Adapting the Curriculum: How K-12 Teachers Perceive the Role of Open Educational Resources

BEATRIZ DE LOS ARCOS
b.de-los-arcos@open.ac.uk

ROBERT FARROW
rob.farrow@open.ac.uk

REBECCA PITT
beck.pitt@open.ac.uk

MARTIN WELLER
martin.weller@open.ac.uk

PATRICK MCANDREW
patrick.mcandrew@open.ac.uk

Institute of Educational Technology, The Open University, United Kingdom

It has been suggested that open educational resources (OER) can lower cost and lead to greater flexibility; however, while there has been significant investment in opening up content there have been few studies looking at how these resources are perceived by those who might use them. This article contributes to fill a gap in our knowledge of how K-12 educators teaching in face-to-face, online and blended contexts currently think about and use OER. It is part of the research carried out by the Hewlett-funded OER Research Hub (OERRH) Project to examine the impact of OER on teaching and learning practices. The authors report findings from an international survey of over 600 teachers who answered a set of attitudinal and behavioural questions in relation to how they use OER, what types of OER they use, and what influences their selection of content, in addition to the purpose, challenges and perceived impact of OER in the K-12 classroom. The research highlights how teachers adapt rather than simply adopt OER, suggesting a strong connection between OER use and personalized learning, and argues that mainstreaming OER in K-12 education is not only a matter of raising awareness but of changing teachers' habits.

INTRODUCTION

At the same time that technology is transforming how students learn in the classroom, cuts in funding to education mean that now, more than ever, schools are faced with having to function effectively, and prepare pupils for college and employment with fewer resources. It is in this context of attrition that Bliss, Tonks and Patrick (2013) describe the potential benefits of using open educational resources (OER) – i.e. "teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others" (Hewlett Foundation, 2013:16). Bliss and his colleagues argue that OER can provide a foundation for collaboration and partnership by enabling teachers to reuse, revise, remix, and redistribute materials; that OER facilitate knowledge sharing and bridge the gap between formal and informal learning by widening access to resources in and outside the classroom; that OER lower the cost of content development by allowing free sharing and reuse of materials; that OER quality is regularly enhanced by sustaining a process of evaluation and updating; and that OER foster independent and personalized learning by engaging students in choosing what they learn and how they learn, and teachers in customizing content to learner needs.

However, a report produced by the Boston Consulting Group (2013), to date the only review of the state of OER use in US schools, implies that these gains are yet to be accomplished. Findings from their survey of K-12 teachers and curriculum administrators (212 non-users of OER and 165 users of OER) indicate that educators use a broad range of OER, primarily because of the flexibility they afford to adapt content and their low cost. Results also point to practitioners' high levels of satisfaction with open resources in relation to their subject coverage, quality, efficacy, and ease of use. Efficacy and quality of OER are precisely the aspects on which non-users seek assurances in order to embrace openness in the classroom (Boston Consulting Group, 2013).

In this light, what research has been conducted so far to provide the body of evidence that is needed for the wider endorsement of OER in schools? If research on the impact of OER is generally limited, in the context of K-12 only a handful of peer-reviewed papers and commissioned reports exist.

On the subject of open textbook adoption, Petrides and Jimes (2008) write a case study detailing the development of the Free High School Science Texts (FHSST) project. Originated in 2002, this was an initiative to provide free and sharable science and mathematics textbooks to teachers and learners in South African schools. The study offers an opportunity for reflection on the challenges and successes of peer-producing open content and highlights the importance of a community-centered approach in sustaining the project's overall mission.

With support from the Shuttleworth Foundation, FHSST became Siyavula, an education technology company tasked with continuing their predecessor's vision of improving education by making high-quality, openly-licensed, curriculum-aligned materials accessible to all. Their impact has been the subject of a series of blog posts penned by Pitt and Beckett (2014) who surveyed 89 educators on their perceptions of using Siyavula open textbooks. Acknowledging that their sample – mainly highly-qualified teachers in private, well-resourced schools, is not representative of the general teaching population in South Africa, the authors are cautious to report the high level of awareness of OER among respondents. They argue that teachers in public schools, who would have received free printed copies of the textbooks distributed by the government, are less likely to have knowledge of open licenses. The extent to which teachers act upon this knowledge and adapt Siyavula textbooks to fit their needs in the classroom is yet to be examined. In spite of this, the report draws attention to the strong percentages of teachers inclined to suggest corrections to the materials and volunteer for future writing projects. This is interpreted as a collective sense of responsibility that strengthens Siyavula's belief in the value of building "a thriving, sharing community around the use of our open resources" (Pitt & Beckett, 2014, n.p.), just as FHSST did.

Within the literature, two articles have focused on the effectiveness of substituting open textbooks for traditional textbooks. In Wiley, Hilton, Ellington, and Hall (2012), seven middle and high school science teachers and approximately 1,200 students in Utah exchanged their publisher-produced textbooks for an open equivalent during one academic year. Wiley et al. (2012) demonstrate that open textbook adoption can decrease costs by over 50%, with no apparent impact on student learning, measured in grade outcomes. The study was expanded in Robinson, Fischer, Wiley, and Hilton (2014) to include 43 schoolteachers and 4,183 secondary students in earth systems, physics, and chemistry. A more complete data set allowed for a more sophisticated analysis of the differences in student performance when using either an open textbook or a commercial textbook. Findings showed significantly higher test scores for students adopting open textbooks "even controlling for the effects of teacher, gender, socioeconomic status, science ability, prior academic achievement, prior science training, and student age" (Robinson et al., 2014, p. 345), although not across all subjects.

On the subject of quality, Kimmons (2015) argues that K-12 teachers evaluate open/adapted textbooks as superior than copyright-restricted textbooks, results which extend the benefits of using OER in schools beyond cost: teachers' needs and expectations are better met when they can remix, adapt, and modify content.

Outside open textbook adoption, research on the effectiveness of OER use in K-12 classrooms is scarce. Murphy, Gallagher, Krumm, Mislevy, and Hafter (2014) review the implementation of a two-year pilot of Khan Academy in 20 California schools, where the resource was used to supplement teacher-led instruction. The exploratory analysis of data collected from classroom observations, interviews, surveys, and access to standardized test scores and user log files suggests ways in which Khan Academy affects teaching and learning that merit more rigorous investigation. For example, teachers agreed that Khan Academy helped them identify both advanced and struggling students, thus making it easier to monitor their needs; positive associations were also discovered between levels of Khan Academy use, i.e. time spent on the site and problems completed, and attitudinal outcomes such as lower than expected math anxiety and higher than expected confidence in one's ability to do math.

The emergence of the Open High School of Utah (OHSU), now Mountain Heights Academy, also advocates greater examination of the benefits of OER in the K-12 classroom (Tonks, Weston, Wiley, & Barbour, 2013). In this full-time online school, students are taught entirely through OER; teachers have the freedom to customize materials to suit students' needs, a stance that marches in step with a feeling of empowerment: "When a school decides to adopt OER, (…) this policy requires teachers to identify resources, judge their quality, align them to standards, aggregate them in meaningful collections, and choose or design accompanying activities and assessments" (Tonks et al., 2013, p. 266).

The potential role of OER in educators' professional development is also discussed in a report on the state of K-12 music OER produced by the Institute for the Study of Knowledge Management in Education (ISKME, 2013). It states that an open approach to music education might be most favorable to teaching musicians, often lacking formal training, by helping them address the demands of the 21st century classroom and promote sharing and collaboration among peers.

Finally, Richter and Ehlers (2010) explore the motivators and barriers to using OER in informal discussions with a small group of German schoolteachers. They note that teachers do not generally differentiate between open and free; instead, they worry about finding resources of suitable quality and relevant to their local context. Support is needed from school administrators and government sources if the use of OER is to be scaled up.

The present study is not about effectiveness per se, but it contributes to fill a gap in our knowledge of how K-12 educators currently think about and use OER. It builds on the report produced by the Boston Consulting Group (2013) to offer a more global examination of schoolteachers' perceptions of OER in classrooms around the world. It is part of the research carried out by the OER Research Hub (OERRH), a project funded by the Hewlett Foundation to investigate the impact of OER use on teaching and learning practices

across four educational sectors: K-12, community colleges, higher educa-
tion, and informal learning. From a bank of questions created in order to
test eleven different hypotheses, a number of online surveys were conducted
in collaboration with several educational projects and initiatives, gathering
data from educators, formal and informal learners, and librarians (de los
Arcos, Farrow, Perryman, Pitt, & Weller, 2014). This paper focuses on the
survey responses of K-12 educators, drawn mainly as a convenience sample
from the OERRH's collaborations with OpenLearn, the Flipped Learning
Network, Saylor Foundation, Siyavula, and P2PU/School of Open. The re-
search was guided by the following questions:

- How do K-12 educators use OER?

- What types of OER do K-12 educators use?

- To what purpose do K-12 educators use OER?

- How do K-12 educators select OER?

- What are the challenges that K-12 educators find in using OER?

- How do K-12 educators perceive the impact of OER use on their teaching
  practices and student learning?

METHOD

Participants

The data set for this study consisted of 657 school teachers, 52.3% fe-
male (47.5% male) from 72 countries around the world, although most
are based in the United States (39.9%, n=258), UK (12.5%, n=81), and
South Africa (11.6%, n=75), home of the OERRH's collaborations. Most
of these schoolteachers are highly qualified – 47.4% (n=253) hold a post-
graduate qualification; experienced – 53.9% (n=229) have been teaching for
over ten years; and mainly employed full-time (65.5%, n=285). A majority
(68.2%, n=351) speak English as their first language. In terms of subjects
taught, science teachers account for the largest percentage (52.2%, n=200),
followed by math (33.4%, n=128), and education studies (25.9%, n=84).
A subgroup of educators was asked to self-select whether they taught in a
face-to-face (85.3%, n=285), online (8.1%, n=27) or blended[1] environment
(6.6%, n=22) to form a sample for comparison.

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1 Teaching in a blended environment was defined in the survey as teaching a course where content
   is partly delivered online and partly in a face-to-face setting.

Table 1
Sample Characteristics

	F2F (n=285)	ONLINE (n=27)	BLENDED (n=22)
Gender	Male 46.3%	Male 51.9%	Male 72.7%
	Female 53.4%	Female 48.1%	Female 27.3%
Country of Residence	USA 27.6%	South Africa 29.6%	USA 36.4%
	South Africa 25.5%	USA 22.2%	Ireland 18.2%
Highest Educational Qualification	Postgraduate 51.4%	Postgraduate 74.1%	Postgraduate 59.1%
	Undergraduate 32.4%	Undergraduate 14.8%%	Undergraduate 27.3%
Teaching Experience	> 10 years 49.5%	> 10 years 51.9%	> 10 years 66.7%
Subject Taught	Math 14%	Math 25.9%	Languages 27.3%
	Languages 13.3%	Science 18.5%	Math 22.7%
	Science 11.2%	History & Geography 14.8%	History & Geography 22.7%

Instrument

Respondents answered a number of behavioral and attitudinal questions regarding their use of OER and open repositories, their purpose for using OER, what they perceived were the challenges to using OER, and how OER have had an impact on their teaching and student learning[2]. These survey questions were originally constructed by the authors to test the eleven hypotheses at the core of the OERRH Project (de los Arcos et al., 2014), then shared with experts to establish face validity, piloted on a subset of the intended population, and subsequently refined.

Analysis

SPSS software was employed in the analysis of the gathered survey data. Frequencies of all responses were calculated to have a general description of the data, and one-way analysis of variance (ANOVA) were used to examine whether there were statistically significant differences among educators teaching in face-to-face, online, or blended contexts. Cases with missing values were deleted analysis by analysis. Reliability was high on all subscales: Cronbach's alphas for the 10 items measuring impact on teaching, and the 13 items measuring impact on learning were .93 and .95 respectively; the inventory measuring purpose of OER use (17 items; $\alpha = .89$) and challenges to the use of OER (15 items; $\alpha = .71$) were found to be also reliable.

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2 A full set of survey questions can be found at http://oerresearchhub.org/collaborative-research/instruments/

Limitations

The research reported here has a number of limitations, which should be borne in mind. First, as a quantitative study, it relies primarily on survey data and the perceptions of those being surveyed. In addition, because of the collaborative nature of the research, data were collected through separate instruments, varying in size and sample, but with common questions. In merging datasets, a thorough process of data cleaning was followed in order to attain consistency before analysis. However, the unequal number of respondents must be raised as a caveat when comparing variables.

RESULTS

How do K-12 teachers use OER?

The frequencies analysis of all responses reveals high levels of adaptation of open materials: 85.5% (n=271) of surveyed schoolteachers have adapted OER to fit their needs in the classroom. The proportion of those who create OER for teaching drops to 38.2% (n=121), while only 10.7% (n=34) create materials and publish them under an open license. When face-to-face, online, and blended educators are examined separately, this pattern of high adaptation but low percentage of creation and lower still of open publishing is repeated across the three groups (see Table 2).

Table 2
Engagement with OER

	F2F		ONLINE		BLENDED	
	Count	%	Count	%	Count	%
I have adapted open educational resources to fit my needs	149	83.2	21	91.3	17	94.4
I have created open educational resources for teaching	57	31.8	14	60.9	14	77.8
I have created resources myself and published them on a CC[3] license	19	10.6	6	26.1	7	38.9
I have added a resource to a repository	45	25.1	11	47.8	14	77.8
I have added comments to a repository regarding the quality of a resource	38	21.2	9	39.1	9	50.0
I have added comments to a repository suggesting ways of using a resource	31	17.3	9	39.1	10	55.6

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3 Creative Commons (CC) licenses help authors give others the right to use, copy, distribute and build upon their work, while retaining copyright. For more information, see https://creativecommons.org/licenses/.

Interestingly, a one-way analysis of variance indicates that there is a significant difference in creating OER among face-to-face ($M = 1.68$, $SD = .47$), online ($M = 1.39$, $SD = .50$), and blended educators ($M = 1.22$, $SD = .43$), F $(2, 217) = 10.8$, $p < .001$. Post-hoc Games-Howell tests revealed that face-to-face teachers create significantly less OER than online and blended educators, $p < .05$, whereas the latter two groups do not differ from each other. The effect size of this difference is relatively large (eta squared = 0.09), which means its magnitude should not be ignored.

In analyzing behavior related to the use of open repositories, data show that 28.1% (n=89) of teachers have added a resource to a repository, 24% (n=76) have added a comment regarding the quality of a resource, and 16.7% (n=53) have added a comment suggesting ways of using a resource. Statistically significant differences were found among the subgroups in relation to contributing resources to a repository ($F (2, 217) = 13.2$, $p < .001$) and adding comments suggesting ways of using a resource ($F (2, 217) = 9.4$, $p < .001$). On both accounts, face-to-face teachers play a smaller part ($M = 1.75$, $SD = .43$ and $M = 1.83$, $SD = .38$ respectively) than blended educators ($M = 1.22$, $SD = .43$ and $M = 1.44$, $SD = .51$ respectively). The effect size was large as measured by eta squared (0.10 and 0.08), giving importance to the relationship between teaching context and use of open repositories.

Table 3
Use of Repositories

	F2F		ONLINE		BLENDED	
	Count	%	Count	%	Count	%
YouTube	109	71.7	12	75.0	13	86.7
TED talks	87	57.2	8	50.0	11	73.3
iTunes	73	48.0	6	37.5	7	46.7
Khan Academy	69	45.4	7	43.8	10	66.7
Saylor Foundation	58	44.3	5	38.5	4	33.3
Creative Commons	28	18.4	7	43.8	9	60.0
CK-12	9	5.9	3	18.8	1	6.7
Curriki	4	2.6	1	6.3	2	13.3
Connexions/OpenStax	4	2.6	2	12.5	2	13.3

In addition, the level of knowledge of various open repositories was also investigated. YouTube, paired with sister sites YouTubeEdu and YouTube-School, is the most popular location (69.8%, n=337), ahead of TED (59%, n=292), iTunes (46.3%, n=171), and Khan Academy (45.5%, n=225).

In the following quote, a math teacher explains this preference for You-Tube: "[YouTube] is the easiest way for me to record videos and instantly have them in the kids' hands (…), there isn't any other video hosting website that is as efficient and vast and easy." In contrast, repositories of OER that particularly target K-12 teachers as their audience are poorly represented – only 11.5% (n=33) of educators access CK12, and 4.9% (n=14) use materials from Curriki. Examination by group conveys a similar picture (see Table 3).

What types of OER do K-12 educators use?

Results indicated that teachers used a broad range of OER, including videos (73%, n=393), images (65.3%, n=352), open textbooks (50.9%, n=275), lesson plans (44.9%, n=137), and quizzes (41.3%, n=223). Table 4 shows the range of OER by group.

Table 4
Types of OER Used

	F2F		ONLINE		BLENDED	
	Count	%	Count	%	Count	%
Videos	131	72.4	19	73.1	15	83.3
Open textbooks	127	69.4	19	73.1	17	77.8
Images	114	62.6	18	69.2	15	83.3
Quizzes	92	50.3	14	53.8	15	83.3
Infographics	34	18.7	11	42.3	10	55.6
Interactive games	73	39.9	8	30.8	8	44.4
Lectures	69	37.7	12	46.2	11	61.1
Lesson plans	43	41.7	4	36.4	6	75.0
Full course	47	25.7	11	42.3	9	50.0
Elements of a course	92	50.3	14	53.8	12	66.7
Audio podcasts	48	26.4	13	50.0	10	55.6

To what purpose do K-12 educators use OER?

In this sample, 80.5% (n=466) of teachers used OER to get new ideas and inspiration, 70.8% (n=409) to prepare for their teaching, and 67.5% (n=390) to supplement their existing lessons or coursework. At the lower end of the scale, 24.4% (n=141) used OER to give to students as compulsory self-study materials, and only 27.2% (n=157) used OER to make their teaching more culturally diverse. ANOVAs showed significant differences among face-to-face, online, and blended teachers, as displayed in Table 5.

de los Arcos, Farrow, Pitt, Weller, and McAndrew

Table 5
Comparison of Purpose of Using OER Variables Across Teaching Context

	M(SD)				
	F2F	ONLINE	BLENDED		
	(n=228)	(n=27)	(n=20)	F	Effect size°
To prepare for my teaching	1.32(.47)	1.19(.40)	1.05(.22)	$F_{(2, 272)}$ 4.11*	0.03
As assets within a classroom	1.56(.50)	1.31(.47)	1.16(.37)	$F_{(2, 269)}$ 8.12*	0.06
To give to learners as optional self-study materials	1.61(.49)	1.30(.46)	1.05(.22)	$F_{(2, 272)}$ 16.4*	0.10
To compare them with own teaching materials	1.68(.46)	1.41(.50)	1.35(.49)	$F_{(2, 272)}$ 7.78*	0.05
To broaden the range of resources available to learners	1.49(.50)	1.33(.48)	1.10 (.31)	$F_{(2, 272)}$ 6.54**	0.04
To stay up-to-date in a subject area	1.39(.48)	1.37(.49)	1.10(.30)	$F_{(2, 272)}$ 3.29***	0.02
To interest hard-to-engage learners	1.69(.46)	1.52(.51)	1.30(.47)	$F_{(2, 272)}$ 7.37*	0.05

*$p < .001$. ** $p < .01$. *** $p < .05$.
°Eta squared.

Teachers in a blended environment reported using OER to prepare for their teaching, as assets within a classroom, to broaden the range of resources available to their students, to stay up-to-date, and to interest hard-to-engage learners with more regularity than teachers in a face-to-face school. Blended and online educators indicated that they gave OER to their students as optional self-study materials and compare them with their own teaching materials more often than face-to-face educators. Eta squared was calculated to test the strength of association. Accordingly, even though the difference in 'to prepare for my teaching' and 'to stay up in the subject area' is significant, the magnitude is too small to be really meaningful. In terms of 'comparing materials,' 'interest hard-to-engage learners,' and 'using OER as assets in the classroom,' however, the effect size is moderate, and large in 'to give to learners as optional study materials.'

How do K-12 educators select OER?

Survey respondents were asked to choose from a list regarding which factors would make them more likely to select a particular resource when searching for open educational content. A majority (78.7%, n=226) indicated that they pay attention to whether or not the resource is relevant to their needs or interests; 67.2%, (n= 193) to how easy it is to download, and 65.5% (n=188) to whether it has been created by a reputable person or institution. Amongst the least important factors, we find that teachers seldom rely on resources featuring a catchy title or attractive images (12.9%, n=37); having a Creative Commons license (26.8%, n=77); or an open license allowing adaptation (35.2%, n=101). Statistically significant differences were observed between blended educators and their counterparts teaching in face-to-face and online contexts in relation to the value given to reputation, relevance, and content description when selecting OER (see Table 6). However, in all cases and as eta squared shows, the percentage of the variance explained by teaching context is rather small.

Table 6

Comparison of Selecting OER Variables Across Teaching Context

	M(SD)				
	F2F	ONLINE	BLENDED		
	(n=258)	(n=27)	(n=22)	F	Effect size°
The resource being created by a reputable person or institution	1.34(.47)	N/A	1.09(.29)	F(2, 304) 3.07*	0.01
The resource being relevant to my particular needs or interests	1.22(.41)	1.37(.49)	1.05(.21)	F(2, 304) 3.81*	0.02
A detailed description of the content being provided	1.50(.50)	1.56(.50)	1.23(.42)	F(2, 304) 3.35*	0.02

* $p < .05$.

°Eta square

What are the challenges that K-12 educators find in using OER?

A majority of respondents feel that their use of OER is being hampered by the difficulty in finding resources of sufficiently high quality (57.3%, n=201); finding suitable resources in their subject area (56.1%, n=197); not having enough time to look for suitable resources (54.4%, n=191); and knowing where to find resources (50.1%, n=176) (Table 7). No statistically

significant differences were found among groups: these challenges are mentioned by all teachers, albeit in different order of importance, with one exception worthy of note: online and blended educators, in contrast to face-to-face, ranked overcoming technical problems above concerns with the quality and discoverability of open materials –70% (n=14) and 68.8% (n=11), respectively.

Table 7
Challenges in Using OER as Perceived by K-12 Teachers

	K-12 EDUCATORS N=351	
	Count	%
Finding resources of sufficiently high quality	201	57.3
Finding suitable resources in my subject area	197	56.1
Not having enough time to look for suitable resources	191	54.4
Knowing where to find resources	176	50.1
Overcoming technology problems when downloading resources	141	40.2
Finding resources that are relevant to my local context	137	39.0
Not having enough time/opportunities to experiment	129	38.5
Finding resources that are up-to-date	123	35.0
Not knowing whether I have permission to use or change a resource	95	27.1
Not having connections with OER-using peers	74	21.1
Getting work colleagues/managers to accept the use of OER	61	17.4
Not being skilled enough to edit resources	61	17.4
Resources not being aligned with professional standards	41	12.2
Lacking institutional support for my use of OER	40	11.9
Not knowing how to use the resources in the classroom	28	8.4

How do K-12 educators perceive the impact of OER use on their teaching practices?

Respondents were asked to agree or disagree on a five-point Likert scale on a series of statements regarding their perception of the impact that using OER has on their teaching. Results showed that 72.4% (n=228) agreed or strongly agreed that using OER allows them to better accommodate diverse learners' needs; 69.4% (n=270) agreed or strongly agreed that using OER broadens the range of their teaching methods; 65.5% (n=258) that they have

broadened their coverage of the curriculum; 64.9% (n=246) that they reflect more on the way that they teach; 63.9% (n=263) that they use a wider range of multimedia, and 61.1% (n=234) that they have a more up-to-date knowledge of their subject area.

No statistically significant differences were observed when comparing face-to-face, online, and blended educators, but curiously in this sample, online educators gave more importance than their counterparts to the fact that, when using OER, they make more use of culturally diverse resources: 50% (n=11) agreed or strongly agreed as opposed to 38.5% (n=69) of face-to-face educators and 38.9% (n=7) of blended educators. Likewise, the percentage of online educators that say that OER have an important effect on their keeping up-to-date knowledge of their subject area is higher than in the other two groups –72.7% (n=16) agreed or strongly agreed as opposed to 55% (n=105) of face-to-face educators and 38.9% (n=7) of blended educators. With regard to the impact of OER use on teachers collaborating more often with their peers, the percentage of face-to-face educators who neither agreed nor disagreed is higher than those who agree or strongly agree – 48.4% (n=88) and 37.9% (n=69), respectively. Higher levels of collaboration are present among online (60.9%, n=14) and blended educators (50%, n=9) in this sample.

How do K-12 educators perceive the impact of OER use on students?

Educators were asked their opinion on the impact that their use of OER in the K-12 classroom has on students, specifically in relation to increased performance, understood not only as improvement in test scores but also other non-grade related aspects (Table 8). A majority of schoolteachers (71.7%, n=231) agreed or strongly agreed that OER help develop learners' independence and self-reliance; 68.2% (n=214) that OER use increases learners' satisfaction with the learning experience, and 68.1% (n=220) that it boosts learners' interest in the subjects taught.

No statistically significant differences were found across groups; having said that, it is of value to draw attention to the fact that blended educators considered the biggest impact of OER use on students is an increase on learners' experimentation with new ways of learning (75%, n=15), whereas for online educators, the impact is equally split between increased interest in the subject taught, increased learner engagement with lesson content, and increased collaboration and/or peer-support amongst learners (71.4%, n=15). On the subject of test scores, only 48.3% (n=97) of face-to-face educators, 57.1% (n=12) online and 57.9% (n=11) blended thought that their OER use led to better grades, the lowest percentages recorded by an item in the scale.

Table 8
Impact of OER Use on Student Performance

OER use in the K-12 classroom...	K-12 EDUCATORS					
	Strongly agree	Agree	Neither/ Nor	Disagree	Strongly disagree	N
Increases learners' participation in class discussions	19.8	43.3	32.8	2.5	1.5	323
Increases learners' interest in the subjects taught	20.1	48.0	28.8	1.9	1.2	323
Increases learners' satisfaction with the learning experience	20.4	47.8	29.6	1.3	1.0	314
Leads to improved student grades	14.8	37.1	45.6	1.6	.9	318
Builds learners' confidence	17.4	44.9	34.8	1.3	1.6	316
Develops learners' increased independence and self-reliance	21.4	50.3	25.2	1.9	1.2	322
Increases learners' engagement with lesson content	22.5	46.2	28.8	1.3	1.3	316
Increases learners' experimentation with new ways of learning	25.2	42.2	29.4	1.6	1.6	313
Increases collaboration and/or peer-support amongst learners	19.4	38.5	36.3	4.1	1.6	314
Increases learners enthusiasm for future study	18.4	37.8	41.0	1.6	1.3	315
Leads to learners becoming interested in a wider range of subjects than before	18.7	34.3	42.5	2.9	1.6	315

DISCUSSION

One of the most significant findings highlighted here concerns the degree to which schoolteachers report adapting open materials: it is seldom that they use a resource as is, but often change it to suit their needs in the classroom. While it has been noted that OER are rarely packaged in a way that makes them easy to grab "off-the-shelf" (Boston Consulting Group, 2013) and thus require input from teachers, this high incidence of adaptation can be seen as an indicator of the strength of the relationship between OER and personalized learning. Patrick and Sturgis (2015) refer to the 21st century schools as places that must be conversant not with one-size-fits-all instruction but with learner diversity. It has been suggested that to make learning personal and reach all pupils, teachers need to expose learners to a

variety of views and resources; tap into their interests and experiences; help them choose what they want to learn and how to learn it; motivate them to self-regulate their learning and be successful in their journeys from school to college and beyond (Riggan, 2015). To provide personalized learning, teachers are expected to tailor content and, in that process of customization, exercise their abilities to find, evaluate, and combine materials to present to students (Gur & Wiley, 2007). When prompted to elaborate on the meaning of adaptation, a survey respondent said, "I use a lot of open resources to get inspiration and to get ideas but then I usually create different things for my own students that I tailor more to what they are doing." Queried about the impact of OER use on their teaching, teachers emphasized that OER allow them to better accommodate diverse learner needs, that through OER they broaden their teaching methods, and they reflect more on the way that they teach. In response to how OER affect learning, teachers stress better-engaged, more independent students. All this gives evidence to the argument that OER play an important role in the personalization of learning in schools. As Kimmons (2015) asserts, teachers are empowered to make content malleable to their students, rather than make their students malleable to the content. In a post-survey interview, a 12th grade teacher provided an example of how he translates this freedom to adapt materials into student engagement. His statistics course exists online under a Creative Commons license allowing adaptation: "I don't use anything that is not open because (…) I don't want to invest in any resources that cannot change." Every year he assigns his students the task of making the course better:

> I have some of the kids looking at some of the content, trying to critique how useful that will be in preparing them for the test; I have some kids looking at homework as a topic –how should homework be done, should it be assigned, should it be optional, should I post the solutions online... I have kids asking questions and thinking critically about their learning and how the curriculum works and then in class I'm asking them to actually show me some evidence that their concerns are valid, so they are doing some surveying and asking peers and they're trying to understand what would make this class better and justify that. They're doing critical thinking about their course content, which is something that the kids are almost never asked to do.

The discovery that face-to-face teachers create and adapt OER less than their online and blended counterparts may well substantiate the relation between adapting OER and personalized learning. Assuming that K-12 face-to-face classrooms are often locked into using textbooks from a particular

publisher, perhaps the need for face-to-face teachers to produce their own resources is less immediate. This is not to imply that face-to-face teachers care less for learner diversity, but that their likely intentions to teach in a more personalized environment may not be as well supported. The following quotation from a high school math teacher illustrates this point:

> It used to be that when I thought about preparing for a lesson, I'd look at a book and see what they did and then I'd teach a lesson similar to it. Now I can go online, watch a video or look at somebody else's material, see what they're doing and either modify [this] and bring it into my classroom, or just get a totally different perspective on it and allow my students to get multiple perspectives on a topic. I guess everything that's out there online allows me to be a better teacher.

While teachers adapt OER, it may seem alarming that only a small percentage base their selection on the resource having a Creative Commons (CC) license or an open license allowing adaptation, despite the fact that three out of four acknowledge the importance of open licensing materials. At the same time, not knowing whether they have permission to change a resource does not figure prominently amongst the barriers to OER use, which does not necessarily indicate that K-12 teachers are CC savvy. Actually, although the question was put to only a subgroup of survey participants (n=193), over half of them reported that either they had never seen a CC logo or that they had seen it but did not know what it meant. Consequently, whether teachers are unintentionally or deliberately shunning open licenses, this disparity between knowing about open practices and engaging in open practices bolsters the argument that mainstreaming OER is not only a matter of raising awareness of openness but of changing teachers' habits. In this sense, our data strengthen the common knowledge that, when looking for resources, K-12 teachers access familiar spaces like YouTube, for instance, where uploading content with an open license is not a default action. The supposition that a resource is online and, therefore, free to use supersedes whether it can be adapted or not. Schoolteachers, however, do indeed adapt material to teach in their classrooms; the onus is on repositories to make it easier to display licenses and on teachers to reject content that does not allow adaptation.

In addition, finding that the most urgent challenges to schoolteachers' use of OER concern the discoverability of open content makes it unexpected to learn of their scant appreciation of existing K-12 repositories. When teachers want a clear OER "destination," "one place to find all the material, sorted by subject" (Boston Consulting Group, 2013, p. 10), how can we explain that such places already exist (i.e. OER Commons, CK-12, etc.) but remain

largely unknown to a majority of educators? It is also of interest to connect this observation to teachers' attitudes to sharing online. For a majority, trading resources in person or via email just happens, whereas few make their materials available to others online by uploading them to an open repository. We argue that mainstreaming OER requires that K-12 teachers be supported in bridging the gap between the personal and the public so that sharing openly becomes the norm rather than the exception.

CONCLUSION

The current study offers a comprehensive picture of how a group of teachers think about and use OER, including purposes, challenges, and perceived impact of open practices on teaching and learning in face-to-face, online, and blended contexts. It highlights how those K-12 teachers surveyed do not merely adopt OER but adapt open content to suit the needs of diverse learners, thus giving evidence to the argument that OER use enables personalized learning. We propose that teachers can contribute to raising awareness and mainstreaming OER in schools but need to be supported in changing their habits and attitudes towards searching for content and sharing resources.

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