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New literacies: Multimodal and social orientation of 'new' in secondary science classrooms

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Abstract: The "new" of new literacies are multifaceted social practices to make and share meanings with new communication tools and technology. Despite gaining considerable research focus in recent times, there is scarce evidence of new literacies as instances of practice in secondary science classrooms. In this article students' engagement in classroom literacy practices has been explored to find out how far literacy practices are indicative of new pedagogical approaches in meaning-making, in response to the digital, multimodal, social, and participative orientation of new literacies rather than conventional literacies. This research is situated in an interpretive-qualitative research paradigm and uses a case study approach. Three science teachers and their classes were study participants. This study concludes that in the New Zealand secondary science context, pedagogical approaches represented only that of "being digital" with conventional literacies. The new literacies as new ways of thinking and doing to make and communicate meanings can be realized if knowledge and expertise are shared through social interactions in online media and peer- to- peer collaboration equally. Classroom environment as a new avenue can serve to build ongoing relationships with extended communities of learners.

Subjects: Teachers & Teacher Education; Theory of Education; Theories of Learning; Classroom Practice; Curriculum Studies; Secondary Education

ABOUT THE AUTHORS

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Nosheen Shahzadi has academic qualifications and experience in science teaching that define her identity and research motivations. She is interested in explaining technological changes have brought about huge shifts in the understanding of literacy. Her latest research focuses on changing literacy theories, specifically disciplinary literacy in science, and how far these theories are implemented in science pedagogy.

Johari Surif is a science education lecturer with 22 years of teaching experience at Universiti Teknologi Malaysia. He is involved in research related to conceptual change, metacognitive strategies, problem solving, scientific thinking, and student creativity which focuses on understanding the thinking process and learning process of students. In addition, he also strives to improve students' scientific literacy in the classroom, laboratory, and outside the classroom through effective teaching strategies.

Keywords: 'new' in new literacies; literacy practices; technical and ethos stuff; multimodal and social

1. Introduction

As an emerging construct, it is difficult to define new literacies with a single universal definition. This broad and interdisciplinary movement termed as New Literacies represent a shift in understanding literacy from autonomous, print-oriented, and language-based notions to literacies as multifaceted social practices to make and share meanings with emerging tools and technologies. Therefore, changes in literacy theory and practices in relation to technological change necessitate shifts in contemporary pedagogical practices.

Over the last 20 years, new literacies have gained considerable research focus, and many researchers and authors have emphasized reconceptualizing school literacy to deal with changing information and communication technologies. It is commonly perceived that the conventional view of literacy cannot account for the new skill set needed to fully participate in social and cultural activities and prepare young learners for twenty-first century (Sang, 2017). It is argued that in response to such a paradigm shift our educational system should acquire new methods, environments, and assessment method (Reilly, 2009). However, when it comes to implications of new literacies, it is unclear what school literacy practices offer to students and how far classroom pedagogical practices conform to new literacy theories discussed in literature.

Many research studies have discussed students working with technology in and out of school literacy practices, nonetheless, there is scarce evidence of new literacies as instances of practice in classroom setting (Cervetti et al., 2006; Karchmer, 2008; Kist, 2005; Tierney, 2009; Wimmer, 2010). Therefore, research work is needed to unearth what new literacy practices should look like to better inform literacy pedagogy.

William Kist (2005) - One of the first scholars who defined and exemplified classroom enactment of new literacies—has identified the common pedagogical features through multiple case studies. These characteristics include explicit discussion of the merits of using the symbol system, use of multiple forms of representation, teachers' use of meta dialogues, a combination of individual and collaborative activities, and engaging context for students learning. While his work is paramount in presenting what new literacies might look like in the classroom, much is missing to discuss how literacy practices can harness the digital, multimodal, and participative features of what is new in new literacies rather than traditional literacies. It is worth making clear that this study sees literacy broadly as "ways to mean" (Harste, 2003) and new literacies specifically in pedagogy as practices of conveying meanings with and constructing meanings from any medium or form of representation (Kist, 2005) specifically with reference to new tools and technologies.

The first part of this paper discussed the difference between ethos and technical stuff with a synthesized definition of new literacies in the context of scientific literacy. In addition, undefined participatory culture framework have been discussed shortly. The evidence of new literacies from real classroom practices has been explored. This study explores the new literacies as instances of pedagogical practices that make use of social and multimodal orientation of science literacy. For this, a comparison of three cases has been made in reference to the idealized definition of paradigm case (Lankshear & Knobel, 2007) of new literacies and Jenkins's et al. (2009) framework.

2. Literature review

2.1. new literacies "Multimodal and Social Orientation" to Meaning-Making

In New Literacies literature (with upper case "N") refers to the overarching research field. According to Coiro et al. (2008) New Literacies research take different forms for different researchers. For instances, some of the researcher have seen New Literacies social practices and

conceptions of reading and writing (Street, 1998, 2003), set of skills, strategies, and dispositions in handling online content (Jenkins et al., 2009; Leu et al., 2004), new semiotic and multimodal context (Hull & Schultz, 2002; Kress, 2003), multiliteracies (New London group, 1996), new discourses (Gee, 2003), change in technologies and associated cultural practices (Coiro et al., 2008) and research that combines several of these orientations (Lankshear & Knobel, 2006).

On the other hand, new literacies (with lower case "n") represents skill set and instances of practices—with or without technology—using collaboration and participation to make and communicate meanings. The association of the word new with literacies can be understood in both paradigmatic and ontological senses. According to Lankshear and Knobel (2006), the paradigmatic sense involves researching New Literacies using a particular sociocultural approach (Gee, 1996; Street, 1993). The ontological sense that forms the core of new literacies and transcends Lankshear and Knobel's views in all three editions of their new literacies books corresponds to the substance and character of the new social practices of producing, distributing, and sharing meanings. Learners engage in these practices through participative and collaborative practices associated with digital text mediation.

Lankshear and Knobel (2006) identified two categories of new literacies cases, namely, "paradigm" cases, and "peripheral" cases while acknowledging the lack of consensus on such a classification. The paradigm cases of new literacies engage learners with new technical stuff and ethos stuff simultaneously, while the peripheral cases employ only a new ethos and not a new technology. Accordingly, the practice that makes use of only technical stuff without ethos cannot be seen as a case of new literacies (Barton, 2017).

In this respect, the use of new technology in accordance with the old mindset is a case of "putting old wine in new bottles"; in other words, the combination of new technologies and old literacies cannot be said to characterize the new literacies because only screen hosted texts served conventional literacies. Similarly, employing new ethos stuff, or what Barton (2017) called a "focus on practice appropriate behaviour", in peripheral cases do not necessarily require the use of new technology or teacher competence in digital literacies as "the behaviors can be enacted using nothing more than paper, pen and exploratory attitudes" (p. 6). But simply, it is the broad ethos character of the new in both the paradigm and peripheral cases integrated with the explorative, participative, interactive, and social orientation—in a digital context for the former case and physical context in the latter case—that serves as the necessary condition for new literacy practices compared to conventional literacies.

According to Lankshear and Knobel (2007), in contrast to typographical technologies, the technical stuff of the new in new literacies takes into account the mediation of digital electronic tools with corresponding new technological trends in social practices. The technical stuff of new literacies indicates two vital characteristics that serve to differentiate them from old technologies. First, with old technologies, one can produce simple forms of production, such as written science texts with multimodal representations of science conventions on paper. Compared to this, the new technical stuff provides means for the hybridization of multimodal media through the remixing of multimodal science texts, images, music, and videos. In new literacy practices, a learner can access the range of original material that can be sampled "copied, cut, spliced, edited, reworked, and mixed into a new creation" of the texts (Lankshear & Knobel, 2007, p. 8).

Second, the new technical stuff allows for distributed means of media production. A learner's repertoire of technical stuff corresponds to their skills in computer literacies to make meanings that result in interactive and interconnected forms of text production and its distribution that can be retrieved conveniently. Overall, on the basis of the two characteristics of what counts as new, Lankshear and Knobel (2007) demonstrate that the new technical stuff is distinctive primarily because of its "enabling" quality.

The ethos stuff of new literacies, on the other hand, addresses the new in terms of new beliefs and practices, that is, new ways of doing, making, and being to initiate participation and collaboration. The new ethos stuff exhibits elements of shared and social characteristics in a way that conventional literacies do not. The underlying premise of the new ethos and participative practices refers to the notion of a "new mindset". This mindset assumes that technologies have changed the world, which is in contrast to the "old mindset" that envisages using new tools to do the old work only in a more technological way. The practice element of new in the ethos dimension of new literacies involves the use of literacies and new tools for participation, collaboration, sharing, negotiating meanings, and learning in participatory culture (Jenkins et al., 2009). This suggests that the new literacies are less "published, individuated, and author-centric" (Lankshear & Knobel, 2007, p#?). Both dimensions of new technology and ethos stuff are not in any sense segregated; rather, they operate in conjoint and interdependent ways as discourse (Gee, 1996) with embedded literacies into which new technical stuff is also a part of generating, communicating, and negotiating encoded meanings alongside the new ethos of ways of being and doing.

The "new mindset" as new ethos stuff also refers to "conceiving, negotiating, and enacting workspaces" (Lankshear & Knobel, 2007, p. 14). From the old mindset perspective, space is perceived as closed and has definite borders such as classroom walls with a prescribed curriculum and students working on singular tasks at any given time. Opposed to this, the new mindset sees the space as "fluid, continuous and open" with possibilities of multitasking while participating and being on task. The technical and ethos dimensions of "new" practices of meaning-making, text production, and learning—is to create, communicate, share, and negotiate meanings. These are subsumed in concepts like "participatory culture" (Jenkins et al., 2009, 2015).

2.2. new literacies Defined

To explore students' engagement in text-mediated practices in making meaning, it was vital to conceptualize the new literacies with an idealized definition that worked as an exploratory frame. This study defines new literacies on two levels, with the first conceiving new meaning-making environments as horizontal networks (Castells, 2010), of multimodal communication for which idealized new literacies parallel the paradigm cases (Lankshear & Knobel, 2007).

The second level views new literacies in relation to a pedagogical focus on developing students' "multimodal representational competency" (MRC), for which technological developments afford students' access to multimodal meaning-making opportunities in ways seen never before (diSessa, 2004). Moreover, using representations for building scientific reasoning is recognized as an established disciplinary practice that draws on human interactions with tools and multimodal texts to generate scientific claims. Seeing new literacies as a way to bring in the element of recognized disciplinary practice in the classroom is an idealized way for students to relate to how professional scientists work with authentic texts in actual practices.

For both levels, this study drew on Gee's (2009) idea that literacy always involves "apprenticeship to a group". Overall, new Literacies do not mark a fine distinction between offline and online spaces; rather, it recognizes instances of new practices as new ways of combining reading, and writing (Gillen, 2015) representing and communicating meanings while participating in collaborative activities to acquire distributed knowledge and skills. It has been argued that "meanings made with language, whether as speech or as writing, are interwoven with the meanings made with other modes in the communicative context, and this interaction itself produces meanings" (Kress et al., 2001, p. 11). In this sense, the exploration of new literacies such as multimodal literacy/MRC necessitates a sociocultural approach to explore interactivity surrounding multimodality as acts of communication where the language "fulfills a bridging function when engaging in multimodal communication" (Ivarsson et al., 2009, p. 205) with available semiotic resources and representations.

This two-level definition states that new literacies are the meaning-making practices that reflect the characteristics of encompassing technical and ethos stuff. Learners' engagement in new literacies enables them to draw on text mediation and social aspects of participation to make meanings and apprentice the novices to become members of a digitally based learning community. Similarly, this study defines new literacies as new meaning-making practices in and through science representations that need explicit instructions and interactive dialogues embedded in conjoint social environments—literacy events in physical classrooms and online spaces that lead to the construction of scientific reasoning.

This study justifies the use of the paradigm case, a pedagogical focus on multimodal science representations, and "apprenticeship" in conceptualizing new literacy practices because all three ideas have implications in the New Zealand context. Changes in science education have long been perceived in terms of "future-focused" science education (see Gluckman, 2011) specifically in an e-learning context. This involves the use of digital texts with varying representational affordances to develop students' science understanding.

Similarly, multiethnicity is a vital characteristic of every secondary school to a greater or lesser extent in the New Zealand context. Research evidence posits that in science instructions, dominant modes of written and spoken words work as valued representational modes (Pozzer-Ardenghi & Roth, 2009) and lead to verbal bias (Coleman et al., 2011) in classroom literacy practices. It has been noted that this affects underrepresented populations to varying extents. Given this background, an idealized definition of new literacies as the paradigm case perhaps best exemplifies the changing opportunities for meaning-making in the secondary science context.

The broad ethos of new literacies that differentiate them from being digital in conventional literacy lies in the "deep interactivity, openness to feedback, sharing of resources and expertise, and a will to collaborate and provide support" (Knobel & Lankshear, 2014, p. 97). This emphasizes the social dimension of new literacies for the making and sharing of meanings. Guided by common purposes, a social practice approach to literacy emphasizes the shared ways of creating and exchanging meanings with tools and knowledge within the social context (Scribner & Cole, 1981). From this view, new literacy practices portray the use of digital tools and techniques with the ethos of intense participation and collaboration (Lankshear & Knobel, 2006).

The technical and ethos dimensions of "new" practices are also subsumed in concepts like "participatory culture" (Jenkins et al., 2009, 2015). This study justified the use of this framework because by keeping in view the new of new literacy practices, any literacy practice can be categorized as new based on how far it exhibits the character of "technical stuff" as technical skills and digital meaning-making together with "ethos stuff" as participation in collaborating, negotiating, sharing, and communicating meanings in learning and text production practices.

According to Jenkins et al. (2009) the defining characteristics of participatory culture and literacy skills include the following:

- Relatively low barriers to artistic expression and civic engagement.
- Strong support for creating and sharing one's creations with others.
- Some type of informal mentorship whereby what is known by the most experienced is passed along to novices.
- Members believe that their contribution matters.
- Members feel some degree of social connection with one another (at the very least they care what other people think about what they have created (Jenkins et al., 2009, p.6).

With the growth of digital media and participative ways of communication and information sharing, the expanded views of literacy emphasize community involvement in learning. The

whole host of new skills that new literacies holds include, but are not limited to, foundational skills of reading and writing, technical skills, research skills, critical analysis of information and information sharing. Jenkins et al. (2009) have mentioned the new literacies skills with the following terminologies:

> Appropriation: refers to the ability to understand and select a text. This includes remixing the text based on its suitability to serve a new purpose, context, and audience.
>
> Transmedia Navigation: refers to the "thinking across the media or the ability to read and write across all available modes of expression". (ibid, p. 89)
>
> Distributed cognition or intelligence refers not just to the technical and cognitive skills rather it is closely "related to the social production of knowledge" also known as collective intelligence. (Jenkins et al., 2009, p. 68)
>
> Networking: refers to "the ability to search, synthesize and disseminate information" (Jenkins et al., 2009, p. 91).
>
> Simulations: refers to the "new media [that] provides new ways of representing and manipulating information. New forms of simulations expand our cognitive capacities, allowing us to deal with larger bodies of information". (Jenkins et al., 2009, p. 41)

2.3. Methodology and methods

The question this study has addressed is: what is the evidence of new literacies in today's science classrooms? This research is situated in an interpretive-qualitative research paradigm and uses a case study approach. This approach enabled the researchers to present, analyze, and interpret the uniqueness of real situations (Cohen et al., 2000). On the one end, case study accounts can portray the realities, while on the other, readers can reflect on what new literacies should look like in real classroom practices. Three secondary teachers: Steve, David, and Amy and their year 9, 10, and 11 science classes, respectively, were selected using purposive sampling to yield "information-rich" (Patton, 2002) cases. From each classroom, six lessons of one-hour duration were observed over a period of 5 weeks. In addition, the field notes and supplementary materials, for instance, the physical characteristics of the site, specific details of the lessons and pedagogical practices, start and ending of the lessons, details of literacy events and their timeline, written details about the screenshots and photos of URL of the websites and articles used, written or composed artefacts, teachers' writings, students' classwork, or assigned tasks and photos of the printed or digitally based teaching resources were collected.

This study used thematic analysis (Braun & Clarke, 2006) to develop the thick narrative of the study interpretations within and across the generated themes. To interpret meaning-making practices for paradigm and peripheral case—the students' and teachers' work with digital text, comments, and feedback and their drawing on shared expertise in social context were analyzed using signposts of "participatory culture" (Jenkins et al. 2009).

This study draws on Guba's four constructs (Guba, 1981) to enhance the trustworthiness of the study. The strategies of multiple lessons observed for each case, informal talks with teachers to clarify questions, member checking of researcher's reflective and analytical comments on observed events and transcripts by the participating teachers were used as methodological triangulations to enhance validity of findings.

2.4. A short introduction to three cases Steve, David, and Amy and their science classes

Steve has taught year 9 science in a "blended-learning environment". The observed class was made up of 19 students. While working on designed e-curriculum activities, different student groups were learning on their own pace.

David's year 10 science class had a roll of 22 students who worked with printed texts using collaborative group discussions. The class worked on the same activities at the same time and students were accustomed to listening to the teacher as novices.

Amy's year 12 biology was a class of 20 students. They were accustomed to listening to teacher's instructional input. However, there were instances when students' were allowed to self-direct their learning individually.

What follows is a short description of literacy events observed in all three cases following the discussion of emerging themes in detail.

2.4.1. Case 1: literacy events in Steve's classroom

Literacy events discussed here describe students' engagement in participatory culture, appropriation, transmedia navigation, and simulation use in science learning. For Matariki inquiry project, students were required to prepare a scientific poster/infographic in groups. For this they watched an explanatory video and read articles to understand the Maori star compass and the Matariki constellation. They then downloaded the "Google map app" application and explored how variations in time and date result in different star/constellation patterns in the solar system.

In another event, a students' group searched for an online infographic website "Make infographic that people love" (2012), watched a YouTube tutorial video (Vennage, 2016) to understand the basic technical features of this tool, made notes, prepared their infographics, and uploaded them to Google Classroom. For most of the students' groups, this inquiry writing was not more than copy-pasting activity rather than paraphrasing or repurposing online texts.

In another activity, Steve used a simulation activity Circumstellar Habitable Zone Simulator (n.d. to reinforce the concept of the conditions deemed necessary for life on the planet. Most students liked this activity because of its interactive and manipulative features that resemble gaming in its operation. Steve advised a students' group to use simulation and complete the table and numerical calculations after finishing their reading activity. Learning to operate accurately the changing parameters that led to changed conditions for life in this simulation required time. Since these students were busy gaming during class time, they copied calculations from their peers after Steve moved to the next group. To the researcher, besides calculations, this activity likely did not help facilitate students' understanding of the concept. This could be due to the pedagogical practice of leaving students on their own to make sense of this visual representation.

2.4.2. Case 2: Literacy events in David's classroom

This case illustrates a developed participatory culture without using technology for students' science learning. In teaching the genre of explanation and science report writing, David used a role-play activity in his year 10 science. Each student took up a role and contributed their ideas in small-group discussions followed by a whole-class discussion. In this process, David acts as a scribe for the class who reworked and scaffolded to turn students' ideas into an approximation of the genre through the joint construction of the text.

Most of the literacy events suggest constructivist pedagogy in David's classroom. Rather than the structured lessons used in conventional teaching, David always drew on students' prior knowledge to introduce new ideas. In pedagogical practices he often questioned and gave a problem to be solved in group discussions. After a short time, he started circulating, monitoring, listening, and intervening while encouraging students to brainstorm ideas as their prior learning.

2.4.3. Case 3: Literacy events in Amy's classroom

These examples show students' engagement in participatory culture, appropriation, and transmedia navigation. Amy instructed her year 12 Biology students to explain "specialized cell functions" and complete a table given in their One Note class notebook. Students worked independently and

searched online information articles such as Schreiner (2018) "Specialised cells in the body and Google images, made notes and completed the table, and uploaded their work on the One Note class notebook platform. Later on, Amy pasted individual students" responses with her written comments on a word document, displayed that page on the overhead projector, and gave detailed feedback on students' work. She mentioned students' names who have copied and pasted the online text. Finally, she allowed sharing of students' writings by giving them time to take a picture of the projector with their mobile devices.

In another literacy event, student groups in Amy's classroom composed and posted their ideas for "active and passive" transport in animal cells on Padlet wall, which was an online information-sharing platform.

3. Results

Based on the analysis of the above-mentioned literacy events, this study argues that in the New Zealand secondary science context during 2018–2019, pedagogical practices fail to align with "new" in new literacy practices to make and communicate meanings. The nature of text-mediated practices in Steve's and Amy's classrooms characterize them as neither the paradigm case nor the peripheral case of new literacies because of the dominant technologized conventional literacies aspects rather than the enactment of new technical and ethos stuff. However, David's classroom represents the peripheral case of new literacies in the enactment of the new ethos of social learning in negotiating and sharing meanings while drawing on distributed expertise in classroom-based learning communities without using technology. Similarly, pedagogical approaches fall short of enacting interactive dialogues using multimodal science representations for students' engagement in new literacies. Moreover, there was scarce evidence of students actively making meanings in text production practices. The following writing serves to support this argument.

4. Discussion

The examples described above involved students' literacy practices of online information search, reading websites articles, watching interactive videos or simulations, and respective text composition activities. Such practices indicate students' digital literacy in aspects of internet search, navigating the hypertexts, assembling knowledge (Gilster, 1997), and multimodal composing through the "remixing" of online content.

Overall, these practices speak only to the digitality of the practices with new tools and technology on the parts of both the teachers and students. However, such pedagogical practices mediated with digital text were partial in exhibiting the use of new technical stuff. According to Lankshear and Knobel (2012):

> . . . the technical stuff of new literacies is part and parcel of generating, communicating, and negotiating encoded meanings by providing a range of new or more widely accessible resource possibilities ("affordances") for making meanings. (p. 51)

Technical stuff enables the distributed means of media production in terms of learners' engagement in creating and circulating media content in online learning communities (Lankshear & Knobel, 2006). In a pedagogical sense, the juxtaposition of print and/or digital resources to communicate meanings was generally a technical phenomenon used for communicating intended meanings in these examples. In both Steve's and Amy's classrooms, students were seen engaged in meaning-making through digital text reading and composing practices. This could appear to be a new phenomenon; however, it seemed that it did not conform to new literacies because according to Lankshear and Knobel (2007):

> If we see literacy as "simply reading and writing"- whether in the sense of encoding and decoding print, as a tool, a set of skills, or a technology, or as some kind of psychological process – we cannot make sense of our literacy experience. Reading (or writing) is always reading something in particular with understanding. (p. 2)

The above mentioned Lankshear and Knobel (2006, 2007) statements imply that new literacies are more about making and communicating meanings in social contexts by drawing on the ethos of shared and collaborative expertise. This involves individuals' contextual experiences of the online activity while working together rather than their engagement in decoding or encoding processes alone.

The student's literacy practices in Amy's classroom indicate that online publishing on the pallet wall represented an opportunity for engagement in new literacy, but it did not make use of technology and ethos stuff efficiently. This was due to the fact that this activity was confined to a one-time upload only, and students were not seen as active participants who used an online platform to draw on distributed expertise while collaborating, negotiating, and circulating generated meanings within the online or classroom-based learning community.

In almost every observed literacy practice in all three cases, students were seen engaged in consuming digital content individually on the grounds of having proficiency in technical skills only. This is in stark contrast to making use of the participative dimension of digital means in communicating the meanings among peers, online learners, or commenting on experts' videos. Thus, the use of technical stuff was confined only to accessing, downloading, remixing, and uploading of the composed writing to Google Classroom for assessment purposes only.

In both Steve's and Amy's classrooms, students' ways of working and using digital content also indicate an informal mentorship that likely developed in virtual spaces. It was informal in the sense that learners were seen engaged in taking up the information from websites without formal rules set by the teachers, and this practice was common to their daily life activities.

The authors of these websites and information, including writings and videos, were experts and mentors in their particular fields who had created and circulated the media content on online platforms. The students tended to access the circulated materials as novices while they engaged in making sense of and synthesizing texts by using various online resources. However, such practices failed to demonstrate the dimension of a new "ethos" of drawing on distributed knowledge because students were not seen in a dialogic relationship with online experts to support and advance their individual and collective ends (Lankshear & Knobel, 2006) and to develop "participatory" forms for their science learning.

In another example, Amy's feedback practices such as writing comments on students' work were also indicative of her participation and engagement in a classroom learning community.

However, it can be suggested that students' engagement in such a learning community can be enhanced if all the students were given the opportunity to comment on each other's work before Amy's feedback. But it is important that students have the expertise and motivation to comment. The activity would have to be carefully selected as one where the students all have something to offer.

In contrast to this text-mediated learning community, in David's classroom, another form of participation was in operation as the students learned about the writing genre. According to Cope and Kalantzis (1993), genre literacy teaching characterizes the role of a teacher as an expert on the language system and function and engages his students as apprentices. This can be seen as an extension of Jenkins et al. (2009) participatory culture in a classroom-based learning community where teacher–student interactions suggest a developed mentorship from the expert teacher to the novice students.

It was evident within the learning environment and social practices in David's classroom that there were low barriers for students to contribute their ideas. Here, the teacher's scaffolded discussions served as strong support for creating and sharing one student's creations with others. Similarly, with established communication norms, participants felt a social connection with one

another while they collaborated, shared, and drew on each other's expertise. Such properties appeared to add new values in terms of doing, meaning-making, and being that privileges participation over the practices of individual work, ownership, and the centralized expertise of conventional literacies.

Even though the use of technical stuff alone is not enough to characterize literacies as new, students' engagement in the new literacies' aspects of reading and writing multimodal texts to gain communicative competence necessitates what Lankshear et al. (2013) termed "heteroglossia over linguistic essentialism" to master changing discourses.

More specifically for science contents, learners draw on a range of non-linguistic semiotic systems, such as information graphics charts, interactive simulations, representations, and hybrid text types, which necessitate an explicit pedagogical focus on interactive discourses rather than rendering them highly individual, or idiosyncratic as described in Steve's classroom. The idealized use of new literacies would enable students' new repertoire as they make sense of the multimodal semiotic resources or representations while they draw on teachers' discourse in a multimodal context. Science pedagogy in all three science classrooms lacked evidence of new practices in terms of pedagogical discourse in using science representations for students' learning of new literacies.

Another aspect of students' learning as new practices of active meaning-making can be assessed by analyzing their text production practices. In David's classroom, the exploratory use of language led to students' active meaning-making as students' written text to indicate the transformed meanings. While in Steve's and Amy's classrooms, students copy-pasted the online contents, indicating the reception or reproduction of the culturally available meanings, respectively.

Generally, in remixing, learners take culture apart and put it back together; they take bits of circulated artifacts and statements to rework, edit, and mix into a new creation without having permission to re-use the contents or referencing the source (Lankshear & Knobel, 2007). Hence, technology-mediated multimodal composing or remixing cannot be referred to as copy-pasting or plagiarizing practices. However, students should be encouraged to repurpose or paraphrase the online content to compose something new with or without technology.

In usual writing practices mediated through digital or published texts, students require skills to select, remember, and produce the most appropriate description of the scientific phenomenon. In the researcher's understanding, it is not straightforward to clearly identify copy-paste practices in the writing of science definitions. If a student finds an accurate scientific definition of a phenomenon—which usually requires accurate expression or lexical arrangements—as online content and reproduces it in a paper-based assessment, would that be termed as a copy-paste practice or not? It is difficult to say.

It is commonly perceived that most students have developed digital literacy skills outside of their digital school lives. This seemed to be true of the white middle-class student majority in Steve's classroom. According to Barton (2017), for such digitally literate students achieving literacy in digital media should not be a pedagogical goal because much of their understanding of how to learn has already been mediated through technology. Rather, he posits that in such contexts:

> New Literacies [a kind of behavior or ethos] can be employed to activate learning processes so that "apprentice" students can begin to access practices that they are not already literate in. (Barton, 2017, p. 3)

In David's classroom, students' interactions with linguistic and written texts and established communication norms constituted contextual resources that catalyzed students' exploratory

ethos or behavior for active meaning-making in science. However, to the researcher's understanding, literacy pedagogy missed catering to students' multi-literacies, which are needed to make meanings with multiple modalities in science. (Lemke, 2000)

4.1. Limitations

It has been argued that, due to the complex nature of classroom literacy practices, students' draw on several texts that lead to different discourses; therefore, a methodological approach using video recordings and digital coding software helps to build the validity of study's findings (Blikstad Balas & Sørvik, 2015). In this study, the methodological approach of classroom observations enabled interpretations of textual and individual factors, but, without video recording, there was the likelihood that various contextual factors would go unnoticed. Therefore, it is recommended that video-recorded data in future studies be used in order to capture comprehensive evidence of new literacy practices.

Literacy events are observable as one can see what people do with texts, while literacy practices must be inferred (Perry, 2012) because of their connection with unobservable beliefs, values, attitudes, and power structures. Barton and Hamilton (2000) noted that practices involve more than actions with texts. Like many other research studies, this study deduced literacy practices from observed literacy events based on teachers' and students' engagement with texts. Having said that, this study falls short in terms of collecting data based on students' interviews to record their feelings and perceptions toward literacy practices.

In addition, because of the case study characteristics, individual case findings were drawn from a data set collected over a short period of time—six lessons in each case. Due to the specific teaching and learning context in an individual case, caution must be taken when seeking the relevance of the study's findings to teachers in other secondary science classrooms that have not been subject to the same research. Because of the small sample size, the research findings cannot be extrapolated to the wider New Zealand science classrooms.

4.2. Future research

Based on study limitations it is recommended that a more comprehensive approach in study design can lead to in-depth exploration of literacy events and practices. To achieve this, ethnographic approach using extended observations including teachers and students interviews could extend study findings.

5. Conclusion and implications

To sum up, the exploration of new literacy aspects in New Zealand's science classrooms uncovers the realities of putting "old wines in new bottles" (Lankshear & Knobel, 2003, 2006). Such practices are manifest in science teachers' mindset, which initially suggests to them that they perform old tasks in more technologized ways. Based on these findings, this study argues that the significance of new technology and ethos stuff that works in close conjunction through meaningful technology integration and could impart participatory, social, multimodal, and active forms of meanings or sign-making for students' science learning is clearly missing in contemporary pedagogical practices. This suggests that the pedagogical approaches represented only that of "being digital" with conventional literacies.

This study implies that new literacies as new ways of thinking and doing to make and communicate meanings can be realized if knowledge and expertise are shared through social interactions in online media and peer- to- peer collaboration equally. Classroom environment, as a new avenue, can serve to build ongoing relationships with extended communities of learners. The idealized new literacy practices avoids mere consumption of screen hosted texts instead promotes meaning making through pedagogical interactions and collaboration. This study has discussed a new connection between the ethos of participation and literacy construction through practices (without using technology). In this respect, students' and teachers distributed cognition matters to promote participatory culture in

class practices. Moreover, in science pedagogy the role of multimodal forms of meaning making cannot be discounted. In teaching science with representations (with digital media or science modals), pedagogical interactions are vital rather than leaving students on their own to develop "do-it-yourself" expertise.

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