



WHITE PAPER

Critical Evaluation of Quality Criteria and Quality Instruments in OER Repositories for the Encouragement of Effective Teacher Engagement



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Table of Contents

ABSTRACT	2
KEYWORDS.....	2
ACKNOWLEDGEMENTS	2
INTRODUCTION.....	3
DEFINITION OF TERMS.....	3
PURPOSE OF THE WHITE PAPER	4
BACKGROUND AND THEORETICAL APPROACH OF THIS REVIEW.....	5
METHODOLOGY.....	6
INTENDED BENEFITS OF THIS REVIEW	7
OVERVIEW OF LEARNING RESOURCE QUALITY CRITERIA AND FEEDBACK SYSTEMS 9	9
TAXONOMIES OF QUALITY IN RELATION TO USING OER.....	9
THE IMPORTANCE OF QUALITY TO THE UPTAKE OF OER.....	14
EVALUATING QUALITY IN OER.....	15
RANKING SYSTEMS & COLLECTIVE INTELLIGENCE	17
EXAMPLES OF REPOSITORIES WITH EFFECTIVE QUALITY SYSTEMS.....	18
<i>KlasCement</i>	18
<i>Curriki</i>	20
<i>MERLOT</i>	21
<i>Further Discussion</i>	23
THE QUALITY CHALLENGES: Three Short Case Studies.....	25
<i>Case Study 1: Scientix</i>	25
<i>Case Study 2: GeoGebra</i>	27
<i>Case Study 3: Photodentro</i>	30
DIFFERENT APPROACHES TO QUESTIONS OF QUALITY IN OER	31
CONCLUSION: A CRITICAL EVALUATION OF QUALITY CRITERIA.....	32
APPENDIX: ACTIONABLE POINTS & RECOMMENDATIONS	36
BIBLIOGRAPHY	38

ABSTRACT

This paper offers a short evaluation of the variety of quality criteria used in Open Educational Resources and some of the methods and practices in use to ensure quality. The paper surveys and reviews effective practices and technologies used in learning object repositories to more effectively engage educators in providing structured feedback. The aim is to provide a useful resource to repository owners and managers seeking to develop and improve on the services they already offer to educators. An important additional aim is to support teachers in using digital learning resources in the classroom so that the deployment of OER in schools in particular might grow and flourish over the next few years. 'Quality' is by no means a simple concept to define in the context of OER repositories and the paper seeks to lay out a number of different ways in which the concept can be analysed and made useful. The paper was produced through a short-term qualitative analysis in which we examined a number of existing OER repositories, a wide range of academic and other writings on the subject, a small number of interviews with key experts and some published slideware relevant to the subject. The paper offers a set of potential further research questions as well as a distillation of a number of 'actionable points' that OER leaders might be able to use as starting points for ongoing development work on their own quality assurance systems.

KEYWORDS

Quality, Quality Criteria, Quality Circle, Collective Intelligence, Evaluation, OER, Repository

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INTRODUCTION

The Open Education movement has gained substantial traction since the term Open Educational Resources (OER) was coined in 2000. However, there remains much scope for further advocacy and promotion of Open Education generally and of the principles and values that the concept embodies. Open Education is a broad canvas that is able to accommodate a range of understandings of the term. It is also a term that gathers an array of different elements beneath its umbrella, of which OER is one, although one that is much discussed. OERs are generally stored in a Learning Object Repository (LOR).

DEFINITION OF TERMS

In terms of the understanding of 'open' in OER, this paper takes as a starting point the statement from David Wiley that:

*"Open is a continuous, not binary, construct."*¹

In other words, there can be no fixed definition of 'open' in the context of OER. Instead it should be interpreted in relative terms – is a repository, for example 'open enough' to be defined as offering OER, or is one repository 'more open' or 'less open' than another? It should be acknowledged, however, that many of those who work in the field prefer to accept more fixed and prescriptive definitions of *openness*.

'Open', in the sense used in this report, relates to the extent to which users are granted rights to use a repository or a resource in relation to the 5Rs of open educational resources, namely:

Retain - the right to make, own, and control copies of the content (e.g., download, duplicate, store, and manage)

Reuse - the right to use the content in a wide range of ways (e.g., in a class, in a study group, on a website, in a video)

Revise - the right to adapt, adjust, modify, or alter the content itself (e.g., translate the content into another language)

Remix - the right to combine the original or revised content with other material to create something new (e.g., incorporate the content into a mashup)

Redistribute - the right to share copies of the original content, your revisions, or your remixes with others (e.g., give a copy of the content to a friend)²

¹ <https://opencontent.org/blog/archives/1123>

² <http://opencontent.org/definition/>

The more that the rights attached to a resource or a repository meet the 5Rs, the more it can be judged to be 'open'. The 5Rs also offer a reasonable foundation for an exploration of quality in relation to OER and open repositories generally.

The oft-accepted definition of OER is that developed by the *The William and Flora Hewlett Foundation*, derived from a number of preceding definitions:

“Open Educational Resources are teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions”.³

This definition states that OER can include both digital and non-digital resources. A shorter, sharper definition comes from OECD, but one that focuses on digital resources in particular:

“Digitised materials offered freely and openly for educators, students and self-learners to use and re-use for teaching, learning and research.”⁴

This paper will address itself mainly to digital resources, although the issues dealt with pertain broadly to non-digital resources as well.

PURPOSE OF THE WHITE PAPER

In their paper, *Open Educational Resources Platform Based on Collective Intelligence*, the authors, De Oliveira *et al*⁵, set out in succinct terms the issue that lies at the heart of this white paper.

“An OER is characterized by its metadata....The OERs are stored in repositories. The purpose of OER repositories is to support educators in searching for content in a structured way, sharing their own resources, reusing existing materials and creating new resources through adapting or translating, and in collaborating with other members of the user community by commenting upon, reviewing, promoting and developing resources.”

Educators searching for OER by and large make use of repositories to search for, locate, download, use, re-use and adapt the learning resources they need for their teaching. It would seem to make sense that effective repositories will make this process as simple and as easy-to-use as possible. They should also seek to give teachers mechanisms that will allow them to provide professional feedback on the value and usefulness of the resources once they have deployed them in their teaching. By this means, and others, the repository will then be able to offer teachers some information by which they are able to pre-determine to some extent the quality of the resources they select.

³ <https://hewlett.org/strategy/open-educational-resources/> *The William and Flora Hewlett Foundation*. Retrieved 27 March 2013

⁴ <http://www.oecd.org/education/cei/38654317.pdf> Ischinger, B OECD *Giving Knowledge for Free*, p.10

⁵ <https://ieeexplore.ieee.org/document/8537851> de Oliveira, et al *Open Educational Resources Platform Based on Collective Intelligence* p.1

The focus of this white paper, therefore, is to undertake a short evaluation of quality issues in relation to OER, with a focus on the K12 sector where that is possible, and to examine any techniques that can be identified, either in proposals by educators and academics or in actual use in OER repositories, that might support educators in integrating digital learning resources into their teaching practice. Much of the literature and research into Open Educational Practices (OEP) generally, and into OER in particular, has been produced and carried out from a higher education (HE) or technical & vocational education & training (TVET) perspective, and, to date, with a few honourable exceptions, less so from the perspective of teachers and students in the schools sector. For whatever reasons, there seems to have been an identifiably lower level of engagement with Open Education from within the K12 sector generally over many years. Of course, many of the Open Education lessons learnt and applied within HE and TVET will apply just as much to OEP in schools, but we should be cautiously aware that their application in K12 might raise some contextually specific issues too.

BACKGROUND AND THEORETICAL APPROACH OF THIS REVIEW

This white paper has been commissioned by the Learning Resource Exchange (LRE) Subcommittee of European Schoolnet. The LRE Subcommittee is a group of European Ministries of Education and other organisations that promotes and supports the creation, discovery, exchange, and (re-)use of OER and OEP. The LRE Subcommittee feels that the time is right to survey and review best practices and technologies used, or proposed for use, by learning repositories to more effectively engage educators in the terms already described above.

The paper provides a review and a small number of recommendations on quality criteria (either already in use or based on current pedagogical research literature) and user-feedback systems that are most effective in closing the gap between OERs, in proposals or in repositories, and their actual use in classrooms. The paper attempts to describe established good practices for educational repositories with regard to rating and evaluative systems and feedback mechanisms based on professional judgement or on well-founded quality criteria, with a focus on systems that capture user feedback within OER repositories themselves.

To achieve these aims, the paper was required to encompass five key deliverables:

- A brief overview of learning resource quality criteria and ranking systems
- Key examples of implementations of these ranking systems that capture user feedback on OERs
- Challenges faced by K12 educational repositories that have implemented ranking systems based on user feedback and the solutions adopted by repositories that address challenges;

- An evaluation of the effectiveness of different types of quality criteria for structuring feedback and ranking systems that support teachers in using digital learning resources in the classroom;
- A comprehensive bibliography referencing relevant readings and studies that can be used in selecting, developing or implementing quality criteria and ranking systems that effectively exploit user feedback for evaluating and using OERs.

Some of the deliverables were more successfully achieved than others. In particular, a rather small number of OER repositories were identified that seem to have implemented effective systems for evaluating quality or for ranking resources by quality, and few also that systematically involved users in feeding back on the quality of the resources they find or deploy. However, within that small sample, there were some examples of good practice.

METHODOLOGY

Given the short timescale available to produce this paper, the information and data were examined and processed on the basis of the type, goals and deliverables set out above. In conducting the review, we used the following techniques:

- a) Content analysis
- b) Small-scale surveying of key repositories and individuals
- c) Desk research
- d) Interviews by email and by audio

The research is exclusively qualitative in nature, using an exploratory approach to an existing range of academic and other work in the field. A few key insights were gained from extensive reading of the material found and from a subsequent attempt to synthesize and summarize the thinking around questions of quality in relation to learning resources.

A number of working repositories were identified and as many of them as could be identified within the time available were examined. The examination was also carried out within the constraints sometimes imposed by the repositories themselves with regard to authentication and ease-of-access. It was hoped to gain a feel for those repositories, if any, that have sought to establish effective practice in the use of quality criteria and ranking systems.

A very small number of key experts were identified (from our own knowledge and from our reading of the literature) who it was felt could offer insights based on their greater experience of the field, and 'interviews' were conducted by email or by phone.

With each part of our approach, the aim was to focus in particular on the situation in relation to K12, this despite an apparent dearth of material and practice relating to the schools sector in Open Education. Some good practice in the K12 sector was identified and this has been highlighted in the paper.

However, it was necessary to depend to some extent on thinking, writing and practice emanating from HE and TVET too.

The information gathered for the report ranges across a broad spectrum of sources, including some well-known (and some less-well-known) academic papers, educational blogs and websites, social media groups (including Facebook, Youtube and others), white papers and a variety of reports. Throughout the process, the investigation sought to address the requirements of teachers in relation to their actual needs in the classroom and to avoid where possible any emphasis on top-down, centralized, pre-determined assertions of quality for resources. To this extent, it is hoped that the longer term needs of real educators, especially in the schools sector, will be met by those repositories that endeavour to give teachers themselves influence over the determination of content quality. The aim is to provide some semblance of a way forward for those who seek to make further progress in this area. The report also focuses on the assumption that, no matter how much quality can be ascribed to any single resource or to any collection of resources, whether open or otherwise, if those resources do not have a positive impact on students' learning, they are ultimately of no educational value. This is, however, an assumption that is itself somewhat problematic when we consider OER in relation to the needs of teachers and their teaching practice as well as in relation to the learning that follows from that teaching.

Having perused the subset of the identified literature, it is difficult not to agree, in general, with the view of Paul Bacsich, Barry Phillips and Sara Frank Bristow in their Final Report on *Learner Use of Online Educational Resources for Learning*, that:

“The literature on learner use of online educational resources is very immature, with a lack of meta-reviews. The overwhelming majority of published studies do not generalise beyond their particular contexts of study. There is no consistent methodology.”⁶

Their finding extends a long way into the literature on quality criteria and feedback systems in learning resources, whether they are open or otherwise, and that is perhaps even more the case when the focus is on these questions in relation to K12. Of course, those who have already contributed over the years to the literature on OER have done so extensively and insightfully. However, the field is still young and needs to grow and mature over the next few years, building on the very good work already done.

INTENDED BENEFITS OF THIS REVIEW

In a short report such as this, it is difficult to capture anything more than an impression of the state of play with regard to the questions at hand. However, it

⁶ <https://www.advance-he.ac.uk/knowledge-hub/learner-use-online-educational-resources-learning-luoerl-final-report> Bacsich, P; Phillips, B; Bristow, SF *Learner Use of Online Educational Resources for Learning* P.3

is hoped that the thoughts gathered here will be able to act as a spur to deeper and broader work in future. Additional research will undoubtedly be required to promote and expand on the efforts that have already been made to ensure that educators are better able to select and integrate digital resources into their teaching practice across Europe and beyond. If the paper leads to further research into questions raised here, that will be regarded as success.

OVERVIEW OF LEARNING RESOURCE QUALITY CRITERIA AND FEEDBACK SYSTEMS

TAXONOMIES OF QUALITY IN RELATION TO USING OER

Any attempt to define quality in relation to educational resources, whether open or not, is fraught with difficulty. Quality is both subjective and heavily context-specific, and attempting to set out the parameters of quality in relation to OER often leads to subjective layer built upon subjective layer, with each level of definition proving difficult or impossible to measure in any simple way. There is also the simple assertion that there can, ultimately, be no inherent or intrinsic sense of 'quality' within a resource other than in a particular context where it has to serve specific needs for educators, students or self-learners. It must impact on the learning in a positive way. A 'good' resource in one context might be a 'poor' resource in another – it depends upon the use to which it is put and for whose benefit.

As David Wiley so succinctly describes the issue:

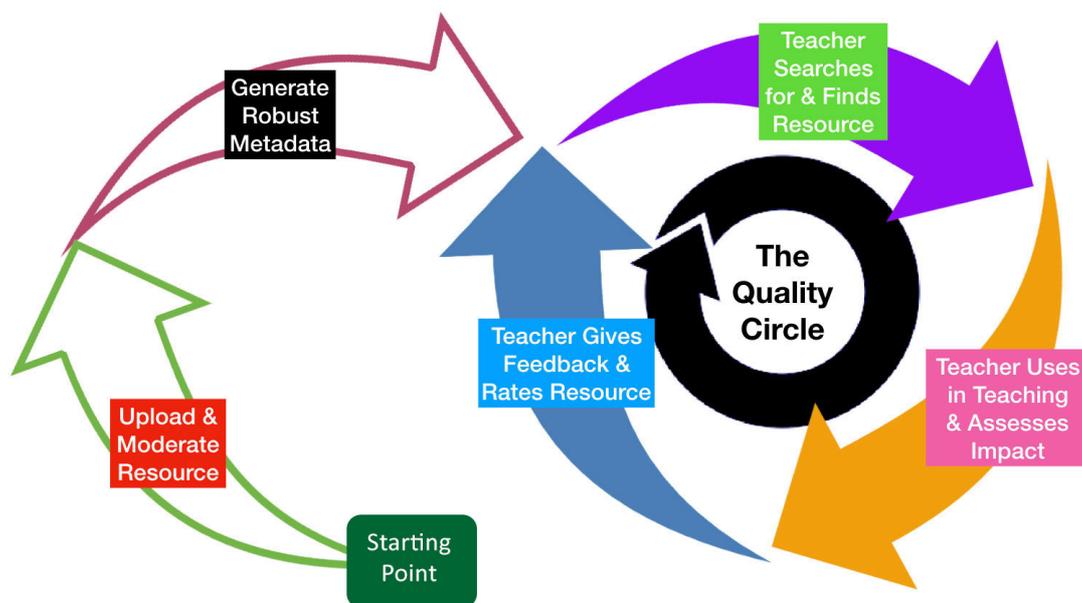
“...the core issue in determining the quality of any educational resource is the degree to which it supports learning. But confusingly, that’s not what people mean when they say that a textbook or other educational resource is “high quality.”the degree to which it supports learning is the only characteristic of an educational resource that matters.”⁷

However, Wiley’s contention, though a fundamental truth, is not enough. It is too simplistic and it takes little account of the realities of a teacher’s needs. Taking account of the broader responsibilities required in teaching and learning, it is important to keep in mind that teachers, before teaching or learning even takes place, have to find learning resources that are appropriate to their teaching requirements, that are readily searchable and available, and that, where possible, already have some perceived level of trustworthiness because the resource has previously been curated or has proved useful to other educators. So while Wiley’s view is central to any consideration of quality, so too are the needs of teachers as they seek out ‘good quality’ learning resources in planning their teaching and their students’ learning. Of course, teachers want their lessons and the resources they deploy to have a positive impact on students’ learning, but they cannot know whether that will be the case until after the teaching has been carried out and the learning has been assessed. Before all that can happen, teachers need some assurance about the perceived quality of a resource in order to help them select the best content possible for their teaching.

So in looking at quality with respect to OER, we should think of ‘quality-before-the-fact’ as well as ‘quality-after-the-fact’. Neither is sufficient, and both are necessary in contemplating the domain of OER. If, out of their teaching practice, teachers are able to evaluate the quality of the resources they used in the

⁷ <https://opencontent.org/blog/archives/3821> Wiley, D *Stop Saying “High Quality”*

classroom, that, in a sense, completes a circle of quality: each time the circle is completed, the perceived quality of a resource can be rendered more and more trusted. So, after a resource has been deployed the teacher is able to give feedback on whether and how the resource was useful or not. An effective repository should allow the educator to complete this 'quality circle', from discovery, to use, to professional evaluative feedback, and the process can then be repeated as many times as necessary.



A Simple Outline of the Notion of the 'Quality Circle' in Relation to OER

This can lead to a ranking of the resources available from a repository or other source, so that when another educator comes along looking for similar resources, the repository is able to serve up an ordered list that reflects previous evaluations. Even better is a function that enables sorting by more than one metric, as is the case in some of the examples examined in this paper.

The quality of a learning resource depends on the demands and requirements both of the educator and of the learner rather than on some pre-determined characteristic of the resource:

“In this sense, quality assurance and validation cannot come from a top-down approach that will perform a centralized quality control. On the contrary, such quality control should take into account the end-users, engage them proactively in providing feedback and suggestions for enhancements, support them in adapting the content themselves and sharing it with the community.”⁸

Taking this approach further, one of the most useful delineations of quality in this context has been provided by Camilleri, Ehlers and Pawlowski in their “State

⁸ http://lre.eun.org/wp/LRE_White_paper_001.pdf Chounta, Irene-Angelica *A review of the state-of-art of the use of machine-learning and artificial intelligence by educational portals and OER repositories* p.22

of the Art Review of Quality Issues Related to OER”⁹. In their paper they set out the following features, some of which are universal or general while others are more specific to a particular instance of use by which it might be possible to come to an understanding of the quality of a learning resource:

Efficacy – by this is meant the fitness for purpose of the object / concept being assessed. Within the context of OER, this might include concepts such as ease-of-reuse or educational value.

Impact – impact is a measure of the extent to which an object or concept proves effective. Impact is dependent on the nature of the object / concept itself, the context in which it is applied and the use to which it is put by the user.

Availability – the concept of availability is a pre-condition for efficacy and impact to be achieved, and thus also forms part of the element of quality. In this sense, availability includes concepts such as transparency and ease-of-access.

Accuracy – accuracy is a measure of (a) precision and (b) absence of errors, of a particular processes or object.

Excellence – excellence compares the quality of an object or concept to (a) its quality-potential, i.e. the maximum theoretical quality potential it can reach.

The first of these factors – efficacy, or fitness for purpose – might be viewed as the single factor most relevant to teachers seeking effective resources for their teaching. Whether that is the case or not, all five factors taken together embrace both the question of impact on learning and the need for a ‘pre-definition’ of quality that works for the teacher hoping to create interesting learning experiences for students. In taking forward these characterizations of quality, they propose a conceptual framework built around three sets of quality approaches:

Quality Assurance of Resources – ... a lifecycle model to understand the quality factors affecting individual resources, including their creation, use and evaluation

Quality Assurance of Strategies / Policies – using a maturity model... the institutional development of policies which govern and promote the creation of OER

Quality Assurance of Learning – ... course-specific quality assurance, including processes of teaching, assessment and recognition¹⁰

By taking this approach, they go beyond defining quality in terms simply of some intrinsic characteristics of the resources. For example, they outline the value reinforced in the resources by the features built into the process of creating the resources in the first place. Even here, though, the ultimate quality of the resource, no matter the calibre of its provenance, can only be measured against

⁹ <https://pdfs.semanticscholar.org/475a/50bbc6bb0b0e580aa1470ff88d972b60983d.pdf> Camilleri, Anthony F.; Ehlers, Ulf Daniel; Pawlowski, Jan *State of the Art Review of Quality Issues related to Open Educational Resources*

¹⁰ Camilleri, Anthony F. et al *ibid.*

its effectiveness in facilitating learning. They note too, in passing, that applying the process of resource-creation to OER is necessarily more complex than the same process applied to traditionally-produced resources, given the potential multiplicity of facets of authorship, sharing, modification, use and re-use in OER.

In their paper “*Quality Assurance in the Open*” Atenas and Havemann¹¹ considered the wider approach of looking at the shared characteristics of OER repositories rather than the quality of the resources themselves. They took as a starting point the assumption that:

“The purpose of OER repositories is to support educators in searching for content in a structured way, sharing their own resources, reusing existing materials and creating new resources through adapting or translating...”¹²

On this basis they set out what they identify as the defining characteristics of the most effective repositories, characteristics that are either social or technical, or both. While the table below would be difficult to translate into guidelines for teachers seeking to evaluate resources, it does serve a potentially useful purpose for those who are trying to develop effective and fully-functioning repositories¹³.

Quality Assurance	Description	Themes	Characteristics
Featured resources	Ability of featuring resources that are potentially of high interest for teachers because of their design or content.	Search, Share, Collaborate	Social
User evaluation tools	Tools for the resources to be evaluated by users aiming to rate a resource.	Collaborate	Social
Peer review	Peer review as policy to revise and analyse each resource to ensure its quality.	Collaborate	Social
Authorship	Analyse if the repositories include the name of the author(s) of the resources.	Search, Reuse	Social
Keywords	Methodically describe the resources to facilitate the retrieval of the materials within certain specific subject areas	Search	Technical
Metadata	Introduce standardised formats of metadata (Dublin Core - IEEE LOM - OAI-PMH ¹⁴) for interoperability	Search, Share, Reuse	Technical

¹¹ <https://eprints.bbk.ac.uk/8609/1/30-288-1-PB.pdf> Atenas, Javiera and Havemann, Leo (2013). Quality assurance in the open: an evaluation of OER repositories. *INNOQUAL: The International Journal for Innovation and Quality in Learning*

¹² Atenas & Havemann, *ibid*, p.24

¹³ We are grateful to David Massart for offering clarification on this distinction

¹⁴ OAI-PMH is a protocol for exchanging metadata, not a metadata format. See: https://en.wikipedia.org/wiki/Open_Archives_Initiative_Protocol_for_Metadata_Harvesting

Multilingual support	Design the interface of the repository in a multilingual way to widen the scope of users by allowing them to perform search of content in different languages.	Search, Share, Reuse, Collaborate	Technical
Social Media support	Introduce social media tools to enable the users to share the resources within social media platforms.	Search, Share, Reuse, Collaborate	Social, Technical
Creative Commons Licences	Specify the type of Creative Commons Licence per resource or give information about the specific type of licence for all the resources.	Search, reuse, collaborate	Technical
Source Code or Original Files	Allow downloading the original files or source code of resources so they can be adapted.	Reuse, Collaborate	Technical

The importance of ensuring quality in digital learning resources (indeed any learning resources, no matter their format) cannot be underestimated. Camilleri, Ehlers and Pawlowski, already cited, made the important point that, although open learning resources are generally available, they are ‘not frequently used’. In the reasons for why this might be so, they list the following:

“...[lack of] organisational support, a lack of sharing culture within organisations, lack of skills, quality, trust or time and skills for adaption. Only one element is related to the availability of technical tools for sharing and adapting resources. Not a single barrier relates to the question of accessibility and availability.”¹⁵

So, lack of quality (including, we presume, *perceived* lack of quality as a consequence of a paucity of prior evaluations), or even a simple lack of information about quality, is a determining factors in the relative lack of actual use of digital learning resources. In the creation of digital learning resources, the European Consortium for Accreditation suggests¹⁶ a number of quality criteria which should be taken into account when designing such learning objectives:

- Internal and external stakeholders should be involved in the process of designing and revising learning objectives, for example by participating in meetings, pedagogical boards, satisfaction surveys, evaluation procedures, etc.
- Learning objectives should be described in a comprehensible way. In particular, they should:
 - Be defined in clear and concrete terms (short and simple sentences),

¹⁵ Camilleri, Anthony F; et al, ibid p.25

¹⁶ Camilleri, Anthony F.; et al ibid. p.17 Quoting from European Consortium for Accreditation - http://ecahe.eu/w/images/b/ba/Publication-Learning_Outcomes_in_Quality_Assurance_and_Accreditation.pdf

- Focus on what students are expected to be able to demonstrate and describe observable abilities which can be assessed.

However, given that the perception of quality is just one of several barriers to uptake and usage of OER, any strategies undertaken to improve quality must be seen as just one facet of policies designed to increase the use of OER in any educational sector. Questions of trust (itself one element of quality, of course), time, skills and culture must be dealt with alongside questions of quality.

THE IMPORTANCE OF QUALITY TO THE UPTAKE OF OER

Some studies have looked at what teachers need in order to encourage them to use OER repositories. In her paper, *Classification and Quality Criteria for Open Educational Resources in the Field of Foreign Language Learning*, Zita Krajcso made the self-evident but wholly-necessary point that:

“...teachers need high quality resources.”¹⁷

However, she went on to say:

“Furthermore, the pool of resources must be big enough to offer something for many. The searching mechanism for the resources is also crucial; teachers need efficient ways for searching and finding materials (reached within three clicks) from different curricula backgrounds (classification by subject, topics and level).”¹⁸

And she continues, echoing the concept of the ‘quality circle’ already mentioned:

“Classification as such is crucial for the search mechanism, but quality factors determine the long-term successfulness of digital resources on the users’ side. In the case of OER these factors relate to input (quality of the structure and potential), implementation (process) and output (outcome) aspects.”¹⁹

She makes the important point that ensuring quality in the process of creating learning resources does not necessarily equate to high impact on the eventual learning intended by its use:

“...[a] focus on the input quality criteria of OER....has not been proven as causal for the learning effect yet. More research is needed to confirm and extend the following quality criteria.”²⁰

We is possible, perhaps, to assert with some confidence that this is a causal relationship that *is unlikely ever to be proven as a universal rule.*

¹⁷ [https://content.sciendo.com/configurable/contentpage/journals\\$002fjplace\\$002f4\\$002f1\\$002farticle-p48.xml](https://content.sciendo.com/configurable/contentpage/journals$002fjplace$002f4$002f1$002farticle-p48.xml) Krajcso, R *Classification and Quality Criteria for Open Educational Resources in the Field of Foreign Language Learning* p.49

¹⁸ Krajcso, R *ibid.* p.49

¹⁹ Krajcso, R *ibid.* p.50

²⁰ Krajcso, R *ibid.* p.50

EVALUATING QUALITY IN OER

In general, it was difficult to identify a significant body of work relating to specific tools or techniques that can be used, and more importantly are already being used, by educators and others to evaluate the quality of the resources they use. A small number of repositories were identified that have successfully implemented effective feedback quality mechanisms and these will be outlined on pages 18 to 24 below.

In terms of the question of quality both in the creation and choice of OER (as opposed to the quality of the resource in relation to its impact on learning) a number of attempts were identified that set out some guidelines that teachers could deploy to assist them in using OER well. A relatively clear and straightforward rubric was created by the University System of Georgia (the USG is composed of 26 higher education institutions including four research universities, four comprehensive universities, nine state universities and nine state colleges, as well as the Georgia Public Library Service, all in the US State of Georgia). A component of USG called *Affordable Learning Georgia*²¹ set out the following guidelines for teachers:

AFFORDABLE LEARNING GEORGIA

OER Evaluation Criteria Clarity, Comprehensibility, and Readability

- Is the content, including any instructions, exercises, or supplemental material, clear and comprehensible to students?
- Is the content well-categorized in terms of logic, sequencing, and flow?
- Is the content consistent with its language and key terms?

Content Accuracy and Technical Accuracy

- Is the content accurate based on both your expert knowledge and through external sources?
- Are there any factual, grammatical, or typographical errors?
- Is the interface easy to navigate? Are there broken links or obsolete formats?

Adaptability and Modularity

- Is the resource in a file format which allows for adaptations, modifications, rearrangements, and updates?
- Is the resource easily divided into modules, or sections, which can then be used or rearranged out of their original order?
- Is the content licensed in a way which allows for adaptations and modifications?

²¹ <https://www.affordablelearninggeorgia.org>

Appropriateness

- Is the content presented at a reading level appropriate for higher education students?
- How is the content useful for instructors or students?
- Is the content itself appropriate for higher education?

Accessibility

- Is the content accessible to students with disabilities through the compatibility of third-party reading applications?
- If you are using Web resources, does each image have alternate text that can be read?
- Do videos have accurate closed-captioning?
- Are students able to access the materials in a quick, non-restrictive manner?

Supplementary Resources

- Have you reviewed these supplementary resources in the same manner as the original OER?

While the tenor of this particular rubric is fairly specific to its own institutional setting (for example, at least some of its focus seems to be on making available complete courses as well as single-use resources - teachers are more likely to require the latter than the former), it does seem to offer simple guidelines that could be adapted for many other contexts where teachers are either creating or choosing OER, or both.

It should be noted in passing that, according to a recent piece from Libby V Morris, *USG's Affordable Learning Georgia* has saved students more than \$31m on textbook costs.²²

More pertinent to this paper, Morris goes on to raise the question of quality, amongst a number of other issues, that she believes ought to inform the research agenda on OEP and OER for the next few years at least:

“The quantity of open materials is large and growing, and the widespread enthusiasm is evident. Next up is to build a more robust research agenda to better understand quality, creation and adoption processes, and outcomes. What are the effects of open educational resources on course development and implementation? On student learning? What are the characteristics of creators and earlier adopters? How do faculty members identify, select, and evaluate open resources for college-level courses? How do instructor-designed resources differ from adopted and adapted resources in course design and effect on learning? Will students’ prior experience with OER affect motivation to independently locate and use other free materials for learning? How will this influence achievement and success?”²³

²² <https://link.springer.com/content/pdf/10.1007/s10755-019-09477-7.pdf> Morris, Libby V *Contemplating Open Educational Resources* p.2 published in *Innovative Higher Education* (2019) 44:329-331

²³ <https://link.springer.com/content/pdf/10.1007/s10755-019-09477-7.pdf> Morris *ibid.* p.3

Many of these questions play directly to any consideration of quality in relation to OER.

RANKING SYSTEMS & COLLECTIVE INTELLIGENCE

De Oliveira *et al* in their paper, already cited, *Open Educational Resources Platform Based on Collective Intelligence*, describe how cumbersome the task can be for teachers to search for, locate, download and use OER from repositories:

“Their content can be of mixed quality, with several resources lacking important descriptive metadata which, allied to the often sub-optimal indexing from their search engines, results in the user having to sort through many irrelevant content when querying for specific educational resources. Since it is often easier for users to search for content on their preferred search engine, these repositories are rarely accessed.”²⁴

For these reasons, an intelligent user of Google or any other capable search engine is often able to identify learning content and even OER more effectively than is possible with the internal search capabilities of many currently operating OER repositories (although with some honourable exceptions, as will be seen in the case study on *KlasCement* below). Given the added fact that many repositories are slow to refresh their cache of content (usually for good, though sometimes bureaucratic, reasons), and that a universal search engine can be used effectively to pinpoint recently created resources from across the Web, the need for an effective system that will truly facilitate the task of the teacher seeking resources from within a single repository is obvious.

If a repository is to compete with Google and its peers, it must be able to match them within its own limited domain in terms of ease of use, flexibility and power, and of course the repository itself needs to be extensive enough to offer a large and enticing cache of resources for the educator to wish to return to again and again to mine for content.

De Oliveira *et al* posit the idea that this can most effectively be achieved through the development of a platform that exploits the concept of *collective intelligence*:

“The platform’s goal is to provide an interactive web platform with social network features, to ease the publication, search and ranking of open educational resources through a collective intelligence. Although collective intelligence may bring to mind the idea of group consciousness, in computer science it usually means the combining of behavior, preferences, or ideas of a group of people to create novel insights.”²⁵

They seek to harness collective intelligence to create a system that will rank content (and users) over time and through multiple uses in which:

²⁴ <https://ieeexplore.ieee.org/document/8537851> de Oliveira, et al *ibid.* p.1

²⁵ <https://ieeexplore.ieee.org/document/8537851> de Oliveira, et al *ibid.* p.1-2

“...the higher the score, the more reliable the user or the content is...”²⁶

Collective intelligence, when combined with machine learning, is also the means by which bureaucracy can be reduced, since:

“The Platform trusts in the community to decide which user is allowed to publish resources, giving high ranking users the ability to publish and invite new users as publishers. The new resources go through an automatic filtering, where machine learning algorithms try to further mitigate the presence of inappropriate content. The result of this filtering is then validated by high ranking users, to avoid any wrongly classified resource.”²⁷

This approach formed the basis for the creation of a prototype platform, called *Plataforma MEC de Recursos Educacionais Digitais*²⁸ (MECRED for short), in partnership with Brazil’s Ministry of Education. The platform, as of October 2018, had some 30,000 published educational resources and 5000 registered users averaging 1200 downloads per month. While it was not possible to make use of the platform for the purposes of this review, the approach outlined by the authors above is one that could perhaps be encouraged and learned from. Some consideration, however, might be given to the expectation that combining collective intelligence and machine learning can only be truly achievable where the repository enjoys a critical mass of data, big enough for ML to function effectively.²⁹

EXAMPLES OF REPOSITORIES WITH EFFECTIVE QUALITY SYSTEMS

A small number of repositories were identified that, it is felt, are making good use of quality feedback and ranking. We focus on three of these here that offer interesting examples to consider in the context of the long-term development of OEP, but given more time, it is certain that others could have been identified too.

KlasCement

KlasCement³⁰, an open repository started by one teacher, Hans De Four³¹, in a school in Flanders in 1998, is now a valuable and extensive OER repository supported by the Ministry of Education that serves educators in Flanders (and in the Netherlands, by dint of their shared language), as well as across Europe. With more than 220,000 unique users, a very high percentage of them active, and with more than 58,000 resources currently held in the repository, KlasCement is a major player amongst OER repositories in Europe and beyond.

²⁶ <https://ieeexplore.ieee.org/document/8537851> de Oliveira, et al *ibid.* p.2

²⁷ <https://ieeexplore.ieee.org/document/8537851> de Oliveira, et al *ibid.* p.2

²⁸ See: <https://plataformaintegrada.mec.gov.br/home>

²⁹ Thank you to David Massart for making this point

³⁰ <https://www.klascement.net>

³¹ <https://www.klascement.net/profiel/1/> You need to be registered on KlasCement and logged in to view this profile

The available resources cover many different types of learning materials, including articles, downloadable learning materials, websites, apps/software, interactive exercises, images, videos, audio materials, and others. Registered users can make flexible use of the resources, being able to search, view, download, re-use and adapt content for their teaching and learning requirements. They are also able to comment on content, give ratings to individual resources and can print resources as well as share them by email or on Twitter, Facebook and other social media platforms.

KlasCement is a continually developing platform, one that seeks to stay at the forefront of OER functionality, not for its own sake but in order to continue to offer its user-body the most effective and useful educational repository that it can into the future. Those who direct KlasCement (a group that still includes its founder) use a group of part-time teachers employed by the Ministry of Education to ensure that all content, whether user-generated or not, meets their minimum standards of quality before it is approved for inclusion in the repository. These quality standards include, amongst others:

- That the resource metadata meets the IEEE-LOM Metadata standard to ensure that it enables full interoperability, covering title, keywords, subject matter etc
- That the resource also includes additional metadata to covers areas such as pedagogical context, theme, etc.
- That the resource is fully proof-read, free of mistakes, trustworthy, curriculum-related and practical
- That there are no copyright violations
- That it offers an identifiable usefulness in an educational setting

There is also a 'crowd-sourced' component that takes account of user reviews, comments and ratings. For example, for each resource available through KlasCement, the teacher or user can communicate an issue about the resource to moderators – they can raise issues of factual error, problems with hyperlinks, or any other issue that the platform should take account of.

To help educators, KlasCement delivers search results based on a mathematical formula that includes:

- Correspondence with the keyword in the search bar
- Scores given by users (and the number of users that give the score),
- Time online
- Type of contributor (teacher, student, company etc)

The end result is a platform that serves its users to the extent that, within its own immediate regional and national context, it encourages many users to bypass the ubiquitous Google and instead to go first to KlasCement when they are searching for good and trustworthy content for a lesson or a course. In their constant desire to improve the functionality of KlasCement so that it better meets the needs of its users, the platform's managers have indicated that they would like to be able to create a more detailed and richer 'collective intelligence' than they are currently using. For example, the score given by a teacher to a resource that has been used in teaching has a limited utility given the fact that the score might be

given for a variety of reasons: design of the resource, cultural compatibility (an assessment that, of course, will vary from culture to culture), factual errors, and many others. Each of these, and any other, reasons, might in themselves be significant but if a future user does not know what that reason was, then the score in itself has restricted value.³²

KlasCement is an OER repository that has been able to grow and prosper organically since its humble origins more than two decades ago, to the point now where it offers teachers and students in Flanders and beyond a truly valuable and admirable platform. But even more commendable than what has been achieved to date is the determination of those who lead it to continue to improve the quality of its offerings to teachers. It is a repository that deserves to be better known beyond its own original boundaries.

Curriki

The feedback mechanisms employed by Curriki³³ are also a useful reference point in this discussion. Curriki is an American education non-profit whose aim is to build a large global community library of OER, and they place sharing at the heart of their mission. They ask members to:

- Share what you learn.
- Share what you know.
- Share your content.
- Together, we can make education more equitable.

When you search for content on Curriki³⁴ the resulting list of resources offers a number of functions that a teacher can use to enhance the search and to evaluate resources for others in the future. There are links offering a greater level of information on subjects, appropriate grade/age levels, and resource-types, as well as links to enable the teacher to share the resource by email, on Facebook, Twitter and Google Classroom, and as a URI (for example, in a blog post). Users can flag the content as inappropriate and also nominate for review. Finally, of course, a user can give the resource a rating between 1 star and 5 stars, a feature already discussed in the section on KlasCement above. Curriki additionally rates resources according to its own rubric, from NR (not yet rated) up to 3.0.

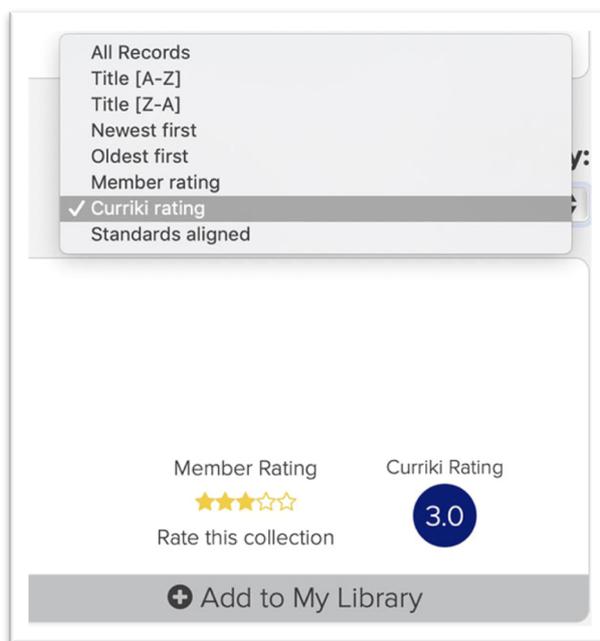
When a user conducts a search they are able to sort the resulting list of resources according to multiple criteria: by title (A-Z or Z-A), by newest first or oldest first, by member rating and by Curriki rating. Interestingly, it also enables resources to be sorted by 'standards aligned'. Indeed, the search function can be enhanced by searching according to whichever curriculum standards you wish to be aligned to. This is most obviously where Curriki's limitations become evident to

³² Indeed, if a score out of 5, for instance, is fraught with difficulty, then a simple like/dislike binary evaluation of a resource is even more problematic, since the reason for the choice can vary considerably, from applicability to a particular group of learners, to educational richness, to grammatical correctness, to pedagogical principles, and so on.

³³ www.curriki.org

³⁴ Note that the Curriki website proved problematic at times in the Safari browser on Apple Macintosh, problems that were not apparent on other browsers

an international audience. Despite its global aspirations, Curriki is very much an established American platform and so the (admittedly very long) list of standards that resources can be aligned to is almost exclusively American, from Common Core to many individual State standards.



Finally, as a member of Curriki, a user can also add the resource to their personal library of content.

Curriki is very much focused on the K12 sector and, from a brisk perusal of the site, most of the content does seem to offer resources of at least reasonable quality to teachers and many appear to be of high quality. Its American origins might, of course, limit its usefulness to European and other international schools systems. Nonetheless, it offers a model that other OER repositories could learn from.

MERLOT

Another American repository of much longer standing than Curriki, is MERLOT³⁵, one which is very well-known generally in the Open Education movement. It offers access to curated online learning and support materials and content-creation tools, and is led by an international community of educators, learners and researchers. MERLOT was set up in 1997 at the *California State University Center for Distributed Learning* and has a Higher Education focus. As such its usefulness to K12 educators is necessarily limited. However, it does appear to offer a good model in relation to the evaluation of quality from which, as with Curriki, other OER repositories sited elsewhere in the world could learn.

³⁵ <https://www.merlot.org/merlot/index.htm>

MERLOT is similar to Curriki (and possibly offered a model that Curriki might itself have learned from) in that it offers users the capability to rate a resource from 1 star to 5 stars. Results of a content search can be sorted by their ratings, but they can also be sorted by whether or not users have commented on the resource or added their own 'learning exercises' to the resource. The search function also, importantly, permits searching by accessibility, and by its inclusion in any 'bookmark collections' or 'course e-portfolios'.

A 5-star rating system such as this might have the virtue of simplicity. However, it can also be argued that such a system is too simplistic, as already noted in the section on KlasCement above. The underlying reasons why a user might give a score of 1 out of 5, example, can differ so greatly that the score given really offers little of substance to subsequent users of that resources, since they will not know whether the low score was given because of poor design or an error of fact or a culture-clash or whatever. On the other hand, if a score can be ascribed alongside some qualitative comment as to the reason for the score, that would at least go some way to increasing the utility of the bare rating.

As a centrally curated repository, there is a 'top-down' aspect to MERLOT, but also a 'bottom-up' aspect. All the materials are contributed by members (membership is free), but many of the materials submitted go through a peer-review process, overseen by any one of twenty editorial boards. Each editorial board is managed by an editor and associate editor, and each has a team of peer reviewers.

"All of these items have been contributed by the MERLOT member community, who have either authored the materials themselves, or who have discovered the materials, found them useful, and wished to share their enthusiasm for the materials with others in the teaching and learning community."³⁶

Materials are reviewed on the basis of:

- Quality of content
- Potential effectiveness as a teaching tool
- Ease of use

MERLOT even provides training for peer reviewers, although all peer reviewers are recognised authorities in their own field.

Crucially, MERLOT is not a repository in the sense that it actually stores all the content within its own storage space. Rather, it is a metadata-based repository. In other words, all of the content made available through MERLOT is retained in its original location and it is the metadata attached to the resources that make them searchable in MERLOT. The content is merely rendered discoverable and retrievable through MERLOT. Of course, this creates the overhead of having to

³⁶ http://info.merlot.org/merlohelp/topic.htm#t=MERLOT_Collection.htm

verify all the links on a regular basis. MERLOT carries out this task on a monthly basis and reports a deletion rate of approximately 2% on average.

This is a model that, on the one hand, might appear more flexible and expandable than a fixed repository that stores all of its content within its own bounds. However, it should also be noted that, in accessing a system such as this, the teacher runs the risk of content previously used disappearing the next time it is searched for, a problem that is unlikely to occur in a repository in which resources are stored on a fixed single server or set of servers (such as is the case with *KlasCement* already described).

Both Curriki and MERLOT offer very easy-to-use mechanisms to users who wish to rate the content they download, using a simple 5-star system. Other systems offer user-feedback systems that are much more complex. One of the most



OER Commons User-Feedback System

complex found during the review was that offered by *OER Commons*³⁷ in which users first have to align the content to one or more of a large number of US-based curriculum standards, and then are asked to evaluate the resources across six further sets of criteria.

Further Discussion

It is possible to conclude that *KlasCement*, *Curriki* and *MERLOT* all offer, to some extent, systems that work on the basis of a form of 'collective intelligence' not dissimilar to that outlined by De Oliveira *et al* above. The simple fact that large numbers of users are evaluating resources within a very large cache of content builds a level of common and shared knowledge across the platforms that would appear to serve the broad needs of their communities of users very well indeed. It should be noted, however, that those developing and managing *KlasCement* feel that they can and will go further in developing the concept of collective intelligence in their repository.

Large and effective repositories such as these also enable the 'quality circle' concept to operate, ensuring some measures of quality both 'before the fact' – i.e. when the teacher is trying to locate good quality usable content for use in teaching practice – and 'after the fact' – i.e. when the impact of any particular resource is assessed and such intelligence is fed back into the system.

³⁷ <https://www.oercommons.org>

A cursory examination of various categories of resources in *OER Commons* searched for reveals that many of the resources within the repository are as yet unevaluated. The complexity and somewhat bureaucratic nature of the evaluation process might have a bearing on this, but the effect is that any perception of collective intelligence dissipates through the system's seeming lack of use. The ease-of-use of a system for evaluating and feeding back on a resource is, it can be inferred, a significant factor in determining whether or not the resources are evaluated to any useful extent. Complex and cumbersome systems are less likely to be used successfully or extensively.

Of course, feedback mechanisms, as well as being too complex or cumbersome, can also be too simplistic. An example of this that can be taken from beyond the world of OER repositories is the tool that Youtube provides to enable a viewer to like or dislike a video, the simple thumbs-up or thumbs-down, which in effect works in similar fashion to the 'Like' facility in Facebook. Using such a tool in an OER repository would certainly make the task of feeding back simple for educators. However, as already noted (p.24) the value of a simple binary 'like' or 'dislike' is likely to be inadequate for the purposes of ranking resources for users in any rigorous way.

However, a ranking system that at least lets users see how many times the resource has been opened, and more importantly, downloaded, would at least offer some notion of the popularity of a resource. Whether that popularity can be translated into an assessment of quality is questionable, of course, since a resource created for a niche subject will appear to be much less popular than a much more prevalent subject. A simple ranking by 'number of times downloaded' therefore needs to be treated with caution.

Both European Schoolnet's own European Schoolnet Academy³⁸ and the European Teacher Academy³⁹ (which was developed for School Education Gateway by European Schoolnet on the basis of its experience with Schoolnet Academy) have similar tools, namely a thumbs-up link for each of the courses or webinar materials listed in their catalogues. However, rather than simply register a user's 'like' of a course in the catalogue, Schoolnet Academy takes the user to its Facebook page so that he or she can leave an approving message or a recommendation there (or, we presume, a note of disapproval).

While both of these repositories undoubtedly offer content of a high quality, the apparent lack of use of the commenting and user-feedback systems available on them must detract somewhat from the overall utility of the platforms. On the Teacher Academy, for example, there are clearly many highly useful courses for teachers seeking to build on their knowledge and skills (the sheer breadth and depth of quality that is evident across all the courses on offer is undeniable, and especially so since teachers can often find it difficult or even impossible to obtain strong and effective support for their professional development needs need from anywhere else). However, it has to be said that, despite the obvious quality on

³⁸ <https://www.europeanschoolnetacademy.eu>

³⁹ https://www.schooleducationgateway.eu/en/pub/teacher_academy.htm

offer, a teacher coming to the catalogue for the first time will find it difficult to get any prior feedback from users on how useful the courses were and why.

THE QUALITY CHALLENGES: Three Short Case Studies

The focus in this section is on the challenges faced by repositories as they seek to ensure that users have the best experience possible in relation to the quality resources they locate and subsequently make use of. Three short case studies that profile different quality issues are offered.

Scientix is a strongly curated site that admits content to its repository only if it meets its own minimum standards of quality. When users search Scientix for content, they can be sure that least the content they identify has some basic level of quality. This section offers some qualitative considerations based on the examination of the search function in Scientix.

GeoGebra is an interactive mathematics application that is both browser and app based on multiple platforms and that is aimed at mathematics learners from primary school through to university. A recent paper co-authored by GeoGebra's CEO offers some fascinating insights into how a platform might go about trying to improve the quality of its search function so as to ensure that users find the resources that are most appropriate to their needs.

Photodentro LOR is the National Learning Object Repository for primary and secondary education in Greece. It is an extensive platform that hosts a large cache of learning objects, each of them tagged with educational metadata based on the IEEE-LOM Metadata standard. It is open to everyone: students, teachers, parents, and others.

Case Study 1: Scientix



Scientix was created in 2010 on the initiative of the European Commission and has been coordinated by European Schoolnet since its foundation. It has become a very popular platform, one that offers a very large complement of mainly (but not only) STEM resources across 24 EU languages. All of its services are accessible to any STEM educators and other stakeholders for free. The Scientix Update, 2019⁴⁰, described its offerings thus:

- Access to information on European science education projects
- Access to high-quality resources in science education, with on-demand translation of some teaching material for free

⁴⁰ SCIENTIX UPDATE 2019

http://files.eun.org/scientix/scx3/publications/Scientix3_Final_Publication_web.pdf

- Access to Scientix news, enabling users to keep informed about the latest news on science education in Europe
- A Scientix event calendar, bringing together science education events from across Europe and beyond
- Exchange and sharing tools such as forums and chats.

A critical objective of Scientix is to support the STEM teaching community across Europe to enable educators to find, download and make use of the very best, high-quality learning resources that can be found in STEM education. The repository itself is a collection that is divided into teaching materials, STEM reports and training courses. It also offers opportunities to attend or participate in webinars and conferences relevant to STEM. In addition to this, Scientix provides a robust platform for discussion and exchange between ministries of education, NGOs and other relevant agencies and organisations as they develop and implement STEM policies across the continent.

Importantly, it is central to the Scientix values and principles that teachers themselves will play a key role in influencing student perceptions of STEM (and other) subjects and in supporting students to aim for STEM opportunities in higher education and in their careers into the future.

The Scientix resource repository is a curated collection of learning materials centred on STEM education. Many of these resources are the products of projects that have been funded and led by Scientix, and to date almost 2,500 teaching materials sit in the repository alongside hundreds of STEM reports and dozens of high quality training courses. The repository also gives access to a range of Scientix Moodle courses which are self-paced and non-tutored.

The curation process is central to how Scientix operates. Registered users on the Scientix portal are able to upload resources, and these are then reviewed by the Scientix editorial team. Upload guidelines are offered so that resource-creators have a clear idea for how they can ensure their resources are accepted into the repository. As with the MERLOT repository, it is only the detailed metadata of the resource that is uploaded since Scientix links to the original location of the resource (and all such links are verified before inclusion). In most cases, this is the website of the project that created the resource in the first place. Those uploading resources are required to offer pre-defined data such as type of resource, appropriate educational stage and age-range of students, and school subjects, amongst many others⁴¹.

It should also be noted that:

“The Scientix resource repository is not open to projects created without official endorsement (i.e. they must have private or public funding, be it

⁴¹ D. Massart and E. Shulman, Learning Resource Exchange Metadata Application Profile version 4.7, European Schoolnet, 2011. Our understanding is that Scientix uses a variant of the LRE Metadata Application profile, as do a number of European Ministries of Education providing resources

regional, national or EU), self-funded projects or school projects (teacher's projects). Resources from such projects will be automatically rejected.”⁴²

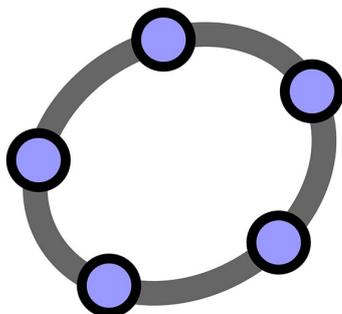
Perceptions of quality in the learning resources within the Scientix repository are almost entirely based on the fact that all resources are curated by the Scientix editorial team and that all the resources have been designed to meet the minimum quality requirements set by the editorial team. The repository places a link within each resource description designed to permit users to add comments and a rating for the resource, but, on the evidence of our brisk survey of learning materials offered, they do not seem to be used much. Quality therefore, in this particular context, is predetermined by the procedures of the repository and does not appear to depend much if at all on users' perceptions of quality.

It is clear that platform offers a broad range of high-quality resources in the form of teaching materials, reports, training courses and LRE materials. Even a cursory examination by a professional educator of the resources on offer shows that the materials and courses available offer much of value to teachers and learners. Each resource offers very complete levels of metadata for filtered searching, as well as the options of writing comments about the material, rating the material from 1 star to 5 stars, and reporting problems with the content. Additionally, Scientix has made the very positive move to offer the search function in 24 European community and other languages. Indeed, Scientix also offers a free translation service for anyone who wants to translate a resource into another language.

The search function itself within Scientix appears to be highly effective. A search for materials in Scientix offers filtering by subject, by resource-type (for example, app, case-study, course, experiment, lesson-plan etc), by appropriate age-group, and by language.

However, on accessing the repository, it quickly becomes clear that only a minority of resource-users are actually making use of the feedback mechanisms available to them. This is of course not a challenge that is faced exclusively by Scientix. Rather, it is a challenge faced by all OER repositories.

Case Study 2: GeoGebra



A very effective and well-designed OER repository in the European context is GeoGebra⁴³. It is based in Austria but has an international footprint. It has won a string of awards and it uses a very large, flexible and dynamic global team to develop its resources and to translate those resources into multiple languages. It is an open platform both in the sense that anyone with the knowledge and skills to do so can create and upload dynamic resources to the

⁴² <http://www.scientix.eu/resources/upload-guidelines>

⁴³ <https://www.geogebra.org>

GeoGebra repository, and in the sense that it is open to anyone to make use of for teaching and learning purposes. GeoGebra describes itself thus:

“GeoGebra is dynamic mathematics software for all levels of education that brings together geometry, algebra, spreadsheets, graphing, statistics and calculus in one easy-to-use package. GeoGebra is a rapidly expanding community of millions of users located in just about every country. GeoGebra has become the leading provider of dynamic mathematics software, supporting science, technology, engineering and mathematics (STEM) education and innovations in teaching and learning worldwide.”⁴⁴

GeoGebra offers a convenient and instructive case study of some of the challenges faced by any OER repository as it seeks to deliver a platform that is consistently able to offer users ‘good dynamic materials’ that accord with their own – that is, the users’ – own standards of quality.

For this section, extensive use has been made of a highly useful article written by Markus Hohenwarter (CEO of GeoGebra) and Cristian Hedes, entitled: “Using Quality Factors to Find “Good” Resources on the GeoGebra Materials Sharing Platform.”⁴⁵ (The paper was very kindly shared with us by Martha Zellinger, who offers Partner Support for GeoGebra.)

Hohenwarter and Hedes offer the insight that expert users of GeoGebra have indicated that they tend to search for materials which have been produced by ‘high quality authors’, namely resource producers who they know have produced good quality materials in the past.

In response to this, GeoGebra took the step of adding the option for users to follow certain authors and to receive notifications whenever these authors uploaded new creations to the platform. But a number of other quality measures suggested by ‘expert users and literature’ were also added in to the platform, and Hohenwarter and Hedes explain what those factors are and how they chose to deal with them in GeoGebra.

Using the findings of Kimeswenger 2016⁴⁶, they defined three further factors that needed to be taken into account in their attempt to improve the search for good materials. These are the material factor, the author factor and the user factor.

The first of these – material factor – seeks to measure the activity happening around a certain material, for example, how much it is being used, copied and favoured. They derived the following parameters to measure this factor:

⁴⁴ <https://www.geogebra.org/about>

⁴⁵ <http://www.iadisportal.org/digital-library/using-quality-factors-to-find-%C2%93good%C2%94-resources-on-the-geogebra-materials-sharing-platform>

⁴⁶ Kimeswenger, B., 2016. Addressing Quality Aspects of Dynamic Mathematics Materials. Proceedings of 13th International Congress on Mathematical Education (ICME 13). Hamburg, Germany

- featured: materials that have been featured by the GeoGebra team should have higher priority
- type: books (collections of worksheets) should have higher priority than single worksheets
- derived: materials with many copies should have higher priority
- groups: materials used by many groups should have higher priority
- books: materials used in many books (collections) should have higher priority
- favourites: materials that have been favoured by many users should have higher priority
- views per day: materials that are viewed more often should have higher priority

The second – author factor – has to reflect the ‘expertise and relevance of the material’s author’. In other words, resources created by people with many followers should be given higher priority than those with fewer followers. They derived the following parameters:

- followers: materials of author’s with many followers should have higher priority
- community: materials of authors with GeoGebra community badges should have higher priority
- public materials: materials of authors with many public materials should have higher priority
- teacher: materials of teachers should have slightly higher priority than materials of other users

The final factor – user factor – is a real-time measure used at the point of searching, and is dependent upon the user doing the searching. The parameters that were derived are:

- language: materials in the same language as the user’s language should have higher priority
- userID: the materials of the searching user should have higher priority than materials from other users

By combining these new factors with the equations previously used to do a text-relevance search, using normalization functions and weighing factors derived from analysing top search results, GeoGebra has been able, they believe, to improve the quality of search results. This is, they say, still very much a ‘work in progress’ and they are working to further improve the quality of results by delving further into the detail of the various parameters established for each of the additional factors. They are also aware that the route they have taken might have the detrimental effect of making good quality materials created by new authors less visible, and make it tougher for new authors to establish a foothold in the platform.

Case Study 3: Photodentro



A critical component of the Greek national infrastructure for K12 education is the Photodentro platform which offers 5 OER repositories making digital content available to all schools in the country. The platform acts as a central access point to school-based learning resources in the Greek education system. It also acts as a national aggregator, a service for harvesting educational metadata from external collections and repositories. The platform now serves as the paramount digital work-space for more than 120,000 teachers and more than 1,000,000 students in the country's primary and secondary schools.

Greece has established digital educational content as one of five fundamental pillars in the education system, the other four being:

- In-service teacher training
- The digital classroom (classrooms equipped with interactive teaching systems and supported by a nation-wide school network)
- Horizontal support actions
- Electronic administration platforms complement the group of pillars.⁴⁷

At the metadata level, quality in Photodentro is assured through adherence to the *Photodentro IEEE LOM GR Application Profile*. However, the task of assuring the quality of the content in the repositories is achieved by means of the *Photodentro Quality Seals*, which is:

“...a new repository of the Photodentro family to support a quality assurance scheme for its content based on *Quality Seals*. A *Quality Seal* can represent either a process, or a set of evaluation criteria, or a brand name. The repository hosts and manages *Quality Seals*, stamping records for OERs, while it has a Registry of Certifiers.”⁴⁸

There is a strong emphasis across the platform on metadata quality so that the search for and retrieval of content is as effective as possible. The *Quality Seals* concept is a valuable attempt to build continuous metadata curation into the

⁴⁷ Megalou, E and Kaklamanis, C *Open Content, OER Repositories, Interactive Textbooks, and a digital Social Platform: The Case of Greece* p.1

https://www.academia.edu/37054610/OPEN_CONTENT_OER_REPOSITORIES_INTERACTIVE_TEXTBOOKS_AND_A_DIGITAL_SOCIAL_PLATFORM_THE_CASE_OF_GREECE

⁴⁸ Megalou, E and Kaklamanis, C *ibid* p.2

platform, and is one that should offer a model that other repositories might benefit from too.

Quality in metadata is maintained in Photodentro through the work of a sub-group of teachers who have been tasked with annotating all content with clear and robust metadata and publishing it. They work to a clearly specified and standardized process that sets out the procedure by which coordinators assign resources to teams all the way through to final publication. These teams are supported by training courses and training materials in the form of FAQs, guides and manuals. Before the process is complete for any individual resource or collection of resources, a final check is conducted by the coordinator of the collection.

The Greek education system is highly centralised and all the resources contained in Photodentro LOR are developed by 120 project-employed fully-qualified teachers working across 10 domain-specific workgroups, with the aim of augmenting and supplementing the specified Greek textbooks with high-quality digital interactive resources. Each group is overseen by an academic with significant domain and pedagogical expertise so as to ensure the quality of the learning objects.

This is a very different model from that employed by, for example, by KlasCement, Curriki and others, which use a much broader system of user-generated content. Different models are needed for different circumstances, however, and the Greek model in Photodentro has much to commend it for a centralised system of education such as that which applies in Greece.

DIFFERENT APPROACHES TO QUESTIONS OF QUALITY IN OER

These three short case studies are by no means intended to offer a comprehensive take on how repositories should seek to offer their users the highest quality of learning materials possible. That cannot be achieved in a short paper such as this. However it does demonstrate three approaches (of many possible approaches) that each of the repositories in question have taken to this issue. Each is derived from a different set of assumptions, but each is a valid attempt to build some level of quality assurance into the repositories.

It is the case of course that, while some might seek to develop universal solutions or global approaches to quality in OER, at the end of the day it is up to each repository to determine how best it can achieve its objectives on behalf of its users, and that best fits with the very particular context in which it exists.

CONCLUSION: A CRITICAL EVALUATION OF QUALITY CRITERIA

Quality lies at the heart of this paper. Definitions of quality in relation to educational resources, open or otherwise, abound. Of all the possible definitions, the one that seems to resonate most with the needs of educators who wish to search for and use OER is that of 'fitness for purpose'. It is the one aspect of the various definitions on offer that most readily bears scrutiny from the perspective of a teacher searching for 'good quality' resources. This links back to the first of the five 'quality factors' outlined by Camilleri *et al* on p.11. From the user's perspective, the best resource they can find will be the one that best fulfils their teaching purpose and, they hope, the learning purpose of their students too. In this sense, quality is viewed as a 'before-the-event' concept with respect to the 'Quality Circle' described in this paper.

The teacher with a clear idea of the purpose of his or her teaching will be able to evaluate any resources they find more effectively than the teacher with only a vague idea of what they hope to achieve in a particular lesson or course. For example, a good professional teacher will know what knowledge or skills they will be teaching, whether they are trying to build on what students already know or simply reinforcing existing knowledge or skills, how stimulating, enjoyable and challenging they want the learning to be, what methodologies they intend to employ, what kind of environment for learning they are trying to create, what kind of assessment and evaluation they will use, and what personal qualities they hope to instil in their students. This is only a subset of all the potential purposes a teacher might have in mind for a lesson, but the teacher who has a clear idea of purpose will be better able to select appropriate and relevant content.

From the perspective of the OER repository, therefore, the more they are able to provide metadata, descriptions, comment and ratings that give the teacher the information they need to connect a resource to their teaching requirements, the more effectively the teacher will find content that is 'fit for purpose'. As such, trying to deliver a critical evaluation of quality criteria is not something that can be achieved in any universal sense: such evaluation can only really be carried out on a piece-by-piece basis by the teacher as they locate and use content. However, with this as the key yardstick by which to measure quality, OERs can perhaps more effectively structure metadata and feedback systems to help teachers trying to assess the 'fitness for purpose' of resources.

When the issue under consideration is that of quality – and particularly the issue of how a repository deals with rating the quality of its resources - the key challenge tends to be around the behaviour of its users: how can educators and others who seek access to open resources either be persuaded to give feedback on resources they have already used or gain some awareness of a resource's quality before they make use of it?

SUGGESTED QUESTIONS FOR FURTHER RESEARCH

From the reading and research carried out for this short review, it is possible to identify, in conclusion, a few key issues that arise out of a critical evaluation of the evidence outlined in this paper. They can be summarised thus:

- i. **In the European context in particular, the real challenge of multiple languages exists.** The language of search and the language of the resources themselves is a critical qualitative factor to be taken into consideration by repositories. Users are often having to search for resources in a second or even third language but it is clear that some repositories are making good progress towards dealing with this challenge. This is a challenge that is already being explored in the EUN Project 'eQNET'⁴⁹, which is examining the criteria by which some resources 'travel well' across national and cultural boundaries while others do not⁵⁰.
- ii. **While users may be downloading resources from OER repositories, they are not always commenting on issues of usefulness and quality within the repositories themselves.** At least one possible reason for this, and that merits some investigation, is that, in some countries at least, teachers often set up their own online groups and communities in which to share ideas, resources, lesson plans and so on. This creates a kind of hinterland beyond the open repositories and open communities in which educators are certainly making use of open resources but they are dealing with quality issues within closed or exclusive groups, often at a regional or national level. There is little research to date to verify this assertion, which is based on experience and observation.
- iii. **The potential contention between two understandings of quality in relation to learning resources has to be dealt with pragmatically by repositories.** For the benefit of educators seeking resources for their teaching practice, their prime consideration will always be finding 'useful' resources, resources that match their pedagogical requirements. In terms of learners, however, the true quality of a resource will always be its ultimate impact on the learning, a determination that can only be made after-the-fact, and often will be a determination that is applicable only in the limited situation defined by the actual learning activity in which the resource was used.
- iv. **We feel the concept of the 'Quality Circle' in relation to OEP is a concept worth developing beyond its initial modest outline here.** The research base for definitions of quality in relation to OER is divided to some extent, therefore, between those who would wish to accept Wiley's definition of quality (outlined on page 11 of this paper) as paramount and those who, in looking at the domain from a teacher's perspective,

⁴⁹ <http://eqnet.eun.org/web/guest;jsessionid=E20318079722343915D3DFAE80661EF8>

⁵⁰ <http://lreforschools.eun.org/web/guest/travel-well>

understand the need for some pre-determination of 'quality' so that, when a search is made for teaching resources, teachers can be reasonably sure of finding something appropriate and useful.

- v. **Further investigation could be made of those repositories that most effectively build practical and usable user-feedback systems into their platforms.** These seem most likely to offer a credible and trusted service to users. Whether these are simple star rating systems or something more complex, they seem to work best when it is the users themselves who are able to play a role in determining questions of quality in relation to the learning resources.
- vi. **Work could be done to determine how many OER repositories are offering such functionality now and how successful they are in their implementations.** It is unfortunate that Curriki in particular is almost exclusively aimed at a US audience despite its stated global aspirations – perhaps they can be persuaded to allow their resources to be mapped to curricula from beyond American shores, although whether the resources are suitable for a non-American audience has to be asked too.
- vii. **The concept of 'collective intelligence' used by De Oliveira *et al* is one that has much to commend it.** Systems such as Curriki and MERLOT, while not necessarily following all the constructs offered by the Brazilian system described, do undoubtedly offer an approach to quality assurance that is built around the collective views expressed by users through the use of rating systems and, as a result, offered in the search filters that enable users to rank findings accordingly.
- viii. **The adaptations made to the search function within GeoGebra in terms of what they call the material factor, the author factor and the user factor is persuasive and is perhaps something that other large repositories could take on board.** They are changes that can only be effectively applied to repositories with very large collections and a very large user community. Again, it might be viewed as a real application of a measure of collective intelligence to the search tool within the platform. That such amendments bring their own issues with them, for example in terms of possible excluding new authors from search results, is something that, as GeoGebra acknowledges, requires further research.
- ix. **The complexity and levels of bureaucracy built into a repository will have a bearing on its effectiveness.** Teachers are unlikely to use a complicated feedback system.
- x. **If a repository is to compete with Google and its peers, it must be able to match them within its own limited domain in terms of ease of use, flexibility and power.** The repository needs to be extensive enough to offer a large and enticing cache of resources for the educator to wish to return to again and again to mine for content

- xi. **Some further work might be done on adding breadth and depth to the concept of 'efficacy' as it relates to the quality of educational content.** The fitness-for-purpose of a resource is critical in helping teachers to find exactly what they need for a particular lesson or course. The perceived or stated efficacy of a resources might be the most appropriate factor to take into account in thinking about 'quality-before-the-fact' in relation to open education resources.

Finally, while this paper did not venture far into the question of Artificial Intelligence and Machine Learning, it is reasonable to suggest that this is an area that will prove to be increasingly important as we move forward to the next generation of OER repositories. Any research questions arising out of this area will have to include not only technical and pedagogical issues but also questions of ethics, fairness and responsibility to teachers, learners and researchers themselves.

Quality is undoubtedly a difficult concept to define in relation to OER. It is nonetheless a difficulty that must be tackled if we all wish to see the Open Education movement go from strength to strength in the future.

APPENDIX: ACTIONABLE POINTS & RECOMMENDATIONS

A list of 'actionable points' have been extracted from the body of the White Paper and have been collected here as a final 'aide memoire' for those repositories that are seeking to improve the service they offer their users. At the heart of the list below is a need always to start from the perspective of the learner and the teacher. The simple truth is that any repository, no matter how big it might be, that does not have a working conception of its user base and of their real teaching and learning needs is unlikely to be able to serve their needs truly effectively.

Each of the actionable points below comes with the relevant page number in the paper so that the point can be placed in its context easily.

- P.4
 - Repositories should also seek to give teachers mechanisms that will allow them to provide professional feedback on the value and usefulness of the resources once they have deployed them in their teaching.
- P.9
 - The simplistic notion that quality can only be determined by the impact of a resource on learning is not sufficient for repositories. It takes little account of the realities of a teacher's needs in seeking out good content.
- P.9-10
 - The concept of a Quality Circle might be consciously implemented in repositories in order to develop a model of collective intelligence relevant and appropriate, but there is no one-size-fits-all.
- Culled from various sections of the paper, this is a list of potentially relevant factors in a repository's quality assurance system
 - P.11
 - Efficacy
 - Impact
 - Availability
 - Accuracy
 - Excellence
 - P.12-13
 - Featured resources
 - User evaluation tools
 - Peer review
 - Authorship
 - Keywords
 - Metadata
 - Multilingual support
 - Social Media support
 - Creative Commons Licences
 - Source Code or Original Files
 - P.15-16

- OER Evaluation Criteria Clarity, Comprehensibility, and Readability
 - Content Accuracy and Technical Accuracy
 - Adaptability and Modularity
 - Appropriateness
 - Accessibility
 - Supplementary Resources
- P.16
 - What are the effects of open educational resources on course development and implementation?
 - On student learning?
 - What are the characteristics of creators and earlier adopters?
 - Will students' prior experience with OER affect motivation to independently locate and use other free materials for learning?
 - How will this influence achievement and success?
- P.19
 - Correspondence with the keyword in the search bar
 - Scores given by users (and the number of users that give the score),
 - Time online
 - Type of contributor (teacher, student, company etc)
- P.24
 - A ranking system that at least lets users see how many times the resource has been opened

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