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Social media use for deaf and hard of hearing students in educational settings: a systematic review of literature

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ABSTRACT
The pedagogical benefits of the social media may be most pronounced when they impact groups of learners who are at a disadvantage in conventional face-to-face contexts. Among such disadvantaged groups are the deaf or hard of hearing (DHH) students who may experience new opportunities with the help of the social media. This paper stems from the assumption that social media can play an important role in enhancing the learning experience for DHH students. The paper presents evidence around derived from a systematic review of the literature on the use of social media by DHH students in educational settings. A comprehensive search through multiple known databases identified a dataset of 172 papers from which 11 papers met the criteria for in-depth analysis. The analysis revealed that DHH students often reported a positive impact of social media on their learning in the form of increased interaction, learning motivation, as well as support and feedback. Students also reported challenges such as privacy, time management, inappropriate content, perceived isolation and parental resistance to adoption. Besides presenting the evidence found in literature, our analysis highlights that researching the effect of social media on DHH student learning remains an under-explored area of study.

The adoption of social media technologies for personal and educational use continues to increase. In educational contexts, social media is seen as a means to enhance information flow, connections with peers and faculty as well as promoting self-regulated learning (Dabbagh and Kitsantas 2012). Over the past decade there have been a wide diversity of social media technologies adopted in education practice such as – weblogs (Azari 2017, Huang et al. 2011, Oravec 2002), wikis (Kai et al. 2017, Kimmerle et al. 2011, Neumann and Hood 2009, Zou et al. 2016); and social network sites (Myspace, Facebook, Twitter, etc) (Greenhow and Askari 2017, Hung and Yuen 2010, Lim and Richardson 2016, Lockyer and Patterson 2008). These technologies have rapidly enabled the generation and dissemination of content (e.g. ideas, photos, and video) alongside the facilitation of synchronous and asynchronous social interactions. In essence, social media has fundamentally changed the way the Internet is used in the classroom and for teaching purposes more broadly (Veletsianos and Navarrete 2012).

Alongside the increased uptake of tools to promote in-class participation, social media also plays a larger role in democratizing learning. The adoption of social media can be seen to provide greater opportunities for all learners to interact and connect with peers and faculty (Antoniadis et al. 2017, Chen and Bryer 2012).

For example, students with special needs can often more readily participate in the digital world and overcome the constraints presented in the physical space (Raike 2011). To explore this notion further, consider the conventional face-to-face classroom setting. In this context, the primary mode of instruction is through verbal communication. The setting of learning activities, feedback and support are largely provided through verbal means. In these instances, deaf or hard of hearing (DHH) students are at a significant disadvantage. The lack of the primary communication channel leads to their further educational marginalization and what Jenkins et al. (2006, p. 3) described as a 'participation gap'. The failure rate of DHH students in post-secondary institutions is significantly greater compared to their hearing peers. Convertino et al. (2009) suggested that a key factor influencing the high failure rate is the associated high levels of dissatisfaction experienced by DHH students through their social life in school. DHH students are required to use modes of communication and learning that differ from their hearing enabled peers. Such differentiation in communication processes can result in perceived barriers towards becoming social integrated with hearing peers (Wauters and Knoors 2007). The complexities associated with communicating require increased effort from DHH students when they try

forming relationships with peers. Often such efforts result in comparatively fewer friends and a lower level of satisfaction with social interaction in the classroom (Kouwenberg 2013, Omar 2014).

The complexities associated with communication impact both on the development of peer relationships as well as the teaching process. The diminished communication for DHH students can weaken the quantity and quality of feedback they receive in learning situations (Lam-Cassettari *et al.* 2015). This has a major effect on student learning given the critical role of feedback in the learning process (Stewart *et al.* 2012). To prevent such a participation gap in the classroom, there is a need to increase social interaction among DHH students with their hearing peers. Social media can play a significant role in mediating this need.

The affordances of social media for communication and support of interpersonal networks may in part address some of the learning challenges experienced by DHH students. Community-based technologies, such as social media, have been commonly suggested for all participants in the learning process. However, these technologies can also potentially cater for special needs students such as the DHH (Zaraii Zavaraki and Toofaninejad 2011). For instance, Lihua and Jiacheng (2010) reported that DHH students prefer text-based in lieu of verbal modes of communication. Furthermore, DHH students are more prone to use text-based communication, social media and internet surfing in their lives compared to their hearing counterparts (Maiorana-Basas and Pagliaro 2014). The everyday familiarity with text-based communication can help reduce the anxiety levels for DHH students leading to increased confidence in communication with peers and teachers (Kožuh *et al.* 2016, Yang and Cheng 2009).

Various researchers have noted that despite the abundance of studies on the use of social media in education, there are limited studies investigating learning through social media among DHH students (Cuculick 2014, Gregor 2014, Kožuh *et al.* 2015, Saunders 2016). Chen (2014) argued that despite the positive relationship between use of social media and quality of life, well-being, self-efficacy and communication skills of DHH students (Gerich and Fellinger 2012, Hill 2015, Oyewumi *et al.* 2015), few studies have focused on the effectiveness of the Internet and computer-based learning through social media. Hence, the systematic review undertaken in this paper aims to identify the studies that address the use of social media for DHH students. The findings of the systematic review can provide insights into the challenges and opportunities encountered by both educators and students when using social media, and to better understand how social media tools can affect learning gains of DHH students. The study therefore addresses the following research questions:

- How are social media tools used for DHH students in an educational context?
- What are the opportunities and challenges when implementing social media into educational settings?
- Is the introduction of social media positively associated with DHH student learning outcomes?

Methods

Search strategy

This systematic review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendation (Moher *et al.* 2009). To identify relevant studies, nine databases such as ProQuest, Scopus, ERIC, Web of Science, A+ Education, Wiley online library, Science Direct, PsycINFO, and EBSCO were searched. The search was conducted in December 2016 and further updated in March 2017. A manual search was conducted using Google Scholar to include grey literature such as reports into the dataset.

The query was built using a combination of keywords in the domains of (a) social media; (b) DHH disability; (c) education. Keywords included 'social media', 'social network site', 'web 2.0', 'blog', 'wiki', and 'online community'. In addition to the social media-related keywords, 'Facebook', 'Twitter' and 'YouTube' were added to the query, as these are the most commonly used social media technologies among students (Poellhuber *et al.* 2011). To locate all studies which related to deaf or hard of hearing, the keywords 'deaf', 'partial hearing', 'hearing loss', and 'hard of hearing' were used. Finally, to address the educational aim of the study, keyword stems 'education', 'learn', 'teach', 'student', and 'instruction' were added. For example, the following query was built to search the Scopus database*: ('social media' OR 'social network* site*' OR SNS OR Facebook OR Twitter OR 'web 2.0' OR blog* OR wiki* OR YouTube OR 'online community') AND (education OR learn* OR teach* OR student* OR instruction) AND (deaf* OR 'hearing impair*' OR 'hard of hearing' OR 'hearing loss' OR 'partial hearing').*

In addition to the database query, a direct manual search was conducted in the following journals: Journal of Deaf Studies and Deaf Education, Journal of Deafness and Education International, American Annals of the Deaf, Journal of Computer Assisted Learning, International Journal of Mobile and Blended Learning, and International Journal of Computer-Supported Collaborative Learning. These journals were selected as their publications contained the highest number of results in our bibliography and digital library search. To identify additional studies, reference lists of full-text reviews and Google Scholar were manually performed.

Study selection criteria

The analysed dataset included studies that assessed the use of social media for DHH students in educational settings. No limitation was imposed on the date of publication, study design, age, geographical, or participants' language of the studies. Published journal articles, conference proceedings, and doctoral dissertations were included, but editorials, commentaries, book chapters and newspaper articles were excluded. The selection of the papers into the final dataset was limited to research conducted in educational settings. That is studies assessing the use of social media without a direct focus in or on education were excluded. Also, studies using other web-based technologies (e.g. email or RSS), one-way transmission of content and mobile education were excluded. Two identified articles (Drigas *et al.* 2013, Vrettaros *et al.* 2010) reported on the same findings that were derived from the same analyses. Thus, only one of these two papers was included in the final analysis, i.e. Vrettaros *et al.* (2010).

Definition of terms

The study defined social media as 'a group of Internet-based applications that build on the ideological and technological foundations of web 2.0, and that allow the creation and exchange of User Generated Content' (Kaplan and Haenlein 2010, p. 61). According to Kaplan and Haenlein (2010), this definition serves as an umbrella term for tools such as blogs, collaborative projects (e.g. wikis), social networking sites (SNS) (e.g. Facebook), content communities (e.g. YouTube) and virtual worlds (e.g. Second Life).

Search outcome

The search and selection process is outlined in Figure 1. A total of 158 articles were identified using the noted search strategies. A further nine articles were added through the manual Google Scholar search giving a total of 167 papers. Next, all duplicates ($N = 47$) were identified and removed leaving a total of 120 articles that were then screened by title and abstract. The process of reviewing bibliographies of full-text reviews resulted in an additional five articles. Having screened the titles and abstracts, 88 articles published in editorials, commentaries, book chapters and newspaper, and were not focused a social media, hearing impairment and education were excluded. Although 37 articles were selected for full-text review, 26 articles were excluded due to the final application of the exclusion criteria delineated above. Finally, 11 eligible articles were selected for synthesis (see Figure 1). Table 1 summarizes the studies and their contents.

Data extraction

Information from the included articles in the systematic analysis was extracted using standardized forms and entered into Microsoft Excel. The following information was extracted into two categories. The first detailed the characteristics of the included studies (Table 1) namely: author, year of publication, participants, type of hearing impairment, age, discipline, type of social media used, usage of social media, data collection tool and primary outcome measure. The second category (Table 2) provides the outcome of the reviewed studies including the purpose of study, conclusion, and statistical significance of the findings as well as positive, neutral or negative outcomes and associated limitations.

## Search results

Study design

As shown in Table 1, the studies analysed predominantly employ quantitative methodologies. For instance, eight studies used quantitative methods, two were a qualitative study (Cuculick 2014, Omar 2014), and one employed mixed methods (Elliot *et al.* 2013). All studies used a questionnaire in their data collection process. Other types of data collected within the studies ranged from interviews (Cuculick 2014, Omar 2014) tests, observations (Cuculick 2014) and online trace data, such as the number of posts in forum, the number of assignments submitted (Chen 2014), Facebook log charts, Facebook pages (Cuculick 2014).

Participants

All the studies in the final dataset involved students from high school and higher education. The age of the participants in the studies was above 17 except in the study by Awad (2013). In this case, the study was conducted in a high school setting. Collectively, the reviewed studies comprised some 795 higher education students ($n = 7$). All of the participants were deaf or hard of hearing except in (Udofia *et al.* 2017) where some 58% of students were DHH, and 42% had a speech impairment. In the Blom *et al.* (2014) study 51% were DHH, and 49% were hearing students.

Type of social media used

Across the studies, most cases analysed the use social network sites (64%) with Facebook being the most common, followed by blogs (30%). Other types of social media sites, such as Wikis, Google hangouts, synchronous forums, skype and vodcasting (i.e. video
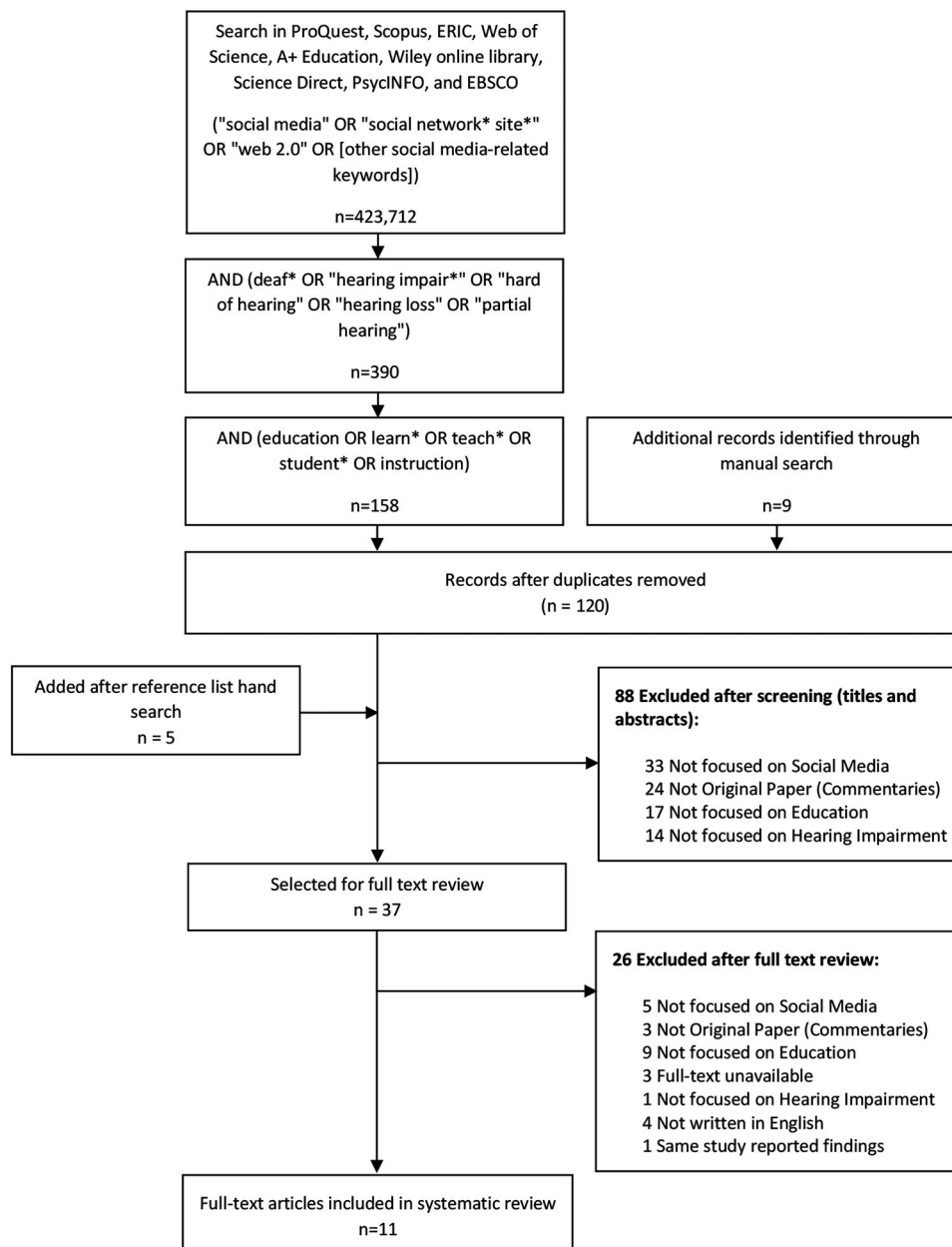
Figure 1. Flow diagram of study selection.

casting) were also used either as standalone tools or in combination with other technologies.

Usage of social media

The types of activities that integrated the use of social media in the studies varied across the papers. The authors used social media for collaborative learning (Udofia *et al.* 2017, Vrettaros *et al.* 2010), decryption of thoughts and ideas (Cuculick 2014, Drigas *et al.* 2010), sharing of educational content (Drigas *et al.* 2010), connecting to professional organizations (Elliot *et al.* 2013), accessing resources and services (Elliot *et al.* 2013, Lihua and Jiacheng 2010, Udofia *et al.* 2017), submitting homework (Chen 2014, Cuculick 2014, Lihua and Jiacheng 2010), asking for help (Lihua and Jiacheng 2010), and keeping in touch with friends and families (Blom *et al.* 2014). Four studies did not mention how social media was adopted.

Measures used

All studies used questionnaires for collecting data. For example, Vrettaros *et al.* (2010) implemented a Likert-scale questionnaire about the usefulness and ease of use of the adopted tools. Lihua and Jiacheng (2010) used a questionnaire to find out what type of social media DHH students used and how they are utilized. Drigas *et al.* (2010) employed a Likert-scale questionnaire to evaluate the teaching experience incorporating social media. Casagrande (2013) used questionnaire with five level Likert scale in five parts: demographic information; usage preferences of different communication technologies and social networks;

Table 1. Characteristics of included studies.

Author (year)	Country	Participants (N)	DHH (%)	Deaf (N)	Hard of hearing (N)	Age (mean)	discipline	Type of social media used	Usage of social media	Evaluation tool	Measured Outcomes	Quality
Awad (2013)	Jordan	students who went to Al-Amal School for the Deaf (330)	100	330		High school	NA	Facebook	NA	questionnaire	psychological and social adjustment	75.0%
Blom et al. (2014)	Netherlands and the United States	Netherlands: special education schools USA: students from RIT/NTID (222)	51	62	51	18–26 (21.02)	NA	social networking sites	Making relation with friends and families	questionnaire	Friendship qualities and Well-being	84.5%
Casagrande (2013)	Italy	people who attended deaf institutes and normal public school with hearing peers (42)	100	21	21	17–63 (33.8)	NA	Facebook	NA	questionnaire	language skills	58.9%
Chen (2014)	Taiwan	hearing impaired freshmen in one of the universities (16)	100	16		College students	Operating software	online asynchronous forum, interactive materials	NA	Questionnaires, tests, surveys, number of posts in forum and assignments submitted	learning motivation and learning behaviour	73.2%
Cuculick (2014)	United States	students from RIT/NTID (15)	100	9*	2	18–23 (20.5)	NA	Facebook	Making relation with friends and families	Semi-structured interviews, Facebook log charts, Facebook pages, focus group	Learning assistance in classroom	85.0%
Drigas et al. (2010)	Romania, Italy and Greece	trainers of the courses (10)	100	NA	NA	NA	Foreign Language (ESOL)	Vodcasting, SNS and blog	description of learners' personal thoughts, post relevant issues, supportive educational content, sharing of content and reflections	questionnaire	Learning motivation	48.2%
Elliot et al. (2013)	United States	students from RIT/NTID[a] (12)	100	NA	NA	Post-secondary college	STEM	Google+ Hangouts	For use in an accessible STEM 'library' (e.g. deaf-friendly STEM resources such as ASL[b] STEM dictionaries) and connections to professional organizations	questionnaire	Grade point averages (GPA) and retention	59.3%
Lihua and Jiacheng (2010)	China	University students (40)	100	40		University students	NA	blogs, wikis, instant messaging, Email	Submit homework, learning communication, ask for help, material collection	questionnaire	The way of using social media	44.6%
Omar (2014)	United States	former or current students from RIT/NTID (30)	100	12*	16	18–35 (27.5)	NA	Facebook	NA	questionnaire and interview	interaction, academic achievement, and overall satisfaction	80.0%

| Udofia et al. (2017) | Nigeria | hearing and speech impaired students who admitted in university between 2009/2010-2015/2015 academic session. (33) | 58 | 19 | NA | NA | Facebook, blogs, Twitter, Instagram, Flicker | to access library resources and services, send and receive messages from friends, access graphical, video and audio information sources, as well as carry out collegial interaction in discussion groups where educative materials and ideas are disseminated among each other | questionnaire | information literacy | 67.9% |
| Vrettaros et al. (2010) | Greece, Cyprus, Italy, England | unions of hearing impaired people (45) | 100 | NA | 30–50 | e – commerce | blogs, wikis, SNS and typical hypermedia | for group-based activities | questionnaire | easiness and usefulness of social media in learning process | 53.6% |

*One does not report his/her hearing impairment type.
[a]Rochester Institute of Technology/ National Technical Institute for the Deaf (RIT/NTID).
[b]American Sign Language.

use of Facebook in particular, the frequency of access and activities to do in; the perception of Facebook as a language learning environment; and two open-ended for how Facebook can support language learning and what tools can be used in the field of deaf people's education. Elliot et al. (2013) implement two online questionnaires about technical issues related to the conditions of the tutoring session and the equipment used, and the impact on tutoring or learning focused predominantly on the types of tools used for the session and the benefits and challenges of remote tutoring. Udofia et al. (2017) used an internet resources and information literacy of hearing and speech impaired students questionnaire. The questionnaire that Awad (2013) used related to five dimensions dealing with psychosocial compatibility which was self, health, family, social and school compatibility. Also Blom et al. (2014) run questionnaire about the participant's online activities, friendship qualities, and well-being. Omar (2014) used both online questionnaire and online interview that focused on the impact of computer-based training (CBT) on DHH interaction, achievement, and overall satisfaction in a higher education environment. The questionnaire covered the participants' demographics, participation, interaction (either online or face-to-face), use of technology, and communication and preferences. Cuculick (2014) used questionnaire just for the deaf college student background information. Her main tools were semi-structured interviews, Facebook log charts, Facebook pages and focus group. More than a questionnaire, Chen (2014) used tests, surveys, observations and interviews, the number of posts in forum and assignments submitted.

Quality assessment of studies

The included studies were also evaluated in regard to their quality. The checklist developed by Batten and colleagues (2014) was adopted for undertaking a quality assessment. The quality checklist was designed to assess quantitative, as well as mixed designs and qualitative research methodologies. The authors created a checklist that was developed through a combination of other quality assessments, for instance, by Downs and Black (1998), Law et al. (1999), the National Institute for Health and Clinical Excellence (NICE 2007) and Sirreyeh et al. (2012).

The adopted checklist consisted of 45 questions, with the answers to each question being yes = 2, partial = 1, and no/don't know = 0. Some 29 questions on the checklist targeted quantitative-based methodologies; some forty questions addressed qualitative-based methodologies; all of the questions could be applied to mixed designed research. Upon assigning numerical codes corresponding to yes/no/don't know categories for each item in the checklist, the sum of

Table 2. Outcomes of included articles

Author (year)	Purpose	Authors conclusion	Statistically significant	Outcomes			limitation
				Positive	No difference	Negative	
Awad (2013)	Comparing the level of psychological and social adjustment among deaf students who use Facebook and high school deaf students who do not use Facebook	Neutral	Yes	in health and social adjustments	in the level of psychological and social adjustment among deaf students who use Facebook and deaf students who do not use Facebook (in self, family and school) and attributed to gender		purposive sampling
Blom et al. (2014)	How SNS is used to communicate with new online friends or playing games with offline friends associated with D/HH friendship qualities	Positive	NA	A combination of the online and offline friendship seems to be the most important friendship type for both hearing and D/HH students. It has a positive relation with well-being. / More computer use with an offline friend was related to a higher friendship quality in both D/HH and hearing students	there were no harmful effects from online friendships on well-being		Different ways of living in Netherland and USA/ The answers cannot be controlled in online surveys
Casagrande (2013)	investigate Italian deaf people's preferences and usage habits of social Networks and whether Facebook support their linguistic learning process or not	Positive	Yes	Social networks are positive settings for the process of language learning. Especially reading skills and learning new words, also affecting deaf people's lives, supporting their socialization, integration, autonomy and self-esteem		the fear of wasting time and of isolation from the real world, inappropriate contents and the problems of privacy seem to discourage deaf people from considering the possibility of using them as educational tools	NA
Chen (2014)	establish an interactive self-regulated learning environment and employs ARC[a] motivation model, hyperlink technology, modular concepts and online learning community to design teaching contents and presentation of teaching materials	Positive	Yes	Learning motivation increase after the experiment/ students have improved learning behaviours, which were more positive and active			limited to hearing impaired students of one university
Cuculick (2014)	how Social Network Sites can be used to assist learning in classrooms of deaf students	Positive	NA	Facebook provided participants many opportunities to engage with language, ideas, and with multiple communities/ three themes emerged: information sharing, community participation, and community support			the short time period for log charts and one focus group was used
Drigas et al. (2010)	design and development of an e-learning course in teaching deaf people in a foreign language	Positive	NA	these tools can support deaf peoples' learning effectively and also encourage learning			small sample size
Elliot et al. (2013)	describe synchronous, remote tutoring for the Deaf STEM Community	Neutral	NA	tutoring beneficial, especially for its convenience. Technical assistance and feedback systems were created to support participants	GPA and retention remained stable		Small sample size
Lihua and Jiacheng (2010)	what social media do the deaf learner have and what to do they use social media	Positive	NA	The educational value of social media in special education, despite some shortcomings in education of deaf university learners, cannot be ignored during the improvement of performance of deaf learners			NA

Omar (2014)	evaluate the effectiveness of using Community-based Technologies (CBT) to enhance the educational experience for DHH students in higher education	Positive	NA	population in this study does not represent all DHH students/ questionnaire also has two open-ended questions
Udofia et al. (2017)	examined the impact of Internet resources on information literacy of hearing and speech impaired students	Positive	Yes	information literacy of hearing and speech impaired students in academic libraries
Vrettaros et al. (2010)	whether web 2.0 tools as well as techniques such as lip – reading, video – sign language and learning activities are appropriate to use for learning purpose	Negative	Yes	social networking tools are simple to use and promote cooperative/ learning Video sign languages help to understand the learning material and lip reading very helpful; Wiki, Blogs and text supported by hyperlinks are not helpful and easy to handle

[a]Attention, Relevance, Confidence, Satisfaction.

the points were converted to a percentage to enable cross-study comparisons.

Studies listed in Table 1 fell within the quality range from 44.6% (Lihua and Jiacheng 2010) to 85.0% (Cuculick 2014). The average quality of all the included studies is 66.4%. In the present study we found most studies to have a high-quality theoretical background and rationale for the study, clear research design and data collection methods, with the conclusions well related back to the research question. However, the majority of studies did not mention if there was a conflict of interests and ethical procedures. None of the included studies reported DHH or hearing control group. A further limitation associated with the quality of the studies, related to the overall size of the dataset noted in the research articles addressing the use of social media for DHH students in education. The sample sizes of the studies were relatively small, and as such all papers included in the dataset were tagged as a feasible approach.

Discussion

This systematic review aimed to investigate how social media implemented into educational settings may improve learning outcomes for DHH students. Table 2 provides an overview of the reviewed studies aims and reported outcomes. The analyses demonstrate that 8 studies concluded that the use of social media had an overall positive effect on various aspects of learning for DHH students. Two studies concluded that social media had no significant effect, while one study noted a negative effect on learning for DHH students. This section discusses the findings of these studies by addressing three main questions.

How are social media tools used for DHH students in an educational context?

The systematic review of the literature demonstrates that social media can improve DHH student performance when used in blended learning environments (Blom et al. 2014, Chen 2014, Drigas et al. 2010, Omar 2014, Vrettaros et al. 2010). Such approaches to teaching are useful to promote access to resources, communication, and collaborations for DHH students (Blom et al. 2014). This finding reflects other research investigating the use of social media. For instance, Smith and Lambert (2014) undertook a systematic review of the use of Facebook and Twitter in university-based healthcare education, noting that the social network tools enhance communication and increase accessibility to resources, peers, and teachers in a blended learning environment. The benefits such a blended model can bring for DHH students in addressing communication challenges warrants further investigation into effective curriculum design and adoption.

Also, the majority of the reviewed studies confirm that social media is an effective tool for DHH student learning when used in combination with other tools. For example, although DHH students prefer to use text to communicate with peers (Lihua and Jiacheng 2010), implementing multimedia for their communication and learning environment, such as Video clips with captions, can also increase satisfaction with their learning experience (Bryant 2012, Elliot *et al.* 2013). Similarly, Vrettaros *et al.* (2010) recommended that course design includes a combination of social media and special hearing impairment technologies such as lip reading or sign language – as captions or directly integrated into video resources.

Compared to other types of social media, social networking sites (SNS), such as Facebook, have the fastest adoption among students. The reviewed studies predominantly reported SNS as the most popular social media within DHH students' community.

What are the opportunities and challenges when implementing social media into educational settings?

Interactions

The analysed studies frequently linked the integration of the social media into DHH student experiences with an increase in interactions between DHH or hearing peers. DHH students often find it challenging to communicate with their hearing peers. For example, Omar (2014) showed that 57% of DHH students surveyed were disappointed with their face-to-face interactions with hearing enabled peers. Furthermore, Lihua and Jiacheng (2010) showed that making connections to other people was perceived as the most important application of the social media among DHH students. Also, as noted by Omar (2014), some 70% of DHH students felt they could better interact with all of their peers through online modes of communication. In line with these expectations, several studies demonstrated that online communication enhanced in-class interactions for DHH students. Elliot *et al.* (2013) designed a STEM course allowing all students and tutors to chat synchronously or asynchronously, as well as share documents and screens, access YouTube, and write on a virtual board. He reported that these tools provided increased opportunities for DHH students to connect and interact with other hearing students. Essentially, these tools aided the learning progress of DHH students in more collaborative based projects by minimizing communication challenges. In a similar manner, Cuculick (2014) suggested that the use of social media technologies could be used to facilitate interaction between DHH and hearing students. The ability to readily form connections and interact with peers can increase a student's social capital, and therefore, contribute to their overall academic

success (Rovai 2002, Woodie 2007, Arnold and Paulus 2010). As noted above, for DHH students the development of strong peer relationships and support networks can be a challenging process due to the complexities of communication. Access to text-based communication via social media affords DHH students easier access to interact with peers thereby increasing their sense of community and belonging. DHH students can use these technologies to form relationships for information exchange, as well as more socially oriented discussions for support and friendship, i.e. enhancing motivation and well-being in general (Cuculick 2014). Given the affordances of social media to facilitate interpersonal interactions, it is not surprising that these tools applied in the education setting are also found to increase the level of interactions among DHH and hearing peers.

Provision of support

The reviewed studies suggest that social media technologies are effectively used to provide learning support through feedback processes (Cuculick 2014, Lihua and Jiacheng 2010) and technical assistance (Elliot *et al.* 2013). Chen (2014) also showed that social media such as online asynchronous forums could support after class activities for DHH students. In this instance, the asynchronous forums were used for chatting with tutors and to provide assistance for students that may have missed key concepts presented in the course. This approach reflects that of Drigas *et al.* (2010), who also used Ning.com as a social network platform to aid the learning of English as a second language for deaf students that used sign language as their first language. Adoption of social media can facilitate faculty and peer feedback to students regarding their learning progression (Cheston *et al.* 2013, Desai 2014). As Hattie and Timperley (2007, p. 104) stated: 'If feedback is directed at the right level, it can assist students to comprehend, engage, or develop effective strategies to process the information intended to be learned'. The inclusion of social media technologies into course design for DHH students may have an impact to instruction and enables the provision of feedback that frequently stems from oral communication processes.

Accessing information

Social media facilitates access to information for DHH students. Udofia *et al.* (2017) showed that hearing impaired students frequently used Facebook, blogs, Twitter, Instagram and Flicker to access library resources and services, and graphical, video and audio information. Cuculick (2014) also found that one of the reasons deaf students use Facebook is that they can more readily find and access information. Cuculick referred to Facebook as one the best ways DHH students can stay updated with events and

news, both in and beyond the educational setting. Lihua and Jiacheng (2010) also reported that 38% of deaf students used social media for collecting instructional materials. Due to an often reduced social network and resources, DHH students can often suffer from a reduction in access to information, e.g. videos are not captioned. To fill the gap of accessing information, Barak and Sadovsky (2008) found that DHH students often used internet resources more than their hearing peers for both personal and group communications. Also, studies found that using social media can increase accessibility of hearing students (Cheston et al. 2013, Smith and Lambert 2014). By increasing accessibility to information, DHH students could benefit social media integrated into their learning context.

Ease of use

The convenience of use of social media for DHH students is still unclear. Some studies have reported that DHH students found SNS difficult to use. For instance, Vrettaros et al. (2010) reported that only 25% of students thought that wikis were easy to use. In contrast, 93% of DHH students found weblogs to be an easy resource to use. Further, 55% of students suggested that social network sites were an easier tool to use for their learning of e-commerce. The use of such tools are not passive. That is socially based technologies such as Wikis or SNS require input and activity from participants in order to derive value. In contrast- technologies such as video enabled with captions or sign language are passive tools only requiring students to watch the embedded resource. The added requirements for students to contribute posts or reflections require added technical and cognitive skills and effort. The added effort required on the part of the learner may effect the negative perception held by the students with regards to the ease of use of social media and like technologies. Lihua and Jiacheng (2010) reported that DHH students also found wikis more difficult to use when compared to blogs, and suggested that DHH students have some difficulty in learning how to use social media tools in their learning process. The authors explained that (at the time of the study) wikis were a relatively new concept and more difficult for deaf students than blogs. Other studies reported the DHH students found social media convenient to use (Cuculick 2014, Elliot et al. 2013, Omar 2014), also for hearing students (Mugahed Al rahmi et al. 2014). Many factors can affect student perceptions around ease of use of technologies such as the specific type of social media, interface, teacher support, technical support and introduction prior to the use of social media. However, none of the included studies mentioned these factors.

Relationships and social presence

The analyses demonstrated that social media can aid the development of relationships among DHH students and peers. Online interaction through social networks helped DHH students to create and maintain their social presence similar to their hearing peers (Omar 2014). For instance, in the study by Blom et al. (2014) 30% of deaf students ($n = 222$) who normally used sign languages as their primary mode of communication reported that the increased use of social network sites led to increased perceived levels of friendship quality. Casagrande (2013) also noted that 95% of DHH students had established a relationship with both DHH and hearing peers on Facebook. The remaining 5% of DHH students formed relationships only with other DHH peers. Similarly, Omar (2014) reported that some 60% of DHH students enjoyed some form of academic relationships and reported a greater affinity with the class community. Cuculick (2014) and Blom et al. (2014) identified that DHH students prefer Facebook more than phones or other technologies to make and maintain relationships with family and friends. Cuculick (2014) also suggested that making a relationship through Facebook could help elevate the visibility of the deaf community in American society. While the studies largely present a positive outcome in the use of SNS and relationship development, Awad (2013) reported no significant difference. Awad (2013) compared the psychological and social adjustment of deaf students who used Facebook with those that did not. The study did not elaborate as to whether students used a different social media other than Facebook, as well as the intensity of Facebook use. However, this finding demonstrates no negative impact when using Facebook for DHH students. In other research, more frequent engagements in online interactions have been shown to be positively associated with social adjustment and a lower level of loneliness (Yang and Brown 2013). Studies have also shown a positive relationship between use of Facebook and social behaviours in hearing people (Engelberg and Sjöberg 2004, Orr et al. 2009, Ryan and Xenos 2011). The establishment of increased social relationships can aid DHH student well-being, and increase the friendship quality between DHH students and their hearing peers (Blom et al. 2014). Although social media use could decrease the amount of time spent with family (Sharaievska and Stodolska 2017), they can also help families understand what it is like to live as a deaf person (Cuculick 2014). Online interaction through social networks helped DHH students to create and maintain their social presence like their hearing peers (Omar 2014). However, virtual world still cannot be a substitute for face-to-face interactions for social support (Wong et al. 2016). Therefore, different social media activities have different implications and effects for students' psychosocial well-being (Yang and Brown 2013).

Challenges

Like other technologies, social media usage by DHH students may produce challenges. Casagrande (2013) reported that negative aspects typical of social networks such as a fear of wasting time and isolation from the real world, inappropriate contents and problems of privacy combine to discourage deaf people from considering the possibility of using them as educational tools. Cuculick (2014) indicated that the concerns around privacy from certain individuals including teachers or families was also a concern for some deaf participants. Further challenges in adopting SNS lie in the capacity for staff or teachers to incorporate such technologies into their teaching practice. Omar (2014) maintained that for the majority of students' the challenge in using social media primarily related to a lack of appropriate integration or uptake by teachers. However, even when such technologies are adopted there remain challenges in accepting new practices. For instance, Elliot et al. (2013) reported that while faculty members acknowledge the convenience of remote tutoring using social media they were often more critical of the quality of their tutoring sessions.

Other challenges in the adoption of social media for DHH students have also been reported. For instance, staff concerns regarding dissemination of misinformation, fuelling misunderstandings, concerns over privacy and ethics including identity thefts, or the loss of control or ownership of data, addiction. This list can be further added to when considering the growing concerns of cyberbullying, information security and stalking, boundaries between student-staff relationships, reshaping the traditional roles of teacher and student, increased workload, cultural resistance and traditional visions of instruction (Aramo-Immonen et al. 2016, Guy 2012, Manca and Ranieri 2016, Smith and Lambert 2014, Tang and Hew 2017). Due to limited literacy levels, young people unable to use social media as much as they would like (Hynan et al. 2014). The literacy level of DHH students has lower than hearing students (Takahashi et al. 2017). Social media provides opportunity to help young people with communication disabilities develop literacy skills (Raghavendra et al. 2015), however the lack of literacy level my negatively influence social media reading comprehension and written participation. These challenges can clearly impact on DHH students and therefore require further investigations.

Is the introduction of social media positively associated with DHH student learning outcomes?

Learning motivation

Analysis of the studies supported the premise that the use of social media in educational settings can lead to increased levels of student motivation for learning. For example, Casagrande (2013) concluded that the use of Facebook led to increased DHH students' motivation in developing reading and writing skills. Similarly, through an experimental study design, Chen (2014) found a positive relationship between use of the online asynchronous forum and DHH students' learning motivation. Other studies (Ktoridou and Doukanari 2015, Vorvoreanu et al. 2015) offered similar conclusions for hearing students. Jung et al. (2010) demonstrated that social interaction increases learning motivation, as DHH students learn to interact on social media with their peers and teachers with minimum limitation.

Reading and writing skills

Besides the increase of learning motivation, social media have a positive effect on DHH students reading and writing skills. Omar (2014) reported that instead of using a human interpreter for explaining the ideas, 76% of DHH students preferred to write their ideas. Casagrande (2013) also reported that SNS are positive settings for the process of language learning, especially reading skills and learning new words. Similarly, |Cuculick (2014) indicated that the application of Facebook improved writing and reading of deaf students. Studies in hearing students also indicate there is some improvement in writing and reading through the use of social media (Alshumaimeri 2011, Trocky and Buckley 2016). The improved outcomes are also reflected in learning a foreign language (Faizi et al. 2014). However, the user-design of social media technologies often force users to write in a specific genre or form such as the prolific use of acronyms substituting for sentences and emoticons substituting for the expression of feelings (Stillwaggon Swan and Goldberg 2015). Further studies are required to examine if these forms of writing have any impact on a student's academic writing. While there is much enthusiasm associated with the uptake of technologies into education, teachers should remain optimistically cautious by reflecting and questioning the stated promise against documented research outcomes.

Collaborative learning

The adoption of social network sites (Vrettaros et al. 2010) and social media (Lihua and Jiacheng 2010) has also been noted to improve collaborative learning skills for DHH students. Collaborative learning is based on understanding each other by doing and discussing learning activities (Savery and Duffy 1995). The social learning context is enhanced through increased interactions that are more readily mediated through the use of social media in class settings. Also, several studies reported a significant positive relationship between social media and collaborative learning for hearing students (Chao and Lo 2011, Cheston et al. 2013, Lam and Ma 2016). Among the challenges DHH

students experience when engaged in group activities is the difficulty to keep track of the discussion between students. Therefore, DHH students' understanding of and learning from the group would decrease (Stinson 1999), and they would not be able to participate in group learning activities like their hearing peers. The inclusion of social media technologies to run collaborative projects can support resource and information sharing among DHH students and their hearing peers (Drigas et al. 2010). Instead of speaking, all members of a collaborative learning group may opt to write their discussions, so that DHH students can track and understand their hearing peers, and increase their comprehension and overall participation.

The evidence collected through the systematic review supports the premise that the use of social media enhances peer interactions in learning contexts. In regard to the effect of social media on learning of DHH students, the effect still remains unclear. Some of the identified studies reported no relationship or even a negative relationship between the use of social media and academic performance. For instance, Elliot et al. (2013) found no significant improvement in the Grade Point Average (GPA) and retention of DHH students who use social media for their STEM courses. Similarly, Lau (2017) also found that using social media for academic purposes was not a significant predictor of academic performance as measured by cumulative grade point average. Leyrer-Jackson and Wilson (2017) noted a negative correlation between social media use and learning and academic performance in hearing students. On the other hand, selected studies have found a positive effect of the use of social media on formative assessments (Chen, 2014) and information literacy (Udofia et al. 2017) amongst DHH students. Similarly, Tang and Hew (2017) noted the potential of promoting positive learning outcomes through the use of Twitter in education as observed through a systematic review of the literature. Such positive learning can take place alongside four different dimensions, i.e. access learning content, create digital content by learner, connect learners and collaboration between learners which has been labelled as the four C's of learning 2.0 (Redecker et al. 2010). As shown, the findings are diverse, possibly confounded with other contextual and pedagogical factors. Hence, the relationship between student use of the social media and learning cannot be clearly drawn out.

Limitation

Conducting this systematic review brought to fore a number of limitations and challenges within the analysed literature. There was no agreement in social media definition and types through the studies. One study even included the use of email as a social media tool (Lihua and Jiacheng 2010). The number of academic papers was limited, and the studies in this domain have only been published since 2010, with few investigating the effects on learning. Most of the studies mentioned the positive capacity (potential) for social media to enhance education. Also, social media were mostly used with other tools such as learning management systems (LMS), and lip reading technologies, etc. As such, it is difficult to ascertain the impact of social media when it is potentially confounded by the use of other technologies.

The lack of studies with experimental designs, random assignment, and controls for the influence of extraneous variables appears to be a challenge and questions the quality of the current findings. None of the studies used experimental methods with a designated control group. Most of the studies relied on self-reported questionnaires that may highlight only perceived effects on learning. Due to the small sample sizes and unreliability of self-report literacy scores, determination of the exact association between social media and DHH students learning was not possible. Future research should use more robust methodologies to examine a cross-section of social media users and non-users.

Since conducting our literature search, the researchers have endeavoured to remain up-to-date in this expanding literature through ongoing reading, discussions with experts in the field, and publication alerts from the databases, however, as this field of study is growing, there maybe studies that have been published or are in the process of the submission that have not been included in this review. Also, it is possible that, despite our attempts to capture all pertinent articles through the use of numerous carefully selected search terms, some relevant studies may have unintentionally been excluded. Lastly, the effect size has not been calculated due to the wide variations in the constructs of outcome measures and reporting. Thus, a meta-analysis was not feasible and therefore has not been undertaken.

Suggestions

Surprisingly, despite the obvious application of social media for network formation among the learning individuals, none of the studies in our dataset applied network analysis methods to examine the effects of social media on student learning. Social media are 'a rich source of behavioral data' (Tess 2013, p. 65). Previous research studies have analysed the data to find out how students form relationships as network actors, where social media technologies serve to support the interactions within the network (Dawson 2008, Skrypnyk et al. 2015, Vivian 2012). Besides analyzing how students form their learning networks, prior research has focused on visualizing these networks

and learner behaviour to help teachers reflect on how students are positioned in relation to one another (Dawson 2010). Such visualizations can help teacher design further interventions to help promote student integration in the classroom. Such visualizations are underpinned by the use of social network analysis (SNA) a powerful method for the analysis of learner relationships within a network. The underused application of SNA in the studies of DHH education can help gain insight into the effect of the social media on learning outcomes for DHH students, especially in the areas of the social capital and belonging.

The characteristics and facilities of social media are changed from the past to now and due to technology development continuing to improve (Yonker *et al.* 2015), conducting research studies about social media and DHH education is suggested every period of time. Also, social media definition, facilities and types vary, and it is recommended that further research studies investigate what characteristics of social media affect which part of the learning environment and education.

Conclusion

This study offered a review of the use of social media in educational settings by DHH students. The study helped understand the strength and weakness of integrating social media to assist DHH students in their education. The analysis also demonstrated the body of existing literature in this area and could be used as a guideline for further related research studies. A systematic and (additional manual search) revealed a total of 172 studies. From the sample, 11 papers met the eligible criteria. The analyses of studies demonstrated that the factors that social media had an effect on DHH students related to increased levels of interaction, learning motivation and learning support such as providing feedback, access to information, ease of use and technical assistance. The findings also suggest that social factors including family, friend or work relationships; increased the level of social presence, social adjustment and well-being are also influenced by the inclusion of social media in educational settings.

The results also support the view that social media has much potential to aid the learning of DHH students. This cohort of students are frequently challenged by the speed of learning and have difficulty making relationships with hearing students and teachers in their classroom. Social media technologies can facilitate more social interactions between DHH students and the social environment around them thereby aiding social and education integration. In this context, it is advised that social media is adopted in both online and blended learning contexts. The adoption of social media can extend beyond the classroom to include aspects of orientation and transition to study. DHH students can use social media to aid their access to academic and social interactions in order to reduce feelings of isolation.

The effect of social media on learning is not clear. Studies in this field are limited and require further investigations. Longitudinal and experimental designs are needed to find clearly demonstrate the impact of social media on DHH students learning. A key method to include in future studies relates to the use of social network analysis to identify how such tools can facilitate social and academic support structures.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix

Quality Assessment Checklist (Batten *et al.* 2014).

No	Part	type	Criteria	Yes (2)	Partial (1)	No DK (0)
1	**Abstract**		The abstract provides a clear summary of the aims, method, results and conclusion of the study			
2	**Introduction**		Theoretical background and rationale of the study are clearly stated			
3		QL only	Seeks to understand processes/ structures/ subjective experiences/meanings			
4			Research aims/objectives/questions are clearly described (in introduction or method section)			
5	**Method Overview**		The research design is clearly stated and justified			
6			The design is most appropriate to the research question			
7		QNT only	The outcomes to be measured are clearly described			
8	**Method Participants**		Participant (child) demographics and setting clearly stated			
9		QL only	Informer demographics clearly stated (if observation – inter-rater reliability?)			
10		QL only	Multiple types of informers/methods used (e.g. child, parents, peers, teachers)			
11			Sample is representative of the target population			
12			Sample size is appropriate/justified			
13			Participation rate/drop-out rate is stated and reason for non-consent or drop-out is included			
14		QNT only	Hearing control group reported			
15		QNT only	Hearing control group matched on confounding variables			
16			Deaf control group reported			
17			Deaf control group matched on confounding variables			
18			Inclusion and exclusion criteria are clearly stated			
19	**Method Procedure**		Procedure clearly outlined and replicable			
20			Data collection methods clearly stated and systematic (if QL: how data was recorded and transcribed)			
21			Clear rationale for data collection given			
22		QL only	Duration of data collection stated			
23		QNT only	Ethical procedures described and adequate			
24			Relationship between the researcher and participant adequately considered			
25			Reliability and validity of measures is appropriate and reported			
26	**Results**	QL only	Data analysis strategy was reported			
27		QL only	Data analysis strategy was appropriate, systematic and justified			
28		QL only	Extracts from the original data are included			
29		QL only	Multiple methods of triangulation were reported (source, method, researcher or theory)			
30		QL only	Justification for triangulation/not triangulating			
31		QL only	Method of resolving differences between triangulation procedures stated and any discrepant results discussed			
32	**Richness of Data**	QL only	Participant checking was used to verify findings (e.g. holding a follow-up meeting)			
33		QNT only	Have actual probability values been reported (e.g. 0.035 rather than <0.05) for the main outcomes, except where the probability value is less than 0.001			
34		QL only	Were any of the results of the study were based on 'data dredging'? Y/N. If Yes, was this specified? If No to data dredging – score 2.			
35		QL only	Results were reported in sufficient detail			
36		QL only	The context of the data is described well			
37		QL only	Diversity of perspective and content explored			
38			Responses are compared and contrasted across groups			
39		QL only	The detail and depth of the responses has been demonstrated well, including a reflective statement.			
40	**Conclusion**		Main conclusions were clear			
41			Main conclusions were consistent and reflective of the data			
42			Main conclusions were related back to the research question			
43			Implications of the study were stated			
44			Limitations of the study were discussed			
45			Conflicts of interests were addressed			

Quality Score: … … / … … .
Quality percentage: … … %.
MAXIMUM QUALITATIVE STUDY SCORE: $40 \times 2 = 80$.
MAXIMUM QUANTITATIVE STUDY SCORE: $29 \times 2 = 58$.
MAXIMUM MIXED METHODS STUDY SCORE: $45 \times 2 = 90$.