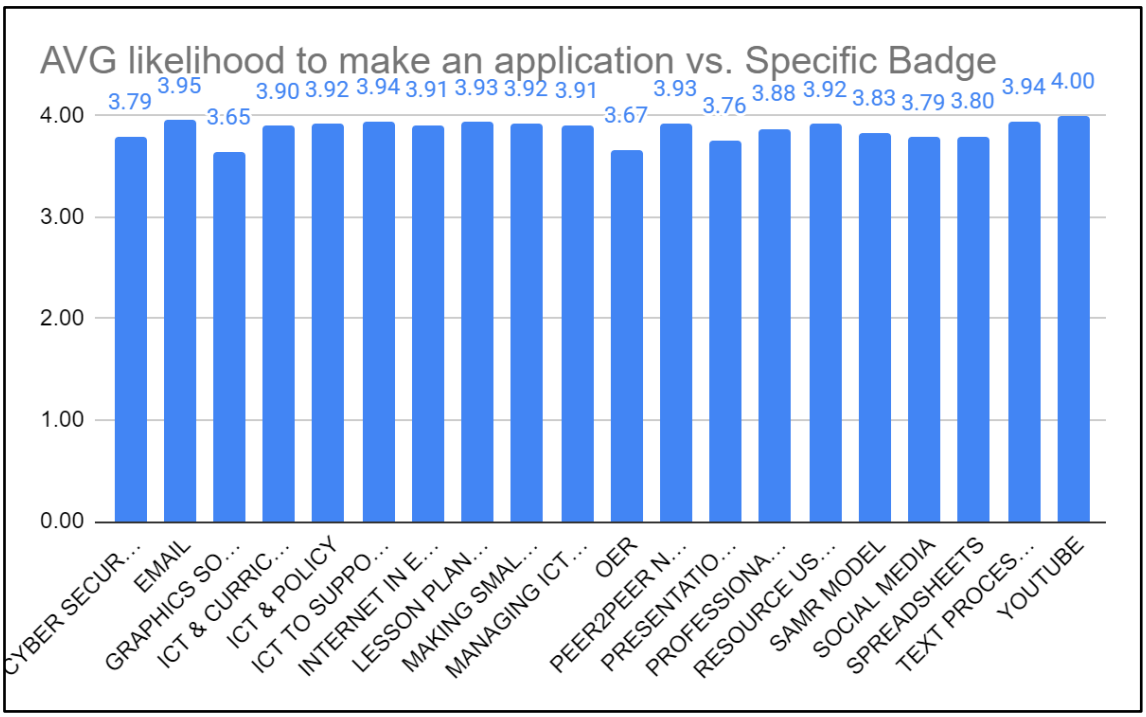

Figure 11. Average likelihood to make another application vs. Specific Badge.

Teachers were asked why they chose to apply for each specific badge. The most common answer was to test their own skills / knowledge on the subject. All other responses were given in even proportions, between 12% and 15%, except a badge having been selected due to its sequential order on the website which is lower than all other options. This is a very interesting result as earlier in this article, evidence to the contrary has been seen.

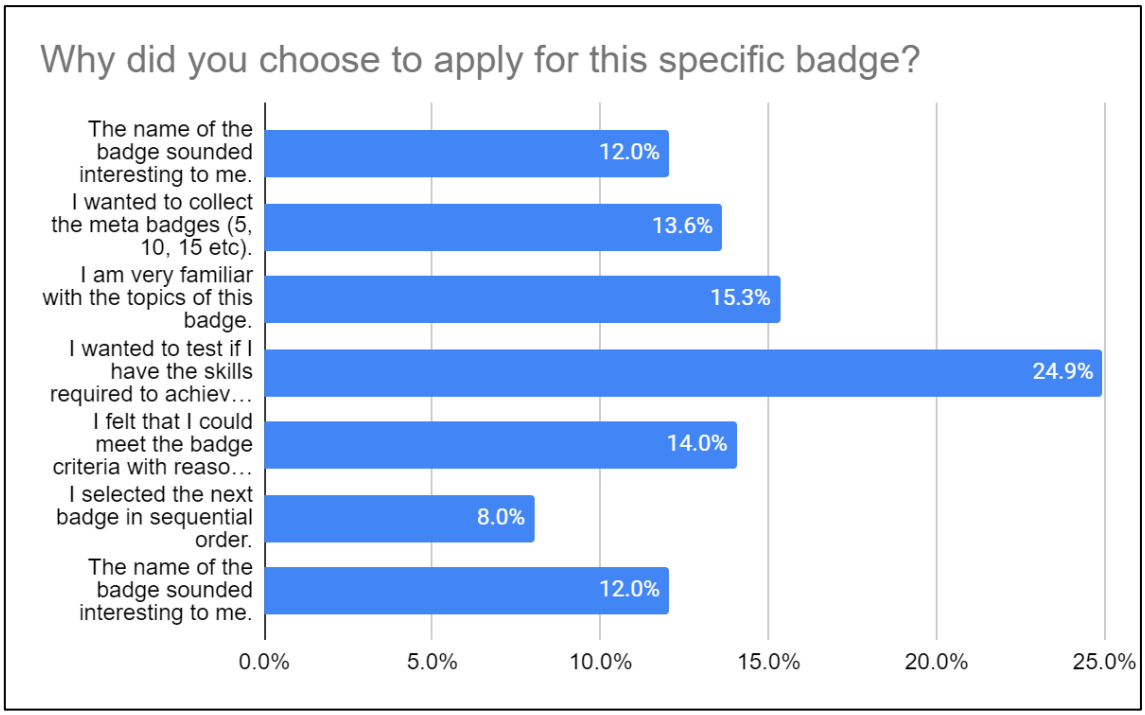

Figure 12. Why did you choose to apply for this specific badge?

When this data is broken down into its individual badges, it can be seen that the only badge that was not chosen due to the "I wanted to test if I have the skills" trigger, but because the pilot teacher was already familiar with the technology. This was the Social Media badge. Indeed the applications for this badge had shown that the pilot teachers were already long term social media users.

Table 2. A sample of the badge-specific triggers

TRIGGER	PRESENTATION SOFTWARE	SOCIAL MEDIA	SPREADSHEETS	TEXT PROCESSING	YOUTUBE
The name of the badge sounded interesting to me.	17.39%	9.76%	13.33%	13.33%	16.28%
I wanted to collect the meta badges (5, 10, 15 etc).	19.57%	17.07%	15.56%	13.33%	13.95%
I am very familiar with the topics of this badge.	17.39%	29.27%	22.22%	20.00%	20.93%
I wanted to test if I have the skills required to achieve this badge.	26.09%	19.51%	24.44%	30.00%	25.58%
I felt that I could meet the badge criteria with reasonable effort.	10.87%	12.20%	13.33%	16.67%	16.28%

I selected the next badge in sequential order.	8.70%	12.20%	11.11%	6.67%	6.98%
SUM	100.00%	100.00%	100.00%	100.00%	100.00%

4.3 Post-pilot survey

After the pilot, each participating teacher was asked to summarise their experience with the pilot. This data was also used to validate their responses from the during-pilot survey. They were asked if they enjoyed the badging experience, if they felt the badges were suitable for PD and their work, if there were any reasons for not applying for every possible badge, what they would be willing to pay in a paid badging programme and how they would improve the pilot. In addition to these questions, the pilot teachers were also asked to agree or disagree, on a scale, on multiple statements related to the pilot and motivational factors.

The post-pilot survey results varied greatly among the respondents. For every question, there were responses for the lowest possible score and the highest possible score forcing mean and median averages to be used to understand the data displayed in table 3.

Table 3. Pilot teachers opinions on the pilot overall.

SURVEY QUESTION	AVERAGE	MEDIAN	MAX	MIN
How much did you enjoy the overall badging experience?	4.48	5	5	1
How well do you think badges are suitable for Professional Development?	4.52	5	5	1
How close did the badges skills match the skills you use for work?	4.3	4	5	1
How likely are you to recommend this kind of badging experience to your colleagues?	4.48	5	5	1

The overall badging experience was positively received and the pilot teachers would be motivated to continue their development through this method, even to the point of being willing to recommend the experience to their colleagues, as had happened during the pilot and more teachers were accepted onto the pilot. These results are aligned with the

during-pilot survey results where participants reported high motivation levels throughout the pilot project (Figure 11).

Those pilot teachers that did not apply for all 20 badges (19/27) were asked what was the reason for this. The most common reason was internet connectivity (8 respondents), followed by time available to participate (6 respondents). The COVID pandemic was specifically mentioned as the cause for difficulties participating in the pilot (4 respondents). School closures caused some teachers to lose access to internet connections and their colleagues with whom they were working with.

It came as little surprise to see the most given response to improving the pilot to be provision of internet access. This was followed by a desire to extend the pilot duration and invite more teachers to the pilot.

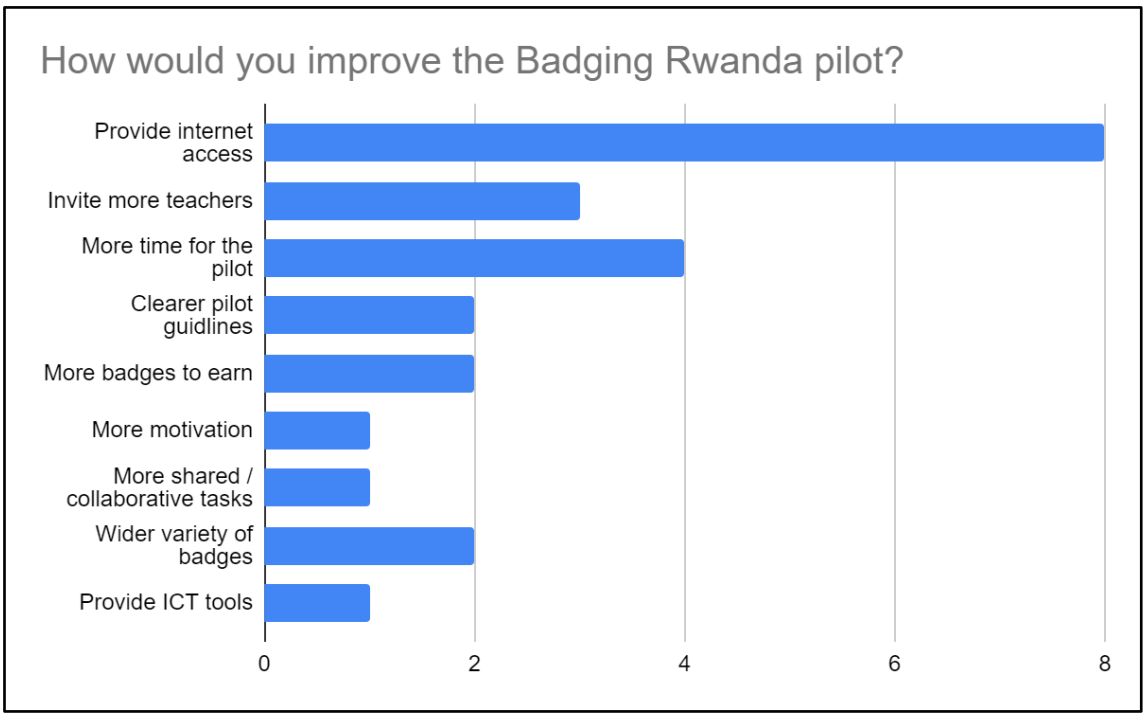

Figure 13. How would you improve the Badging Rwanda pilot?

The final round of questions directed the pilot teachers to consider how much they agreed with the set of closed statements. These statements would be used to gain insight into the perceptions of participants to the badging approach. Table 4 provides quantitative information on the statements presented in the survey. Generally, the results show a clear positive perception on the badging experience and show that the participants felt the approach helped them to understand their skills better.

Table 4. Participant perception on badging

How much do you agree with the following statements:	AVERAGE	MEDIAN	MAX	MIN
The badges helped me to understand my skills because I needed to provide evidence.	4.85	6	6	1
It was easy to plan the order in which I complete the badges	3.85	4	6	1
I think that open badges were a good motivator for me to develop my skills	4.7	6	6	1
I liked that this pilot was not tied to a specific time or place	4.26	5	6	1
I liked that the difficulty of the badges was varied.	4.44	5	6	1
It was important to me that I could track my progress.	4.78	6	6	1
The meta badges (1, 5, 10, 15, All) motivated me.	4.67	6	6	1
I wanted to share with others that I had received the badge.	4.44	6	6	1
I would be interested in another programme that used badges?	4.93	6	6	1

5 DISCUSSION

Open badges are used in a number of ways across the globe, very often as micro-certifications gained from completing a course or assignment, or by participating in an event or programme. So far it has not been possible to identify programmes related to teacher skills validation outside Finland.

The overall results of the pilot are encouraging because the teachers' motivation stayed high throughout the project, despite the difficulties they experienced with certain badges. This also reflected in the number of applications rising and remaining high despite radical changes in the working environment with schools suddenly closing mid-project due to COVID-19.

The main trigger for badge applications was the willingness to measure if the skills the teachers perceived having were sufficient to earn a specific badge. After each badge application, participants were asked to identify what caused them to apply for the specific badge. The assurance of having the necessary skills was a secondary reason, which could suggest an interest to explore and get feedback on skills by teachers. This would align with Dyjur & Lindstrom (2017) who note lack of feedback as one factor having a negative effect on teacher motivation. The teachers valued highly the personal feedback received during the project and were quick to request feedback before the badge application assessment timeframe (24 hours) was over.

This interest in testing their skill level was also shown in the effort and time spent on badge applications by teachers during the process. The further they advanced in the process, the more effort they had to put in gathering the required evidence and conducting small scale self studies to increase their skills levels to be able to meet the badge criteria. This suggests that even though the purpose of badges is to measure existing skills, they also transform to educational scaffolding elements supporting self-directed learning.

The main comments relating to developing the pilot related to internet data charges, teachers expressed a wish that participation in programs would cover the investment they need to make on data. That can be seen as an element of the enabling conditions (ability) that affect motivation as seen in Muntean (2011) and Dyjur & Lindstrom (2017).

When triggers are examined together with motivation and ability, it can be seen that this badging process was able to offer triggers, feed motivation and that the ability of teachers to participate was at a sufficient level. What this resulted in was high engagement in the process, which was indicated by the level of applications sent and the wish to continue the project beyond the original deadline.

The results of this research are similar with results from the work done by Patti Dyjur and Gabrielle Lindstrom that examined perceptions of digital badges in higher education (Dyjur & Lindstrom, 2017). The overall responses they gained from participants were similar: participants in both studies rated high in motivation to earn badges and their willingness to earn more badges from the same or another organisation. The participants in both studies also had a positive response to the ability to print their badges as pdf files.

A large number (70%) of participants found badges as a motivating factor to keep progressing with the program, though they indicated that solely gaining badges will not be a sufficient reason for them to take part in professional development. The difference between the work done by Dyjur & Lindstrom and this study was that this resarch used badges as a tool for validating existing skills rather than mark completion of a course or tasks, meaning the intention for using badges was different between this research and theirs.

What can also seen is that the results of this research are in line with previous research done by Brauer, Ruhalahti, & Hallikainen and Dyjur & Lindstrom. Another factor speaking for the validity of the research is that data collected during the pilot was collected after every badge application, resulting in close to 300 datapoints that were analysed, allowing a reasonable confidence level to be found in the validity of the findings.

In their research examining learning triggers in Finland, Brauer, Ruhalahti & Hallikainen found similar results in terms of badging being a motivating factor. (Brauer, Ruhalahti, & Hallikainen, 2018). One difference in results is that in the Finnish research the role of gamification was higher than in this project, Brauer found gamification to be the lead motivating factor for teachers while in this case gamification seemed to play a smaller role (Brauer, 2019). Three viewpoints can be proposed that might explain the difference in the results:

1. In the project implemented in Finland the role of gamification was perhaps more stressed whereas in this project, the gamification of the badging process was

limited to the introduction of achievement badges at different stages of the process.

2. Finnish teachers live in a more digital environment with more gamified solutions at their disposal and are therefore more likely to react more strongly to gamified teacher CPD than their peers in Rwanda.
3. The questions with which the role of gamification was measured were different, which could lead to respondents interpreting the question and the role of gamification differently in the two studies.

Rwanda runs a Microsoft Certified Educator programme that is equally based on teachers earning badges for their ICT skills (S. Järvinen, personal communication, December 4, 2019). However, unlike in this project that focused on validation of skills rather than learning content, the Microsoft programme issues badges as a token of completion of the course materials related to the badge (Microsoft, n.d.).

Google also runs a teacher certification programme that is based on smaller learning units completing at an individual base. However the Google programme does not offer Open badges as a way to award learning (Google, n.d.).

The badging approach used with teachers in Rwanda is based on ideas of teacher self-direction, establishment of communities of practice, gathering data on strengths in weaknesses of teachers in the predetermined competences and ideas of transformative learning.

As such the approach does not directly fit into any single model proposed by Kennedy but is able to cross over multiple models (training, deficit, standards-based, coaching/mentoring, transformative), thus developing more types of knowledge than is possible through CPD programmes that focus on a single approach like on site workshops. At the same time the approach is very fitting with the discursive development process proposed by Appleby, Pilkington (2014) that focuses on identity creation through discursive processes in contact and with the communities teachers belong to. The individual knowledge construction is done based on these interactions.

6 CONCLUSION

Making larger scale predictions on the usability of badges in other countries or domains is difficult due to the heterogeneity of badging approaches and heterogeneity of countries' and contexts where badges have been deployed. This challenge is commonly shared between ICT projects in developing countries (Thashmee & Hansson, 2018).

So far there is a limited amount of research done on the use of open badges overall and especially skills validation. There is still much to learn about the use of digital badges to develop good practices. What the authors find positive is that these results align well with existing research, despite the difference in scope and context where studies were made. Further research on using open badges in African contexts would provide value in further insights of this novel and seminal approach in providing an alternative method for professional skill validation.

The results of this study are encouraging and a clear indication to continue developing badge driven professional development. The curiosity of teachers to test and validate their skills and continued high levels of motivation throughout the project points to future possibilities in developing and researching the badging approach.

7 ACKNOWLEDGEMENTS

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REFERENCES

About Open Badges. (2016). Retrieved 18 May 2020, from https://openbadges.org/about

Appleby, Y., & Pilkington, R. (2014). Developing Critical Professional Practice in Education. Abingdon, UK: Niace.

Baartman, L. K. J., & de Bruijn, E. (2011). Integrating knowledge, skills and attitudes: Conceptualising learning processes towards vocational competence. Educational Research Review, 6(2), 125–134. https://doi.org/10.1016/j.edurev.2011.03.001

Brauer, S. (2019). Digital Open Badge-driven Learning. Lapland, Finland: Lapin yliopisto.

Brauer, S., Ruhalahti, S., & Hallikainen, V. (2018). Digital professional learning: triggers in an online badge-driven process. Education in the North, Volume 25 (1-2), 64–86. Retrieved from https://www.abdn.ac.uk/eitn/journal/545/

Butcher, J., & McDonald, L. (2007). Making a Difference: Challenges for Teachers, Teaching and Teacher Education. Rotterdam, The Netherlands: Sense Publishers.

Cambridge Assessment English. (n.d.). Digital Open Badges – What are they? Retrieved April 22, 2020, from https://www.cambridgeenglish.org/events/open-badges/

Dean, J. (1991). Professional Development in School. Philadelphia, USA: Open University Press. https://doi.org/10.1177/174114329101900409

Diaz, V., Finkelstein, J., & Manning, S. (2015). Developing a Higher Education Badging Initiative. EDUCAUSE, 1–11. Retrieved from https://library.educause.edu/~/media/files/library/2015/8/elib1504-pdf.pdf

Digital Credentials Consortium. (n.d.). Building the digital credential infrastructure for the future , A White Paper by the Digital Credentials Consortium. Retrieved April 14, 2020, from https://digitalcredentials.mit.edu/wp-content/uploads/2020/02/white-paper-building-digital-credential-infrastructure-future.pdf

DiSalvio , P. (2018, August 4). New Pathways to Credentialing: The Digital Badge. Retrieved 14 April 2020, from https://nebhe.org/journal/new-pathways-to-credentialing-the-digital-badge/

Dyjur, P., & Lindstrom, G. (2017). Perceptions and Uses of Digital Badges for Professional Learning Development in Higher Education. TechTrends, 61(4), 386–392. https://doi.org/10.1007/s11528-017-0168-2

Finnish National Agency for Education. (2016). National Core Curriculum for Basic Education 2014 (2016:5.). Helsinki, Finland: Finnish National Agency for Education.

Gatete, C. (2016, December 16). THE RWANDA WE WANT: TOWARDS 'VISION 2050' [Slides]. Retrieved from http://www.minecofin.gov.rw/fileadmin/user_upload/Hon_Gatete_Umushyikirano_Presentation_2016.pdf

Google. (n.d.). Teacher Center. Retrieved 2 May 2020, from https://teachercenter.withgoogle.com/

Hassler, B., Hennessy, S., & Hofmann, R. (2018). Sustaining and Scaling Pedagogic Innovation in Sub-Saharan Africa: Grounded Insights For Teacher Professional Development. Journal of Learning for Development, 5(1). Retrieved from https://jl4d.org/index.php/ejl4d/article/view/264

HPass. (2019, June 28). About. Retrieved 3 May 2020, from https://hpass.org/about/

Iliya , A., & Ifeoma, L. G. (2015). Assessment of Teacher Motivation Approaches in the Less Developed Countries. Journal of Education and Practice, 6(22), 10–17. Retrieved from https://eric.ed.gov/?q=motivation+teachers&ft=on&id=EJ1079453

Jirgensons, M., & Kapenieks, J. (2018). Blockchain and the Future of Digital Learning Credential Assessment and Management. Journal of Teacher Education for Sustainability, 20(1), 145–156. https://doi.org/10.2478/jtes-2018-0009

Järvinen, S., & Stockley, P. (2020a, February 20). Badging Rwanda - ICT Level 1 Badges. Retrieved March 31, 2020, from https://sites.google.com/skillsafari.io/badging-rwanda/ict-level-1-badges

Järvinen, S., & Stockley, P. (2020, February 20). Badging Rwanda - Track your progress. Retrieved March 31, 2020, from https://sites.google.com/skillsafari.io/badging-rwanda/track-your-progress

Kempen, M., & Steyn, G. M. (2008). Continuing professional development for teachers in South Africa and social learning systems: conflicting conceptual frameworks of learning. International Journal of Special Education, 31(1), 32–45. Retrieved from https://eric.ed.gov/?id=EJ1099963

Kennedy, A. (2005). Models of Continuing Professional Development: a framework for analysis. Journal of In-Service Education, 31(2), 235–250. https://doi.org/10.1080/13674580500200277

Metsäpelto, R.-L., Poikkeus, A.-M., Heikkilä, M., Heikkinen-Jokilahti, K., Husu, J., Laine, A., … Warinowski, A. Conceptual Framework of Teaching Quality: A Multidimensional Adapted Process Model of Teaching.
https://Doi.Org/10.31234/Osf.Io/52tcv

Microsoft. (n.d.). MCT Training | Microsoft Certified Trainer Certification. Retrieved 2 May 2020, from
https://www.microsoft.com/en-us/learning/mct-certification.aspx

Moodle. (2013, April 15). Moodle 2.4 release notes. Retrieved April 18, 2020, from https://docs.moodle.org/dev/Moodle_2.4_release_notes

Moodle. (2014, February 12). openbadges. Retrieved April 18, 2020, from https://docs.moodle.org/dev/openbadges

Muntean, C. I. (2011). Raising engagement in e-learning through gamification. In Proc. 6th International Conference on Virtual Learning ICVL (pp. 323-329).

OECD. (2005). Education and Training Policy Teachers Matter Attracting, Developing and Retaining Effective Teachers. Zaltbommel, Netherlands: Van Haren Publishing.

OECD. (2009). Evaluating and Rewarding the Quality of Teachers: International Practices. Zaltbommel, Netherlands: Van Haren Publishing.

Ono, Y., & Ferreira, J. (2020). https://www.ajol.info/index.php/saje/article/view/52602. South African Journal of Education, 30(1). Retrieved from https://www.ajol.info/index.php/saje/article/view/52602

Open Badge Factory Ltd. (2019). Retrieved May 18, 2020, from https://openbadgefactory.com/

Open Badge Factory Ltd. (2019). Open Badge -merkki voi olla myös digitaalisella allekirjoituksella varustettu PDF-sertifikaatti. Retrieved April 18, 2020, from https://openbadgefactory.com/badgenewsobfcase20/

Opetus- ja kulttuuriministeriö. (2016). Opettajankoulutuksen kehittämisen suuntaviivoja. Opettajankoulutusfoorumin ideoita ja ehdotuksia. Opetus- Ja Kulttuuriministeriön Julkaisuja, 34. Retrieved from https://minedu.fi/documents/1410845/4583171/Opettajankoulutuksen+kehitt%C3%A4misen+suuntaviivoja+-+Opettajankoulutusfoorumin+ideoita+ja+ehdotuksia

Oon-Seng, T., & Woon-Chia , L. (2015). Teacher Effectiveness, Capacity Building in a Complex Learning Era. SIngapore, Singapore: CENGAGE Learning.

peda.net. (n.d.). Ope.fi. Retrieved February 20, 2020, from https://peda.net/poke/projektit/tvt-hanke/ope-fi#nav

Presant, D. (n.d.). Building a trusted skills network in the humanitarian sector with Open Badges. Retrieved 3 May 2020, from https://openbadgefactory.com/badgenewsobfcase8/

Redecker, C., & Punie, Y. (2017). European framework for the digital competence of educators. https://doi.org/10.2760/159770

Republic of Rwanda, Ministry of Education. (2016). ICT in Education Policy. Retrieved from

https://mineduc.gov.rw/fileadmin/user_upload/pdf_files/ICT_in_Education_Policy_approved.pdf

Republic of Rwanda Ministry of Education. (2019). 2018 Education Statistics Report. Retrieved from http://statistics.gov.rw/publication/2018-education-statistics-report

Thashmee, K., & Hansson, H. (2018). Implementing small scale ICT projects in developing countries – how challenging is it? International Journal of Education and Development Using Information and Communication Technology, 14(1), 118–140. Retrieved from https://files.eric.ed.gov/fulltext/EJ1178348.pdf

UNESCO. (2011). UNESCO ICT Competency Framework for Teachers (Version 2). Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000213475

UNESCO. (2018). UNESCO ICT Competency Framework for Teachers (Version 3). Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000265721

University-led Digital Credentials Consortium explores technology for digital academic credentials | Open Learning. (2020, February 3). Retrieved 14 April 2020, from https://openlearning.mit.edu/news/university-led-digital-credentials-consortium-explores-technology-digital-academic-credentials

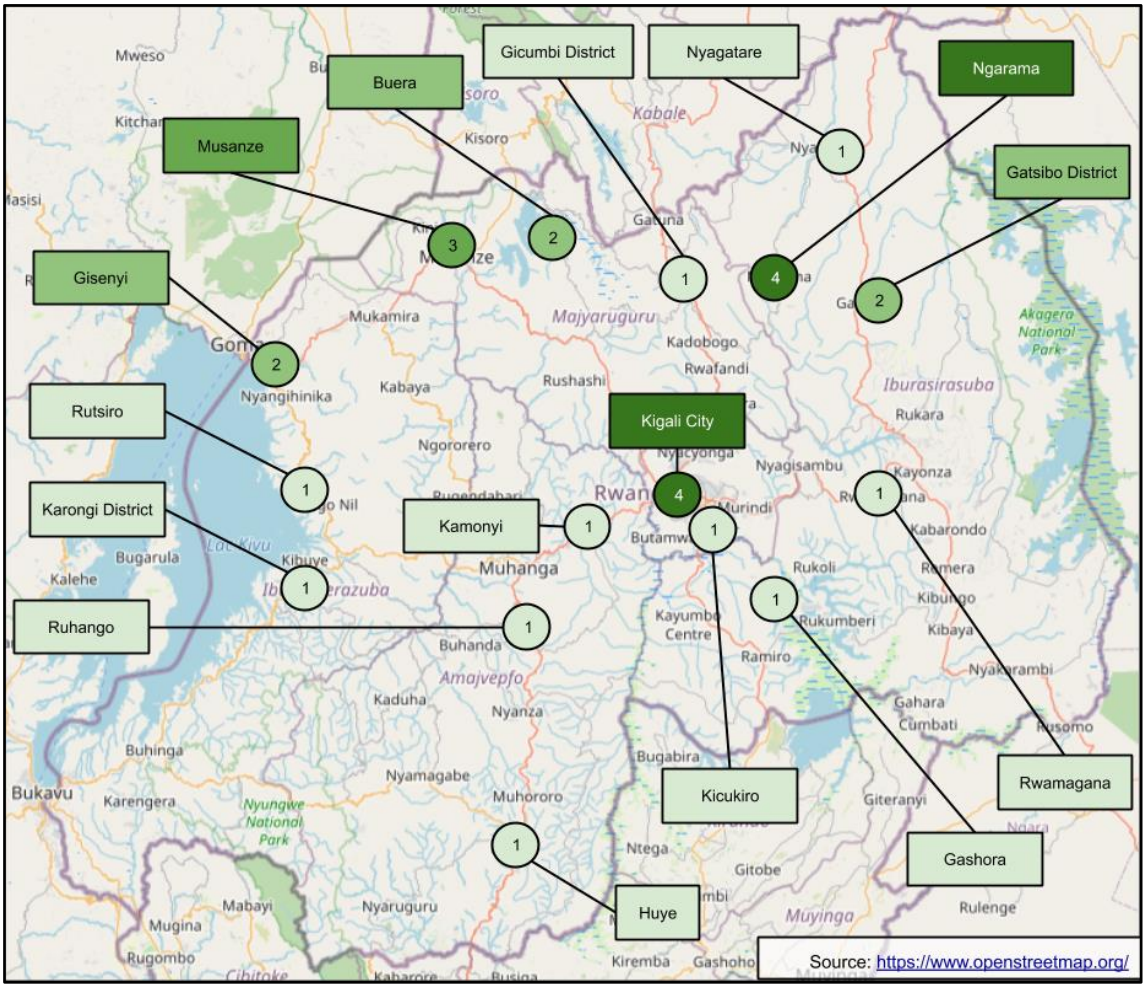
van Halsema, W. (2016). Competence and TVET Innovation in Sub-Saharan Africa: The Case of Rwanda. Technical and Vocational Education and Training: Issues, Concerns and Prospects, 487–504. https://doi.org/10.1007/978-3-319-41713-4_23

Whitehouse, C. (2011, May 19). Effective continuing professional development for teachers. Retrieved 3 May 2020, from https://research.aqa.org.uk/sites/default/files/pdf_upload/CERP-RP-CW-19052011.pdf

World Bank. (2018). Future Drivers of Growth in Rwanda: Innovation, Integration, Agglomeration, and Competition (English). Washington, D.C. : World Bank Group. http://documents.worldbank.org/curated/en/522801541618364833/Future-Drivers-of-Growth-in-Rwanda-Innovation-Integration-Agglomeration-and-Competition

SUPPLEMENTARY DATA

Geographical locations with Rwanda of the pilot teachers and number of pilot teachers from that location.



Teacher personas and profiles: A collation of each teacher's responses combining their individual pre and post survey responses and timelines of their progress during the pilot:

https://docs.google.com/spreadsheets/d/1YaSTpYiXKCys-JPkOthSA3sNDegftvP1YflnmrDYmDw/edit?usp=sharing

Teacher personas visualised into a set of more traditional persona cards:

https://docs.google.com/presentation/d/1r1GYlXic2C9i3lWS2xbomKtCQGUuz556xkw5xmXb6_Y/edit?usp=sharing

The full table of individual triggers given by pilot teachers for choosing to apply for each badge.

TRIGGER	CYBER SECURITY	EMAIL	GRAPHICS SOFTWARE	INTERNET IN EDUCATION	MAKING SMALL VIDEOS
The name of the badge sounded interesting to me.	15.52%	16.33%	20.00%	21.15%	5.56%
I wanted to collect the meta badges (5, 10, 15 etc).	15.52%	16.33%	14.29%	15.38%	11.11%
I am very familiar with the topics of this badge.	15.52%	18.37%	17.14%	9.62%	16.67%
I wanted to test if I have the skills required to achieve this badge.	25.86%	22.45%	20.00%	23.08%	38.89%
I felt that I could meet the badge criteria with reasonable effort.	17.24%	14.29%	14.29%	15.38%	16.67%
I selected the next badge in sequential order.	10.34%	12.24%	14.29%	15.38%	11.11%
SUM	100.00%	100.00%	100.00%	100.00%	100.00%
TRIGGER	PRESENTATION SOFTWARE	SOCIAL MEDIA	SPREADSHEETS	TEXT PROCESSING	YOUTUBE
The name of the badge sounded interesting to me.	17.39%	9.76%	13.33%	13.33%	16.28%
I wanted to collect the meta badges (5, 10, 15 etc).	19.57%	17.07%	15.56%	13.33%	13.95%
I am very familiar with the topics of this badge.	17.39%	29.27%	22.22%	20.00%	20.93%
I wanted to test if I have the skills required to achieve this badge.	26.09%	19.51%	24.44%	30.00%	25.58%
I felt that I could meet the badge criteria with reasonable effort.	10.87%	12.20%	13.33%	16.67%	16.28%
I selected the next badge in sequential order.	8.70%	12.20%	11.11%	6.67%	6.98%
SUM	100.00%	100.00%	100.00%	100.00%	100.00%

TRIGGER	ICT & CURRICULUM	OER	SAMR MODEL	PEER2PEER NETWORKS	PROFESSIONAL COMMUNITIES /NETWORKS
The name of the badge sounded interesting to me.	13.64%	6.67%	5.88%	5.26%	7.41%
I wanted to collect the meta badges (5, 10, 15 etc).	13.64%	13.33%	17.65%	15.79%	18.52%
I am very familiar with the topics of this badge.	18.18%	6.67%	11.76%	15.79%	18.52%
I wanted to test if I have the skills required to achieve this badge.	27.27%	46.67%	35.29%	36.84%	29.63%
I felt that I could meet the badge criteria with reasonable effort.	18.18%	26.67%	23.53%	21.05%	22.22%
I selected the next badge in sequential order.	9.09%	0.00%	5.88%	5.26%	3.70%
SUM	100.00%	100.00%	100.00%	100.00%	100.00%
TRIGGER	ICT TO SUPPORT ASSESSMENT	LESSON PLANNING, WITH ICT	MANAGING ICT FOR PROJECT-BASED LEARNING (PBL)	ICT & POLICY	RESOURCE USAGE PLAN
The name of the badge sounded interesting to me.	14.81%	11.54%	0.00%	11.11%	13.33%
I wanted to collect the meta badges (5, 10, 15 etc).	18.52%	15.38%	9.09%	16.67%	6.67%
I am very familiar with the topics of this badge.	14.81%	15.38%	9.09%	16.67%	20.00%
I wanted to test if I have the skills required to achieve this badge.	33.33%	30.77%	54.55%	44.44%	40.00%
I felt that I could meet the badge criteria with reasonable effort.	11.11%	19.23%	18.18%	11.11%	20.00%
I selected the next badge in sequential order.	7.41%	7.69%	9.09%	0.00%	0.00%
SUM	100.00%	100.00%	100.00%	100.00%	100.00%