A GAMIFIED, BLOCKCHAIN BASED, LEARNING RECORD STORE AS A PERSONAL LEARNING ENVIRONMENT COULD OFFER A SOLUTION TO THE HUMAN RIGHT OF EDUCATION

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Abstract

Although universal digital identification systems are explored by many and personal learning record stores as part of LTI or xAPI collectors do exist, the creation of a global digital identification systems is currently contested by Google, Microsoft and Facebook as most widely used 3rd-party authentication systems. Furthermore, open access to educational resources is despite the digitalization a dream for many.

Aggregating formal and informal learning data and collecting them in a personal learning record store is a very sensitive issue and can't be trustworthy offered by companies or countries. This might be a reason there are currently no initiatives that succeed to implement a global system of digital identification nor a personal learning record store for everyone.

Creating a biometric digital identity verification system to grant access to a personal learning record store where informal and formal learning achievements get aggregated by xAPI-protocol, is building the ground for further use. An artificially intelligent, tokenized, value-backed platform that analyzes personal achievements, badges and certificates and further learning opportunities according to culture and field of experience will offer additional educational resources, job opportunities or new fields of interest.

The combination of institutional or open educational resources and informal learning opportunities with selectable educational achievement maps and a tokenized value system for further access to payed learning resources has not been realized yet. By creating a token system that is backed up with real funds as part of a personal learning record store, also the un-banked population can experience learning as value and gets invested in further educational resources. Achievement maps and a non-biased evaluation and matching-system will give orientation and offer individual, personalized learning paths for further exploration as well as new possibilities to proof or certify achievements and competences.

By constantly adding new resources, learning results and achievements the data can be crunched and analyzed by artificial intelligent systems to offer clusters, trends and insights. The results in combination with an engaged community of learners can be used for further, also collaborative learning, the creation of new educational resources or for paid projects, job recruitment and job offerings. The semantic matching-system will help to find fits according to industry according to its cultural backgrounds. A blockchain as ledger will store all sensible data and build the trusted system for the users.

The concept is highlighting the elements needed for an educational solution to UNESCO's SDG 4 goals and is part of a Master thesis at Zurich University of Arts and Zurich University of Teacher Education. It should be shared and further developed in the sense of "Working Out Loud" together with interested individuals, organizations, developers, educators, NGOs and learners. The realization of a working prototype is planned early 2020 in cooperation with UNICEF or other international organizations.

Keywords: LMS, Learning Record Store, LRS, OER, SDG 4, AI, Blockchain, Digital ID, Certificates, xAPI, Batches, Matching-System, Achievement Maps, Gamification, PLE

1 INTRODUCTION

Considering that THE HUMAN RIGHT OF EDUCATION has found its instantiation within the Sustainable Development Goals (SDGs) as SDG 4, "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" [1], the means to make it happen is not as clear and little has happened since the SDGs were launched in 2015, the provision of inclusive education for refugees or unbanked learners around the world is adding complexity. The Brussels Declaration [2] of UNESCOs Global Education Meeting states that the world is not on track to achieve SDG 4 targets by 2030. 750 million youth and adults are not literate, 262 million children and youth do not attend school at all, half of all adolescents and youth complete secondary school, with only 18% in low-income

countries – and 1% of the poorest girls. It is stated that "social, political, environmental and economic changes, as well as accelerated technological innovations, have profound implications for education and training systems." Accordingly, lifelong learning opportunities for all should be supported to ensure necessary competencies for personal development, decent work and sustainable development. The declaration highlights the important role of higher education and technical and vocational education and training. It recognizes the importance of skills through non-formal and informal education and learning.

At the "UNESCO Mobile Learning Week 2019 – Artificial Intelligence for Sustainable Development" [3] it was clearly stated that data driven decisions and solutions to improve education are welcome and will be pursued further. In a joint UNICEF/UNESCO workshop, a UN-wide strategy on the future of education and learning was discussed. The SDG 4 goals got divided into three principles: education is a fundamental human right; education is a public good; gender equality. To reach the goals five strategic approaches were suggested: strengthening policies, plans, legislation and systems; emphasizing equity inclusion and gender equality; focusing on quality and learning; promoting lifelong learning; and addressing education in emergency situations.

End of March 2019 the importance of continuous professional development of teachers, efficient and effective policies, opportunities for sharing promising practices, professional autonomy and career pathways for teachers as stated in the Brussels Declaration were discussed at Zurich University of Teacher Education with UNICEF's Regional Office for Europe and Central Asia. Based on the concept paper "Realizing the rights of children to quality and inclusive education through a blended learning approach" [4] and against the background of the most diverse requirements of regional and national educational areas and the learners themselves, elements of a sustainable solution were identified.

Based on the SDG 4 goals [1], the Brussels Declaration [2], the findings of the Mobile Learning Week 2019[3], the UNICEF's concept paper [4] and against the background of the most diverse requirements of all possibly involved stakeholders and learners, the complex task of developing a sustainable digital educational platform, that serves the needs and fulfils the requirements today and in future, needs to be acknowledged. A system-wide, holistic approach to deliver inclusive, equitable and innovative education and learning for all must be taken.

It is possible to develop versatile, sophisticated solution that seems to meet all requirements. There are increasingly fewer technological hurdles hindering the design of a multinational, openness-driven learning platform. Potential challenges can often be mastered by using corresponding resources. However, fundamental questions of data protection and the right to privacy are increasingly coming to the fore and become part of the political and regulatory agendas. Ethical and culture-based questions regarding the use of data are getting into focus, especially in regard of vulnerable groups and of biased data and its use for machine learning in artificially intelligent systems. Sustainable, long-term operation and further ongoing technological and educational development of a digital educational service pose additional challenges for a provider.

This article obeys the following structure. In section 2 the objectives and requirements of the proposed solution are formulated and the problematic of culture bias, data protection and financing are laid out. An achievable solution is described in section 3 and section 4 concludes the work.

2 OBJECTIVES AND REQUIREMENTS

As mentioned in the introduction, the design and implementation of a multilateral learning platform through the distinctive application scenarios and needs of individual stakeholders and future users are a challenge that can be met through a holistic approach. A platform that offers a solution to the human right of education has different objectives with regard to

- how and in what settings we learn or teach;
- how we access, maintain and use our personal data;
- how we produce, access, reuse and exchange content;
- the skills and competences that are reflected in curricula or by industry;
- the feedback, e-assessment and certification;
- social interactions, communities of practice and personal learning networks;
- maintenance, data ownership and operational funding

In the sub-section "Objectives, Procedures and Methods of Instructional Design", the requirements of users, institutions and organizations with regard to the intended way of learning and teaching, and under consideration of various settings are explained. The aim is to empower the user for lifelong learning. For

example, requirements change before, during and after enrolment in institutional training courses or job seekers have different needs than students with a defined curriculum.

In the second part "Requirements and Potentials", the general and institutional requirements are formulated. Subsequently, the paper examines the aspects of personal profiles, their comparison with offered competence profiles and the design of possible learning paths. Formative aids as well as summative learning objective checks are important elements of learning support and contribute to lifelong learning, in addition to social interactions, learning groups and the design of learning networks.

2.1 Objectives, Procedures and Methods of Instructional Design

Before reflecting on different requirements and frameworks to promote lifelong learning, one should think about what characterizes good learning. Conole [5] summarizes it as:

- Encourages reflection
- Enables dialogue
- Fosters collaboration
- Applies theory learnt to practice
- Creates a community of peers
- Enables creativity
- Motivates the learners

These can be realized with technologies in many respects and fostered by various pedagogical approaches that can be described as associative, constructivist, situative and connectivist. In addition, Conole stresses the importance of ensuring and improving the quality of the learner experience in Massive Open Online Courses (MOOCs). In addition to the MOOCs, there are several other educational and instructional designs that all require quality control.

2.1.1 Motivation, Curricula and Instructional Design

Learning desires or needs may be personally motivated or initiated by an institution or organization. A personal interest in learning may be oriented towards other goals than the often curricular-based offers of countries, organizations or institutions. An educational platform should serve both. Learners are expected to create their learning pathways according to their individual aspirations. A rich, finely segmented, filterable educational offer provides the basis for designing appropriate learning paths according to personal goals.

Institutions, organizations or countries must be able to provide identifiable individuals or groups with appropriate educational resources in accordance with curricula or educational plans. Planned courses and monitoring of learning objectives in compulsory learning situations must be provided for.

In order to meet the individual needs of learners and the requirements of education providers, a learning platform must also facilitate various forms of blended learning, the use of content repositories and the provision of fully virtualized learning environments. These settings can be supported by tutors or teachers or are designed to require complete independent study.

- Every learning platform should offer help and guidance to the learners and motivate them in form of
- possibilities of an individual curricula design according to needs;
- formative elements like tests or learning progress indicators;
- collaborative exchange in communities of practice or feedback from peers, tutors or teachers;
- learning outcome assessments, badges, statements of accomplishments and verified certificates;
- influencing behavior while taking cross-cultural differences into account.

Learning Management Systems (LMS) and MOOCs usually integrate parts of these elements. Informal learning and the use of social networks, on the other hand, tend to take place in Personal Learning Environments (PLE) or Personal Learning Networks (PLN).

2.1.2 Gamification of Learning Experiences

One also should think of introducing game design elements or integrate game design principles to influence behavior and motivation. The hope is, that adding elements, such as those found in games, to learning activities will create immersion in a way similar to what happens in games. By incorporating

game mechanics in the design of a learning process, we would engage learners in a productive learning experience.

Dichev's review about gamifying education [6] "reveals that (i) insufficient evidence exists to support the long-term benefits of gamification in educational contexts; (ii) the practice of gamifying learning has outpaced researchers' understanding of its mechanisms and methods; (iii) the knowledge of how to gamify an activity in accordance with the specifics of the educational context is still limited." Further it is stated, "This does not mean though that gamification cannot be used with success in a learning context. It simply means that the educational benefits of gamification have not been scientifically confirmed yet."

Antonaci identified in her study [7] game elements that are eligible for further testing within Massive Open Online Courses (MOOCs). She suggests, "Empowerment, Smooth Learning Curves and Communication Channels" to enhance users' learning performance, "Levels, Clues, Communication Channels, Smooth Learning Curves, Goal Indicators and Skills tree" to enhance the goal achievement and to enhance MOOC users' engagement "Guild, Skills tree, Storytelling."

An adaptive gamification model based on relations of player types and gamification features as suggested by Lavoue [8], could enhance motivation and participation of learners separately. The suggested educational platform should be built in a way one is able to introduce game design principles and connect gamified elements with learning analytics to track the users' activity in the form of sequential streams (i.e., Activity Stream and its derivatives). Then a dynamic learner profiles adaption based on activity, could take the evolution of preferences into account.

2.1.3 Lifelong learning and Accessibility

SDG 4 is based on a broad understanding of education and the principle of lifelong learning. To complement and complete formal school education, lifelong learning opportunities should be provided through non-formal pathways with adequate resources and mechanisms and through the promotion of informal learning, as well as through the use of ICT. The learning platform outlined by this paper will provide access to the tested, qualitative materials and offers, links the learners, institutions and organizations and enables a comparison of learning goals, learning statuses and programs. This can make a significant contribution to achieving the objectives in the sense of the INCHEON Declaration and Framework for Action for the implementation of SDG 4.

As stated in Lindberg's article [9] "Around 40 percent of the world's population now has access to the internet. Increasingly, however, new users come online using a mobile phone only, especially in emerging markets such as India, Indonesia, Brazil, and Nigeria." The platform must be accessible with mobile devices. It has to support the demand to enable all learners to receive education at any time and almost anywhere. Thus, it also offers refugees or war victims in times of need a learning opportunity and a place of documentation (learning progress, certificates). To cover the full potential of mobile learning, one should focus on formal and informal learning settings and perspectives that range from cognitive to participatory learning viewpoints as stated in UNESCO "A lifeline to learning: Leveraging technology to support education for refugees" [10].

Previously, various procedures and methods of instructional design have been brought to light. Based on individual needs and curricular requirements, a system of identification, pacing and scheduling is needed. Various forms of interaction, feedback, assessment and certification have to be provided. A quality control of learning objects and activities as well as of the instructional design has to be implemented. Game design principles should be combined with learning analytics and for the creation of adaptive, dynamic learner profiles to support good learning. The support of boundless and frontierless lifelong learning for all is not only a technical but also a privacy and data protection issue that has to be thoroughly discussed.

2.2 Requirements and Potentials

In the previous sub-section "Objectives, Procedures and Methods of Instructional Design" different facets of online supported learning and derived elements of a digital learning environment were presented. This sub-section explains the requirements to support learners, institutions and organizations on their way to achieving the SDG 4 goals and shows the potential of connecting the elements. The following aspects are described:

- General and institutional requirements;
- Personal profiles, their comparison with competence profiles and the creation of learning path recommendations;

- Formative support systems and summative review options;
- Recognition, validation and accreditation
- The problem of the unbanked;
- Learning groups, social interactions and learning networks;
- Sustainable, long-term operation and further ongoing technological and educational development

The aspects presented in this section are necessary elements of a digital learning environment to meet the different needs and requirements of learners, teachers, institutions and organizations.

2.2.1 General and Institutional Requirements

Registration, Access and Secure Digital Identity

To grant access to a digital learning platform for as many users as possible, it is important to design the user interface and the login procedures simple, clear and flawless. Today many users are accessing platforms through 3rd-party authentication systems provided, for example, by Facebook, Twitter, Google, Microsoft, etc. [11]. These comfortable opportunities to register and login are widely used. Today most learning management systems (LMS) or massive open online courses (MOOCs) offer 3rd-party authentication as an additional service to its own user registration and login process or even provide access only through 3rd-party authentication.

With respect to privacy laws and (trans-)national data protection legislations, 3rd-party authentication by tech-giants might get inhibited in the future. Therefore, ideally a digital educational identity (DID), provided by or in the corporation with international organizations like UNICEF, UNESCO, the Internet Society and so on, would grant identification and access. A strong encrypted DID would facilitate boundless lifelong learning and grant learners the security of independent non-profit, non-governmental care. In general, "Authorities and institutions - including the European Commission and the European Parliament – are trusted more than commercial companies [12]. While widely applauded as a tool for empowerment and inclusion, DID have also raised many red flags, especially for human rights experts as discussed at recent re:publica convention [13]. Several different digital identification systems have already been or are in the process of getting developed, but none has had a global educational perspective yet. The concept of a self-sovereign identity as a novel framework for the creation, management and interaction of digital identities, represents a major leap for both digital and analog interactions [14].

Open Educational Resources, Open Licensing and Interoperability Standards

Open Educational Resources (OER) "… help improve education across the globe. They are important for developing countries, where many students may not be able to afford textbooks, where access to classrooms may be limited, and where teacher-training programs may be lacking. They are also important in wealthy industrialized countries, where they can offer significant cost savings" [15].

Downes [16] states that in addition to the provision of an open-source licensed infrastructure "the primary mechanism employed in support of open access, and therefore, open learning generally, is open licensing." Not only free access to content is important, but also the ability to share content thus accessed (typically under Creative Commons license).

To exchange content, also in form of learning objects like repositories of learning resources (like exercises, tests, e-assessments, parts of created courses, etc.), between various learning management systems (LMS), interoperability standards have to be met. As Bakhouyi [17] states "The standards of content and e-learning structure are established to ensure the interoperability of e-learning systems so that accesses to sources of information such as content reuse or discrimination of subjects from different sources at different times are possible." Interoperability standards (SCORM, IMS Caliper Analytics, xAPI, CMI-5) lay the ground to be able to exchange, combine and (re-)use content from various environments like LMSs (Moodle, ILIAS, OLAT, etc.), MOOCs or from more informal learning resources as YouTube, Wikipedia and other cloud-based learning resources.

A multilaterally implemented digital learning environment has to build its core upon "Open Educational Resources", aggregate content consequently and under an "Open License" policy and ensure interoperability, reusability, flexibility and scalability by applying newest standards.

Institutional Requirements

For institutions, organizations and other educational providers, it is not only important to be able to provide OER and open licensed materials to learners but also to ensure and be ensured that the materials provided are of good quality and meeting their educational standards.

In addition to the general requirements of a system that can enable "Education for All" in the sense of SDG 4 objectives; such a system must make involved, participating organizations and partners identifiable and visible. Offers from UNICEF, curricula from institutions or from a country and additional resources from further educational providers like Kahn Academy, edX, Coursera, Pearson, Udemy and so on should be clearly displayed, tagged by the system and easily selected by the learners.

A comparison of the materials of organizations or syllabus of countries with specified standards enables selective and individual recommendation of learning paths to the platform's users upon the provided learning objects and materials. Organizations, institutions and teachers can address individual learners and learning groups and offer structured curricular learning paths upon their own or combined standards and curricula.

2.2.2 Profiling, Matching and Learning Path Recommendation

In addition to the individual recording of existing skills and competences through self-evaluation, confirmation by peers or through badges and certifications, the personal value profile in relation to skills, competences and learning objects should also be compared with the offers of regional, national or global organizations and institutions. Every learning program is based on values. The contents conveyed, the competences to be achieved and also the way in which they are presented are culturally shaped. The concepts of the producers or the specifications of national curricula define the offer. These cultural values correspond or collide more or less with the learners' ideas and values.

Individual as well as institutional conceptions of current and future important competences that are necessary for the exercise of a certain profession are systematically recorded. An evaluation of, for example, the values of what constitutes a good teacher or good teaching allow the individual user to compare his or her own ideas with the standards of an institution or organization. As a result, supply-specific or curricular gaps and similarities can be mapped not only at the level of content, skills and competences, but also at the level of values.

Profiling serves, on the one hand, to control supply, as described above as an institutional need, and on the other hand, to support lifelong learning under the aspect of changing needs over time.

Conversely, organizations and institutions can look at the level of competence and attitudes of a group on specific issues and compare them with their own or other organizations' and institutions' value and competence profiles. The membership of users in learning groups, classes or training courses also give group administrators an overview of the existing and still to be developed competences of their learning group and their basic attitude towards the standards on which the offer is based.

Achievement maps

Achievement maps are intended to provide further access to new skills and competences in a visually appealing way. They map individual skills and competences and point to learning opportunities to acquire new ones. The achievement map supports the reflection of one's own learning status and the comparison with future learning or career goals. Further comparisons and their evaluations, also by means of artificial intelligence (AI), are conceivable and possible according to need and provisioned data.

However, AI systems struggle to be responsive to the values, goals, and principles of different communities. We now have too many examples of systems that make incorrect tradeoffs, focus' on "needs" that do not really exist, or otherwise reflect the biases and perspectives of the developers rather than the people who are affected by the AI. "Big Data analytics and artificial intelligence ("AI") draw non-intuitive and unverifiable inferences and predictions about the behaviors, preferences, and private lives of individuals." [18]

2.2.3 Formative Guidance and Summative Review Options

Feedback is an important component to be able to classify one's own learning success. Proven successes have a motivating effect. A simple form of feedback is the representation of learning progress within a selected learning object, course or learning path. By offering short tests within learning units, learning success can be verified quickly.

The exchange with other learners in discussion forums, peer reviews and feedback from tutors in accompanied learning units on learning products and reflections form further possibilities to be able to classify one's own learning process. Communities of Practice work together on learning products. The learning process is also promoted by the group in a participatory way.

If a learning object, course or learning path is successfully completed, badges can be awarded as success badges, for example. Learning success can also be tested in automated assessments.

Learners should also be awarded a statement of accomplishment or verified certificates after successfully completing courses or modules of institutions or organizations. Usually, certification in a digital environment requires a continuous identity check. If the learner's verification does not take place on the spot in an examination institution, systems, such as those described by Fenu [19], can now also verify the learner's identity in various ways. A digital identity as described in "General and Institutional Requirements" could serve as a basis for identity verification and trusted certification.

2.2.4   Recognition, Validation and Accreditation and The Problem of the Unbanked

In 2018, Thellmann stated in a Cointelegraph article [20], that two billion adults were still unbanked, not having a bank account at all and moreover, many with bank accounts do not have access to financial services and are underbanked. In 2015 in the United States 33.5 million households were recognized by the Federal Deposit Insurance Corporation as unbanked or underbanked [21]. In 2012,s Chaia stated that 2.5 billion adults, just over half of world's adult population, do not use formal financial services to save or borrow, 62% of adults, nearly 2.2 billion, living in Asia, Africa, Latin America and the Middle East are unserved and a little more than 800 million served adults live on less than $5 per day [22].

Besides learner's satisfaction and completion, recognition constitutes as one of the three incentives of MOOCs. According to Yang, "Recognition, validation and accreditation (RVA) refers to the establishment of arrangements to make visible and value all learning outcomes (including knowledge, skills and competences) against clearly defined and quality-assured standards. RVA covers the whole process, including identification, documentation" [23] On the MOOC List, a directory of Massive Open Online Courses and Free Online Courses from different providers, there are various forms of recognition listed. One can filter courses with "Open Badges," free "Statements of Accomplishment," to pay "Statements of Participation," "Statements of Accomplishment," "Verified Certificates" and all its combinations [24]. Pietkiewicz found in a cost comparison of courses by Coursera and edX price variations from USD 49 up to USD 949 for certificates and from USD 25 up to USD 100 for the authentication procedure [25].

Without access to financial services like bank accounts or debit/credit cards, the underbanked or unbanked population will not be eligible for RVA of paid courses and MOOCs. "In order to facilitate lifelong learning, MOOCs should play a role of a bridge between formal and non-formal education" [25]. By providing a solution where the use of the personal learning record store in combination with a secure self-sovereign digital educational identity acting as a virtual bank account and by establishing payment solutions with educational providers, the problem could get solved.

2.2.5   Dedicated Learning Network and Social Interactions

Social interactions play a key role in the process of learning. At the same time, learning increasingly takes place in virtual communities and knowledge is acquired through the connections between the learner and his personal learning network (PLN). Collaborative learning with digital technologies and open educational resources is part of the proposed learning platform.

Communities of practice (CoPs) foster both individual and group knowledge and through the common activities, a sense of common identity and its shared practice, CoPs have been identified as an important success factor in educational contexts [26]. Social media and mobile devices are creating a range of opportunities. CoPs are established as part of the PLN and rely on elaborated communication tools like chat systems, e-portfolios, blogs, wikis, forums, etc. to share, interact upon and co-create knowledge and practice with members of the platform.

Learning activities are not only happening on a specifically dedicated learning platform but also on numerous other (learning) platforms and social media services like Youtube, Facebook, Google, etc. As Göschelberger [27] states "while the term PLN emphasizes the micro-scale of learning networks i.e. the local network of an individual, macro-scale analytics of the network provide essential information about roles of individuals and affiliation to communities. … personal learning networks evolve over time and

changes in the personal learning network reflects information about the development of the learners' focus, preferences and aptitudes."

The analyzed, combined data over all activities will be stored together with formative and summative learning records, building a personal learning record store as the backbone for learning analytics [28]. The personal learning record store (LRS) connects the learning data across different learning management systems, institutions and organizations and is therefore, a crucial element of the proposed learning platform.

2.2.6 Sustainable and Trustworthy Long-Term Operation

The operation of an educational system that combines all the above elements, meets today's and tomorrow's requirements and serves as a provider for other systems can only be established and ensured by trusted technology companies or universities with the financial support of international organizations, countries, NGOs, fundraisers and philanthropic benefactors.

Already for the interconnection of OER and the support of Open Access for learning objects, as well as for an independent, secure digital ID, joint efforts of universities, countries and international organizations are necessary.

The establishment and maintenance of an independent Learning Record Store, which can be administered by the user with ease and which is accessible from various platforms taking into account the user settings, as the core of Learning Analytics, Gamification, Profiling and Matching, as the basis for achievement maps, in each case taking into account cultural characteristics and ultimately as a repository of verified batches, participation attestations and certificates, requires the patronage of independent, trustworthy parties.

The quality assurance of content, settings and the platform, the qualification and classification of learning objects as well as the periodic review of cultural values and ideas could be jointly undertaken by the users. This collective work on the common learning environment could generate new ideas for learning and development and be compensated with social capital in form of tokens, similar to Oracle's N2N platform [29].

3   RESULTS

First, the "Objectives, Procedures and Methods of Instructional Design" were described to elaborate various elements of a multilateral learning platform. Then the "Requirements and Potentials" of such got laid out in more detail.

Openness, accessibility, interoperability, profiling, individualization, adaptivity, social interaction, data control, and the comparison of learning offers by all providers and on the basis of personal learning objectives and values, form the elements of the digital learning system, which is recommended. Profiling and matching, based on learning objectives, goals, curricula and cultural values, is an essential part and must be implemented due to cultural differences and individual needs. The learning record store (LRS) forms the core that establishes connections between decentralized learning systems, maintaining a continuous log of learning activities performed by learners and serves as an engine for gamification. In combination with the LRS, the proposed digital educational identity (DID) acts as a key for access, recognition, validation and accreditation (RVA) in free or paid learning courses.

All parts mentioned are essential for the creation of a learning environment that serves the purpose and needs outlined. Combined they will empower learners, institutions and organizations in their goal to ensure lifelong learning according to their needs and requirements.

The core elements of the solution to be taken into account are:

- Simple and easy registration and login procedures through a secure self-sovereign DID as single sign-on solution that also serves the requirements for RVA.
- Strict use of OER, open licensing and interoperability standards to remix learning objects according to needs and requirements.
- LRS as core for learning analytics, personalization, profiling, matching, gamification, learning path recommendation and the creation and storage of badges, certificates and other achievements.
- Solutions to interact with other learners via chat, in system mail, blogs, e-portfolio functionalities, project co-creation spaces, etc. to foster good and collaborative learning.

- A trusted ledger as supported by blockchain technology for tokenization and monetarization.

A blockchain based approach for connecting learning data across different Systems, Learning Record Stores, institutions and organizations as proposed by Ocheja [28] is a possible solution. Leveraging on the unique features of blockchain technology, solutions are proposed that ensure consistency of learning data, availability, immutability, security, privacy and access control. A decentralized personal data-management system as described by Zyskind [30] is "combining a blockchain, re-purposed as an access-control moderator, with an off-blockchain storage solution. Users are not required to trust any third-party and are always aware of the data that is being collected about them and how it is used. In addition, the blockchain recognizes the users as the owners of their data." N2N [29] as part of Oracles' cloud infrastructure, is "in the process of developing a blockchain "personal value ledger." The idea is to take work projects from employment histories and employment agencies, vet them through a transcript and credential-evaluation services, and then make those "certified assets" available to universities and employers."

By building secure DID and LRS solutions, a tokenized reward system can now be introduced. Similar to games, special achievements, user engagement or collaboration can be rewarded with points or tokens. Badges and free statements of participation can be traded as well. Adding social capital tokens for quality assurance jobs a system is created, that values education and offers also the unbanked learners a possibility to "earn" capital that ideally can be spent for paid educational courses and services. Further a whole closed educational marketplace could be created. To give the token a value, a price has to be set, and a system introduced to regulate the token production and distribution. In a first step, the token is backed by initial capital from NGOs, governmental support, donations, etc. and later by revenues from the private sector.

The active or passive use of the culturally situated competence profiles by companies in recruiting personnel or feeding projects and tasks into the international community, as well as the verification and identification of skills from institutional certificates and training courses, could generate private sector income streams. Further financial resources could include rights of use for research or royalties for infrastructure use. The more active users the platform will have, the more network effects [31] will have an effect, which can be used profitably and contribute to the long-term operational sustainability of the platform.

In view of the learning experience platform (LXP) market growing up fast and vendors like Degreed, LinkedIn, EdCast, Percipio, and IBM have started to add skills-based discovery tools into their systems, the provision of an international learning platform could benefit, support or disrupt this market. These vendors are starting to build skills assessments, skills inferences, and skills-based learning paths, similar to the solution described. [32]

4 CONCLUSIONS

Today we fail the SDG 4 goals dramatically, but technology available could already create a system that supports the future of education and learning. All proposed elements were developed, prototyped or theoretically described. By taking a holistic perspective and shifting the emphasis to the learner and good learning, institutional solutions provided first get out of focus and values as identity, access, sharing, learning objectives, gamification, skills, social interactions, collaboration, networks, motivation, opportunities, achievements, security and privacy take over. Introducing curricula, institutional requirements and private interests again, profiling and matching according to culture and need, broaden the vision and a closed, tokenized monetary system is introduced as a solution to enable unbanked learners' access to education and foster motivation through gamified elements and game design principles.

The task to realize a system proposed seems huge and joint efforts are needed. Observing today's investments in digital education solutions and artificial intelligence initiatives it should be possible to channel some funds and resources and take a real step to solve the educational crisis described. Key stakeholders are international organizations like UNESCO and UNICEF and all the initiatives supporting its goals. Education and technology providers like Harvard with its LabXchange project [33] or HPI [34] and other developers of innovative solutions described should be invited to add their expertise. Cultural values, similarities and differences can be revealed by tools like Nextexpertizer [35].

As a next step, the platform with its learning record store as a core that could offer a solution to the human right of education has to be refined, contextualized and then presented to stakeholders and

supporters. After proof of concept, a working prototype with all functions and elements would support financing and realization.

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