Scientific Literacy and Agency within the Chilean science Curriculum: A Critical Discourse Analysis

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Abstract

This paper aims to analyse the concepts of scientific literacy and agency in two official documents of the Chilean science curriculum. We used the three-dimensional model of Fairclough (1989) as a critical lens, based on critical discourse analysis, where every discursive event can be analysed: i) as a text, ii) as a discursive practice, and iii) as a social practice. The research questions were: 'How are the different visions of scientific literacy operating and being promoted within the Chilean science curriculum?' and 'How is student and teacher agency declared in those documents?'. By understanding the curriculum as a dialectical process, as a social event between planning, executing, and evaluating education, we evidence tensions among different visions and paradigms for both concepts (scientific literacy and agency), specifically, in the transition from one cycle to another in secondary education. The first document has a predominantly neoliberal approach to scientific literacy and the second one presents a focus on citizenship, democracy, and social justice. As a social practice, in both documents, teachers appear under the idea of curriculum implementers, to a certain extent, based on a banking model where teachers are containers to receive someone else's curriculum expertise. The preceding imbalance raises potential tensions based on teacher performance and on student agency. Specifically, students must transition from a passive role and then consider themselves as active subjects who question how to produce knowledge, understanding their role within environmental conflicts within current socio-political structures for instance.

Keywords: science curriculum, scientific literacy, agency, critical discourse analysis

Introduction

Analysing the science curriculum implies exploring the content and attitudes that are valuable for an educational system but also identifying where it is grounded, what the ideas and beliefs are that sustain its norms. According to Apple (2014), this is crucial to understand hegemonic culture within a country, its development, and their understanding of citizenship. The curriculum should work as a guide for teachers' praxis and should create a basic framework from which science education is understood. However, this vision also might encompass a critical understanding of the curriculum as a political text, document, or discourse from our positionality—an ideological and political hypothesis.

From a critical perspective, the ideological dimension is related to how representations of a society or specific group make (maintain) reality linked to existence's material conditions (Torres, 2009). The actual conditions in which human life unfolds. The curriculum understood as an ideological text has been documented, receiving attention in studies on, for example, African curricula (Fomunyam, 2018), reflecting struggles to preserve interests, values, histories, and ideas from a dominant class and hegemonic culture. Fewer studies have been conducted in Latin-America through this critical view. Martins et al. (2013) highlight the need to explore how global discourses do or do not permeate local meanings. In a similar vein, Redon and Angulo (2015) posit the question on the need to explore how the curriculum creates certain types of subject while silencing others. Accordingly, this paper proposes that the secondary education curriculum can be readily analysed within the context of political changes of a country interconnected with global and local political discourses and trends.

As a global trend in science education, the aim of the science curriculum has been closely tied to scientific literacy as one of its core aims. According to Norris and Phillips (2003), 'literacy (from its fundamental conceptualisation) is understood in two related but distinct ways. In one sense, literacy means the ability to read and write. In the other sense, literacy means knowledgeability, learning, and education' (p. 1). However, the concept of scientific literacy seems to go beyond its fundamental meaning and has been identified and acknowledged as one of the central aims of science education since its conceptualisation. It not only means to read or write but also reflects attitudes, values, and knowledge about science (Roberts, 2007). However, there is no global consensus on the meaning of scientific literacy. Its definition is still complex and dependent on the social, cultural, and political context where it is developed (Queiruga-Dios et al., 2020). Nonetheless, scientific literacy has acquired a crucial role in the reforms, agendas, and science curricula in the last years. In the case of Chile, it has been present in its curriculum for more than two decades (MINEDUC, 1998) as what it is expected for teachers to develop in students. However, teachers have historically put it aside during the development of a new curriculum, creating a mismatch and a banking logic between curriculum design and its implementation (Freire, 1970).

Within science curriculum studies, the focus has been mainly on how teachers implement, enact, and align, or not, with a new curriculum (Ryder & Banner, 2013). Only a few studies have explored how the curriculum itself positions key actors within society, such as teachers (Ryder et al., 2018) and students (Ko & Kris, 2019). Few studies have explored how these changes — usually made without teachers views in the Latin-American context (Redon & Angulo, 2015) — may create problems due to the transition of one curriculum to another. The exploration of these issues is crucial since as Philippou and Priestley (2019) argue, curriculum needs to be 'in conversation between these [teachers and students] and other social and material actors' (p. 217), and as such how their role is declared within it could shape such a dialogue. As Tadeo da Silva argues, 'beneath the curriculum theories there is an "identity" or "subjectivity" issue' (2001, p. 17) and as such, an idea of teachers and students, in who they are and could be.

Thus, curricular changes impact teachers' identity as professionals (Ryder & Banner, 2013). Along with this, what is expected from them and their sense of agency that influences students' agency possibilities. In this study, agency is understood as the power that lies within us to act upon the world to transform it, informed by our biographies and projected to what we want to achieve for the future (Archer, 2007; Freire, 1970). Our agency as educational actors, however, can be facilitated or restricted by different structures. As such, the curriculum is one of those structures that can either give possibilities for creativity or hinder teachers' work.

Moving from one curriculum to another could entail contradictory discursive changes (O'Connor et al., 2020) regarding teachers and students' roles and the understanding of the nature of a discipline, such a science. This research aims to critically analyse the discourses and visions of scientific literacy presented in the secondary science curriculum in Chile. At the same time, it will evaluate how students' and teachers' agency is declared, an area of research not only overlooked but also important to understand the contradictions and tensions that working with a new curriculum may entail.

To achieve this aim, this study adopts a critical discourse analysis approach, exploring and critically interpreting the discourses within the science curriculum at the secondary education level.

Curriculum and science curriculum as a discourse and as social practice

Over the last decades, policymakers and educational leaders have embraced the idea that a high-quality curriculum remains an essential strategy for changing educational practices (Debarger et al., 2017). The curriculum's new aims claim to reflect and respond to transformations in social, cultural, and economic conditions. Therefore, it can be inferred that the term 'curriculum' is not philosophically or politically neutral but rather that it involves diverse expressions of educational discourses and political hypotheses. Science education is always a political activity since it is never neutral, and like all knowledge, it is potentially an object of ideology (Ruitenberg, 2009). For that reason, it is necessary —especially within a neoliberal agenda— to critically address the disconnection that exists between science education, economic globalisation, and socio-scientific problems.

Understanding the corpus of the curriculum as discourse is equivalent to approaching it as a social practice, a form of action between people articulated from contextualised linguistic use, whether oral or written. Discourse, thus, is part of social life and, at the same time, an instrument that creates social life (Fairclough, 1989). According to Freire (1970), the curriculum is a dialectical process, a social event between planning, executing, and evaluating education. In this line, curriculum texts as discourses and social events can construct changes in our knowledge, beliefs, attitudes, and values within the world, and therefore, also influence our subjectivities since they shape the commitments that teachers are called to take regarding science (Morales-Doyle et al., 2020). As Bazzul (2014) argues, ‘subjectivities may be constituted through discourses found in science education texts’ (p. 422) and that it lies in one of the rationales of why to explore and unveil them.

According to Fairclough (2003), a discourse such as a particular curriculum could bring about change depending on whether it raises or diminishes the ideologies of power, domination, and exploitation. As such, particularly national curricula, are frequently ideological extensions of hegemonic socio-economic policies depending on who is in power (Yates, 2012), and as such, perpetuate its ideologies. Alternatively, as Apple (1990) states, ‘texts are messages to and about the future. As part of a curriculum, they participate in no less than the organised knowledge system of society. They participate in creating what society has recognised as legitimate and truthful’ (p. 20).

In science education research, except for a few exceptions (e.g., Bazzul, 2014; Martins, 2016; Ninnes, 2002; Tarmo, 2019), it is not common to find critical studies exploring and unveiling curriculum or curriculum materials’ beliefs and values. This is mainly because, typically (with some exception to the rule in some countries to take considerations around of indigenous worldviews, knowledges or epistemologies), science education, and thus its curriculum, is understood as free of biases (Apple, 2014) and a series of facts to delivered by teachers to students. Notwithstanding this, curriculum making is always a process of negotiating meanings. However, since the science curriculum has been produced under the idea of the universality of science, or as Bazzul (2014) calls it, as ‘closed text’ with singular meanings, there is a historical dependence of ‘global trends’ that are the primary influence for curriculum creators. These ‘global trends’ are commonly the result of the work where the developers of theories are usually from the Global North (Rudolph et al., 2018), reproducing hierarchical epistemic logics where countries from the south, such as Chile, typically take the position of consumers of such trends (e.g., MINEDUC, 2016). Teachers' voices and concerns about what they must interpret and teach rarely or never are considered sources of knowledge for it (Redon & Angulo, 2015).

Unfortunately, teachers are usually conceived as ‘receivers of curriculum wisdom’ rather than transformative actors who can acknowledge teaching practice as a process of organisation, interpretation, and presentation in a communicative sense of the lived experience (Freire, 1970). This passive view of teachers is problematic since they are blamed for failures (Benzce & Hodson, 1999) under outcome-based accountability logics. Under this rationality of a curriculum created in a top-down manner, the nature of teachers’ work is reduced to mere executors, ignoring its emancipatory and intellectual dimension (Giroux, 1998).

Thus, exploring how a curriculum is created as a text, its events, its design process as social practice, and what ideas are taken for granted are crucial to understanding what is expected from students and teachers. Firstly, these processes are articulated with values, responsibilities, and beliefs that citizens are expected to develop and understand in a particular scientific literacy framework. Second, it gives us information on what counts as valid knowledge and to whom these discourses are speaking (Bazzul, 2014).

From a critical-oriented science education research standpoint, this study seeks to provide a methodological and theoretical analysis for examining how scientific literacy and agency are presented in the discourses found in the Chilean science curriculum. Thus, it explores how discourses declare and orientate teachers and students concerning their practices within their contexts and with others.

Visions of scientific literacy and agency

Scientific literacy is a broad concept embracing many historical and educational themes that have shifted over time; it is usually established as an analogy or metaphor between basic literacy and as part of an international extension movement of scientific and technological education (Bybee, 2015; Laugksch, 2000).

Sjöström and Eilks (2018) consider a new focus of scientific literacy connecting science learning with political and economic issues to find a model of science teaching for transformation. The authors suggest three levels of humanistic science education considering different *Visions* of scientific literacy with increasing complexity: (1) *Vision I*, which looks inward at science – its products, such as laws and theories, and its processes, such as hypotheses and experimentation. Science learning for later application; (2) *Vision II*, which looks outward in situations where science has a role, for example, in decision-making on socio-scientific issues (Roberts, 2007, p. 9), meaningful for an approach of science education for all; and (3) *Vision III*, science education for transformation. The first two were discussed by Roberts (2007) who distinguished between two main orientations of scientific literacy. The last level can be understood based on Hodson (2011), who never used the term *Vision III* but acknowledged the term 'universal critical scientific literacy' and added a fourth level – engaging in socio-political action. These *Visions* will be relevant as an analytical framework to answer our first research question.

From reviewing recent literature, scientific literacy is still being recognised as the primary goal of science education. However, a problem seen in the literature reviewed is that low-income countries that are part of the OECD are adjusting their educational curricula to achieve 'adequate' levels of scientific literacy defined by global standardised tests such as PISA (Dillon & Avraamidou, 2020). Some authors consider that students and, in some cases, teachers are not well-equipped with the essential elements of scientific literacy (She et al., 2019). This situation could have the effect of mimicking the education system of one country to implement it in another without questioning the specific educational context (Hwang et al., 2018). Therefore, this might imply that teachers become immersed in or susceptible to accountability practices, affecting teachers' autonomy, profession, and practice (Holloway & Brass, 2018).

Studies addressing the concept of scientific literacy, typically do not critically examine the (dis)connection between science, politics, economics, socio-cultural backgrounds, history and, therefore, the distribution of power and wealth (Hodson, 2011). Consequently, conventional approaches to scientific literacy can be understood as a global standard where knowledge and learning are based on an unsustainable, individualistic (neoliberal) ideology that does not take into account the fundamental relationships between the individual and society, knowledge and power (Hodson, 2011). As such, these assumptions are usually framed within a deficit discourse, failing to account for local knowledge, understandings, and conceptualisation of what scientific literacy is for, and, as Sammel (2009) argues, 'pushing for assimilation of students [and teachers] into Western science ontology' (p. 653), its values and ways of being.

In the same vein, and connected with our second research question, we are interested in how students' and teachers' agency is declared within the science curriculum. Students are usually portrayed as future citizens who need to develop a consciousness to act in the world, or as future scientists, depending on which view of scientific literacy is taken. However, the common point is to understand them as future citizens, leaving aside their experiences of today and how they relate and impact the world (Millar & Osborne, 1998). This conceptualisation as a future someone is particularly crucial in the Chilean context, where students have been the main actors of policy change, for example, the recent protests during the social uprising (Rodríguez, 2020). Nevertheless, there are certain traditions in science education where researchers have investigated how to develop, facilitate, and encourage students' agency to empower them to analyse scientific problems in their communities critically (e.g., Calabrese-Barton & Tan, 2010), or in terms of learning science out of the school (e.g., Adams & Gupta, 2017). Some of these studies have called this type of agency 'critical science agency' (Schenkel & Calabrese-Barton, 2019), understood as the ability to put scientific knowledge dialoguing with different types of knowledge to address issues of injustice in meaningful ways in the communities they belong. One issue that is still missed is understanding how much the science curriculum itself affords possibilities or constrains agency both for teachers and students.

Methodology

To address the aim of analysing how the visions of scientific literacy are promoted and how student and teacher agency are manifest within the science curriculum, we conducted a critical discourse analysis (CDA). CDA is an interdisciplinary approach to study discourse as a form of social practice. As such, discourse is constitutive and contributes to building social identity, subjects, social relationships, and systems of knowledge and beliefs. More specifically, discourse is a practice that gives meaning to the world, but simultaneously, meaning is produced, reproduced and transformed through discourse (Fairclough, 2003).

In this paper CDA is understood as a theoretical model and methodology, seeking to unveil how discourse mediates in social situations (Fernández et al., 2016). As Grundy (1987) points out, analysing how human activities are described through the curriculum allows us to reveal the interests behind it; therefore, a textual-oriented CDA (Fairclough, 2003) allows us to unveil them. Additionally, CDA also must commit to improving human conditions since it articulates critique, explanation, and actions (Palacios, 2020) in the. light of those discourses. Thus, the critical analysis of curriculum discourse affords the possibility of unveiling the idea and roles of scientific knowledge, teachers, and students and opportunities to offer counterarguments to change it.

For this study, the three-dimensional model of Fairclough (1989) is based on three complementary dimensions: i) as a text, ii) as a discursive practice, and iii) as a social practice. In the first dimension, what the analyst does is provide a description of the text, exploring aspects such as vocabulary (alternative ways of naming, ideological meanings, frequent domains), grammar (clauses or simple sentences), cohesion (how clauses are linked together), and textual structures. At this level, we also focus on whether sentences are active or passive, how the actor is situated, how tenses are used, modality, use of pronouns, use of metaphors, and other semantic structures. In the second dimension, the analysis accounts for the intertextual dynamics of the text, considering the strength, coherence and intertextuality. This intertextual dynamic demands that we understand texts and discourses from a historical perspective, as every text is constructed from multiple previous texts (Fairclough, 2003). The third dimension consists of analysing and explaining the characteristics and functions of the text from a theorisation of social processes in which they are inserted. In this dimension, it is relevant to consider the implicit elements, and what appears as the unsaid and the level of the events (Fairclough, 1989).

Identifying and using visions of scientific literacy and approaches about agency

In this study, we analysed two official documents of the Ministry of Education drawn up by the National Curriculum and Assessment Department: 1) The current science curriculum plan of secondary level (first cycle) from 7th grade (12-year-old students) to 2nd grade (15-year-old students), developed in 2016 (MINEDUC, 2016); and the current science curriculum of secondary level (second cycle), 3rd and 4th grade (16 and 17-year-old students), developed in 2019 (MINEDUC, 2019). The process of analysing and exploring textual structures was developed according to visions of scientific literacy is illustrated in Figure 1, following Sjöström and Eilks (2018) and Valladares (2021). Moreover, we also focus on whether sentences are active or passive, how the actors and their voices (students and teachers) are situated, how tenses are used, modality, use of pronouns, use of metaphors, and other semantic structures related to agency.

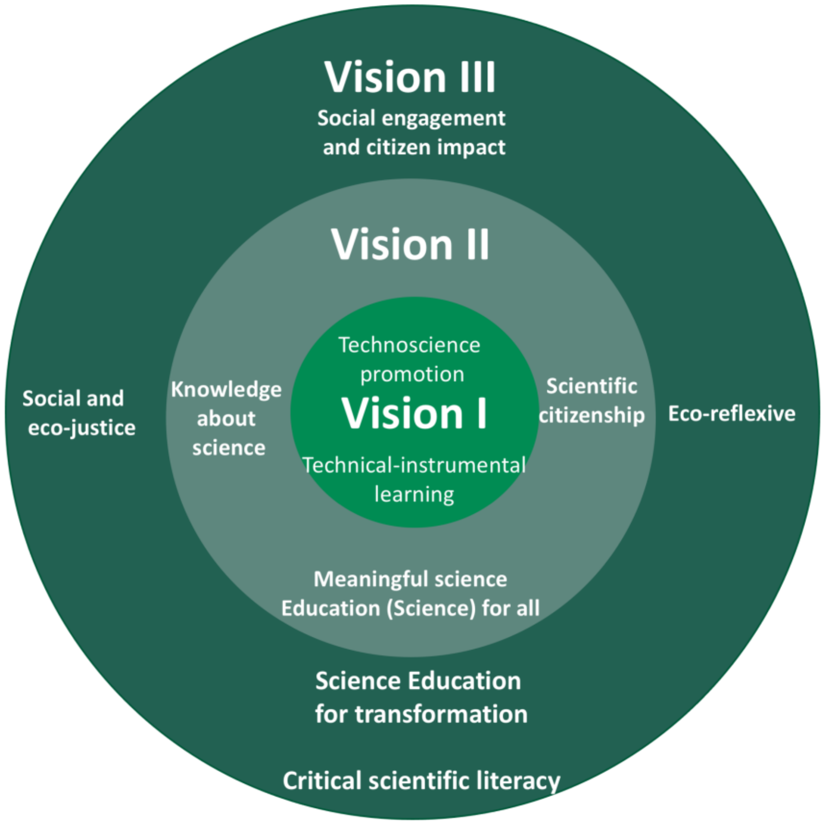

Figure 1 Adapted from three visions of scientific literacy (Sjöström & Eilks, 2016; Sjöström et al., 2017).

The process of analysis

The first analytical step was to identify critical nodes, words, and concepts associated with our research questions following a content analysis process (Braun and Clarke, 2013). Then, we conducted a pooled analysis to compare convergences, enrich them, and explore elements that we found separately. In this step we followed a procedure and guidelines suggested by O'Connor and Joffe (2020) for intercoder reliability in qualitative research. After this initial analysis of the documents, we used the software NVivo 12 to explore the frequency and relationships of words. The second analytical step entailed collecting and analysing public documents such as news, statements from teachers, and ministerial documents to place the new curriculum's construction with the events that occurred during its construction (see Table 1). Furthermore, the list of references at the end of both documents were used to analyse the second dimension of CDA (Fairclough 2003). From these analyses, categories were created from theory such as 'visions of scientific literacy', 'agency for transformation', 'intertextuality' and others from the same data as 'transition between paradigms', 'tensions between teachers and curriculum development', which later were defined to answer the research questions. Finally, to analyse the curriculum as a social practice, the last analytical step was based on the links between these dimensions the aims of science education from a socio-political practice.

Table 1. List of public documents and analysis topics for the intertextual dynamics of the text

Documents	Institution	Title	Topic	Date
Minutes of meeting	National Council of Education and Ministry of Education	Agreement Nº 126/2018	Agreement about new school subjects of secondary level (second cycle), 3rd and 4th grade (16 and 17-year-old students)	October, 2018
	National Council of Education and Ministry of Education	Agreement Nº 034/2019	Agreement about curriculum proposal of secondary level (second cycle), 3rd and 4th grade (16 and 17-year-old students	February 2019.
Press release	Natural Sciences Teachers Network (Chilean teacher UNION)	The urgent need of Sciences and Philosophy	Opposition to National Council of Education Agreement Nº 034	March, 2018
	Natural Sciences Teachers Network (Chilean teacher UNION)	What kind of science is neccesary to learn and teach in our country?	Democratisation of the curriculum development process	May, 2018
	Natural Sciences Teachers Network (Chilean teacher UNION)	Consequences of the implementation of the new curriculum reform for 3rd and 4th grade	Information blockade from Government and National Council of Education and rejection of curriculum reform and demand for a truly participatory and binding process with respect to the national curriculum.	June, 2019
	Natural Sciences Teachers Network and Chilean Teachers' Union	Sciences for citizenship Is science education strengthened or weakened in Chile?	Teacher Education to tackle new reforms in Science Education curriculum	July, 2019
News from press	Bio-Bio Chile radio and TV	Court admits to processing appeal that seeks to paralyze new curriculum of 3rd and 4th grade	Protective appeal against the Minister of Education, Marcela Cubillos, and the National Council of Education (CNED) by 10 academic and social organisations	August, 2019
	Cooperativa radio and news	Council of rectors rejects curricular change: A serious threat to the educational system is underway	Express to the Government its disagreement with the change of curriculum for third and fourth half	August, 2019

Findings

Scientific literacy: A conflict in the transition between visions and paradigms.

The first research question guiding the analyses was: 'How are the different visions of scientific literacy operating and being promoted within the Chilean science curriculum?'. This question was addressed by analysing the vocabulary, clauses, metaphors, and frequency of words. We identified two different approaches to scientific literacy within the two documents. At the textual level, both documents explicitly refer to the concept of scientific literacy. The first document of 2016 states that doing science at the school level translates into building or reconstructing scientific concepts based on scientific research that can be experimental, non-experimental, or documentary, among others (p. 130). It is emphasised that the student must understand the laws and theories that best explain natural phenomena.

Additionally, the document states that the curriculum should emphasise the scientific literacy of the students 'which should promote the acquisition of basic concepts and ideas of science to understand experiences and close situations and, thus, generate creative solutions for everyday problems' (p. 130). Thus, at the level of semantic level and vocabulary, we find an amalgam between *Visions I and II*. This result can be seen in the following fragment:

> By becoming literate in science, students will be able to reason about facts as diverse as the operation of instruments made from scientific discoveries, the reproduction and feeding of living beings, or changes in matter due to different forces.(p.41)

The conceptualisation of scientific literacy in this document is complemented by a semantic field focused on digital literacy, where information and communication technologies are considered an essential part of scientific literacy and a fundamental competence among students. As an example, we illustrate the following fragment:

> Students must acquire the concepts and ideas – from their own experiences – of the exact sciences and their method that will enable them to understand and explain the physical world, use technology in an informed and autonomous way, and assess empirical evidence as a method of analysis and approximation to knowledge. (p. 131)

It is attention-grabbing that the vision here is based on the autonomy and the own experience (individualistic) perception of the student without a connection with local or global problems. Community participation is absent, suggesting in individualism as the hegemonic discourse. Moreover, and in regards of the second dimension of CDA, at the level of the inter-texts, the curriculum was developed also based on curriculum from other countries. Curiously, the list of references is composed of documents from countries with different educational contexts and backgrounds, not only society as a whole but also for the circumstances in which teachers work.

Finally, other frequent concepts that accompany scientific literacy are research, skills, knowledge, models, procedure, theories, forms of scientific reasoning, concepts, empirical evidence, analysis, understanding of phenomena, science and technology, the reasoning of mathematics, methods, knowledge, competences, among others.

The second document (2019) states 'that a scientifically literate citizen must develop the ability to think critically, to participate and make informed decisions based on the use of evidence' (p. 42). The scientific literacy approach is merged with science for citizenship, which seeks to promote an integrated understanding of complex phenomena and problems in our daily work, to educate a scientifically literate citizen. In the same vein, the concept is accompanied by an interdisciplinary aspect. With a more critical and active language and a vocabulary where the agency of students in society and the world is considered, for example:

> Students acquire the ability to apply reasoning, concepts, and procedures of science to understand daily experiences and situations and propose creative and viable solutions to problems that may affect people, society, and the environment, in local and global contexts. (p. 42)

Thus, the new curriculum seeks to develop skills and attitudes necessary for scientific research, understanding the central knowledge of science, relating science and technology with society and the environment, and establishing integration between topics of science and other disciplines. Thus, science is no longer understood as impervious to social processes, but rather as part of them that students are considered active subjects who can question its role. Another interesting paragraph that we interpret as positioned from a critical scientific literacy or *Vision III* (Hodson, 2011) and that could serve as a guide for the promotion of critical scientific agency (Schenkel & Calabrese-Barton, 2020) is:

> Assess the importance of integrating the knowledge of physics with other sciences to analyse and propose solutions to current problems, considering the ethical, social, and environmental implications. (p. 195)

At a semantic level, this document presents the meaning of scientific literacy as opportunities to 'critically analyse social, economic, ethical and environmental implications of problems related to public controversies that involve science and technology' (p. 179). This document addresses a critical scientific literacy approach through projects and research. For instance, with activities about 'designing local projects, based on scientific evidence, for the protection and sustainable use of Chile's natural resources, considering energy efficiency, emission reduction, treatment of water resources, ecosystem conservation or waste management' (p. 10). Likewise, one aim of the environment and sustainability module is 'to model the effects of climate change on various ecosystems and their biological, physical and chemical components, and evaluate possible solutions for their mitigation' (p. 52).

From the third dimension of CDA, this document explicitly emphasizes and moves towards a collective and socio-political vision of scientific literacy. Words related to the analytical category *Vision III* with a discursive and social practice based on democracy, society and social justice are repeated across the document. Running the tool word frequency query and text search, some recurrent concepts are equality, diversity, health, environment, citizenship, learning, distribution, politics, teachers.

In terms of intertextuality, this critical approach is not casual since this document includes the citizen education subject for the first time, cross-linked with the rest of the science curriculum. For example, it states that the 'current environmental scenario in the world, especially climate change, demands the participation of a citizenry educated in these issues and possessing the ability to advance towards sustainability' (p. 56). Moreover, the document suggests that people must make good consumption, investment and saving decisions to satisfy their present and future needs. This paragraph implies 'understanding that there are human needs whose satisfaction is not always achievable individually and that certain conditions of life in society are required that a democratic state must promote, support and stimulate' (p. 56).

Thus, the transition – given as natural – from one level to another, produces tensions and stresses teachers and students to move to a new approach to science education closer to *Vision III*. These tensions show a difference between concepts within these two documents (see Figure 2).

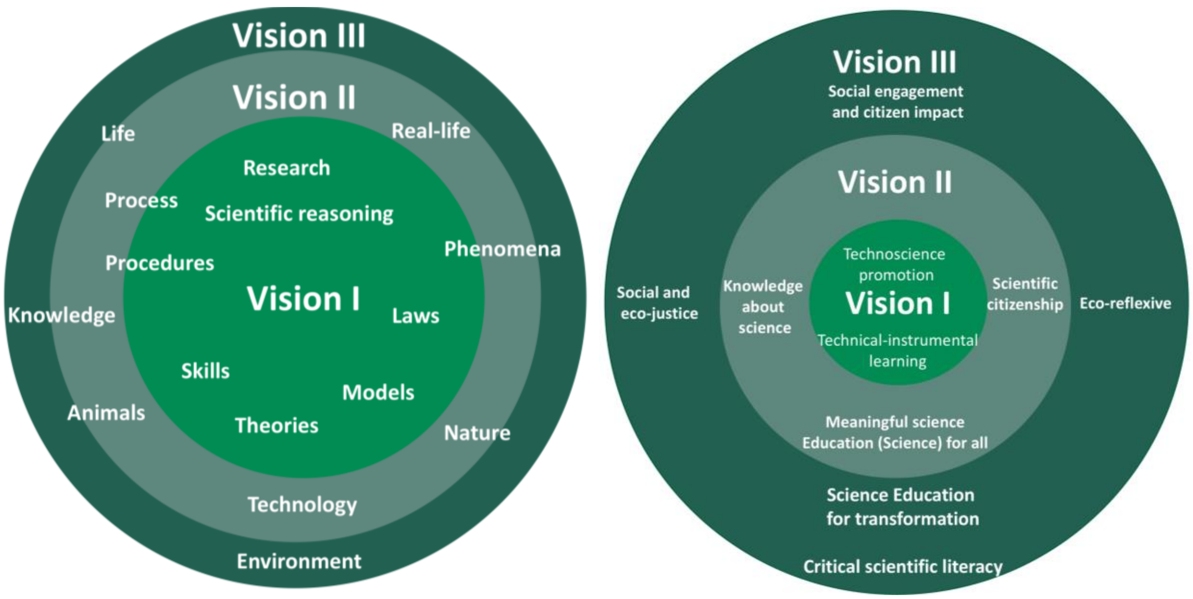

Figure 2. Two models of scientific literacy and word frequency presented in different levels of Chilean curriculum, a) curriculum plan of secondary level (first cycle) from 7th grade (12-year-old students) to 2nd grade (15-year-old students), developed in 2016; and b) the current science curriculum of secondary level (second cycle), third and fourth grade (16 and 17-year-old students), developed in 2019.

Curriculum, teachers' and students' agency

Regarding the second research question, 'How are student and teacher agency declared within those documents?', we identified that in the new curriculum, students' agency is acknowledged as something that needs to be urgently encouraged, as opposed to the previous one where there was a mix of considerations regarding it, considering students as active citizens in certain parts and as citizens for the future in others. Contrarywise, at the level of teachers' agency, there are still some problems due to invisibilities of key actors.

Most of the activities mentioned within both texts contain subjects linked to different types of activities/actions. In both documents, most of these activities are usually between a subject (the student) and an object (the curriculum). For example, in the new curriculum, it is stated:

> In the case of sciences for citizenship, the STEM methodology allows the student to learn that mathematics and science, together with technology, are necessary tools to help identify problems, collect and analyse data, model phenomena, test possible solutions and solve problems (p. 45)

And in the previous one:

> These guidelines are expected to introduce students to the development of the skills involved in the scientific method (p. 135)

As such, we can see an agency related to ‘the curriculum’ as an agent that is clearly stated. Through the curriculum, students will develop specific competencies, ‘the STEM methodology allows the student ...’ and ‘these guidelines introduce students’. However, both documents fail to account for the dialogical process that needs to happen between people to produce knowledge and student and teacher agency is not clear in these types of sentences.

In terms of students, we can see the differences in how they are situated as current or future citizens. In the 2016 curriculum, students are presented as the citizens of the future in some sections, and the learning of science aims to ‘allow them to face their future with the necessary tools to participate actively, responsibly and critically in society’ (p. 16). By contrast, in the new curriculum, students are expected to be active and engaged citizens, to develop knowledge and skills that ‘allow them to exercise active citizenship’ (p. 7).

This change is expected due to the critical role that youth have had in the last years in the Chilean political scenario. As was mentioned previously, curriculum documents are the products of political and social circumstances. As such, ignoring students’ agency for societal transformations is not possible since they have been active critics of the educational model. However, one tension this change may cause is the transition that this presupposes from one curriculum to the other and one paradigm of scientific literacy to another, creating tensions among teachers in the transition.

Regarding teacher agency, this new curriculum privileges teachers’ decisions, since it is less focused on content and more on an interdisciplinary view of science. However, teachers as actors are almost invisible throughout the document, and, at the level of the events, teachers’ agency was denied in the instruments’ construction. Thus, its genesis is once again problematic and creates tensions between teachers and the science curriculum.

According to the second dimension of CDA, we analysed how the text has been produced, including its relationships with similar texts, modes of diffusion and how the text has been received and interpreted by teachers. The new curriculum placed under tension the role given to teachers, and that was evidenced at the level of events and the document itself. An illustrative example regarding this point, is an excerpt of a public communication, where Natural Science teachers network (March, 2018) stated “a historic opportunity has been lost to make the national curriculum a space for reflection and deep analysis of reality”, emphasising the vertical mode of decision-making.

As the curriculum is not only a result but a series of events that needed to happen during its construction, we argue that teachers’ ‘epistemic agency’ (Miller et al., 2018) was denied, since their contributions to the knowledge and practices of a classroom are absent from the genesis of the document. For example, in 2017, a national consultation was made for teachers after creating these new curricular guidelines. No notice was taken of teachers' concerns that this new subject integrates the three sciences when their initial teacher education was in separate disciplines: biology, chemistry and physics. Moreover, teachers' unions and some science education departments raised their concerns since they were not part of creating these curricula, a discourse which they must work with, interpret and create educational materials for. The new curriculum was implemented in March 2020, in the context of the COVID-19 pandemic, without any negotiation with teachers. At the level of the text itself, teachers' agency is unclear, hidden under concepts such as 'school community' or 'curriculum', reducing the role of the teacher to that of an anonymous, compliant provider of instruction. At the same time, the passive tense is used throughout the documents; for example, 'it is expected that students will be capable of …' (p. 50), without mentioning the teacher as an essential subject within the process of teaching and learning.

Discussion

In this study we identified two different paradigms between the two curricula. In the first, we found that neoliberal rationality permeates the curriculum and thus the associated values of science education, in particular individual responsibility for scientific aspects. As such, changes lie with the individual and their behaviour. In turn, science is presented as if it is impervious to social or political dimensions. Student agency is limited to an uncritical relationship with the world without considering power structures that may hinder it. For example, Chile's unequal access to water or the effects of industrial companies' pollution in people's lives are issues that could not be explored and problematised through this understanding of scientific literacy. In the new curriculum, these notions change to a more collective understanding of our relationship with the natural and social world.

Some questions arose regarding how this new curriculum is expected to coexist with the previous one and move towards a critical scientific literacy. The new curriculum is considering students as active subjects in terms of their field of action towards the world and positions them as critics of how science contributes (or not) to collective wellbeing and that in turn is affected and affects socio-political aspects. The valorisation of students' experience is now conceptualised from an intersubjective plane, and the individual with others and the world.

As Bazzul (2014) argues, texts do not exist in a vacuum but are also the result of events that permeate their refinement. However, this new curriculum does not consider the epistemological (such as their idea of scientific literacy) and ontological (such as the role of students as citizens) assumptions present in the previous curriculum. Usually, teachers at the first level of secondary education are the same as those at the second level, so the same teachers need to 'switch' how they perceived students' roles from one year to another. The new curriculum involves a shift from valuing what students need to do to what students can practice. However, despite the potential of the shift for transforming science education at the school level, if one key actor for this transformation is absent, the learning environment could remain the same since it does not consider the dialogical process of teaching and learning. Teachers, who interpret, make sense, and evaluate curricular materials, whose knowledge is relevant to knowledge building, are once again dismissed from the curricular production. Nevertheless, the new curriculum offers opportunities to advance a transdisciplinary view of science, and to reflect and act onto socio-scientific issues, though these powerful opportunities are blurred behind how it was developed.

Conclusions

We began by noting the need for critical analysis of the science curriculum. The first contribution of this paper is addressing this gap within the region and the field, following Fairclough's (2003) suggestion that the starting point for CDA is the recognition of a social problem. In our case, the tensions arose from the new science curriculum and the need for unveiling what presumptions of students, teachers, and scientific literacy it presents. The second contribution is to show how positioning from a CDA perspective offers opportunities for agency within the new science curriculum.

One of the affordances of the new curriculum is its holistic view of the curriculum, where science is one of its parts instead of a fragment. In that case, the teachers' pedagogical action could move in a more critical and transformative direction, attending to new aims of the sciences, for example, by offering the possibility of working with a transdisciplinary approach, moving towards a more ecological view of knowledge (de Sousa Santos, 2018). This could allow for the exploration of issues such as the history of science, or environmental education, by breaking conventional boundaries among disciplines (Moura, 2021) to understand social problems where science plays a role, moving towards a problem-posing education (Freire, 1970) rather than a specific content-driven one.

One of the study's limitations is the need for concrete examples regarding how to expand the possibilities of the new curriculum, for transdisciplinary work for instance. This limitation invites us to continue this work to find such examples by working with school science teachers and teacher educators. At the same time, it gives us the task of moving towards thinking how to change curricular views from initial teacher education, changing the relationship we create with the curriculum, usually seen as fixed rather than a territory of contestation (Bencze & Hodson, 1999).

Regarding implications of the analysis, a paradigm shift could offer new hope, which we believe is present in the new curriculum, even though we cannot ignore the problems that it generates from both the teachers' and students' perspectives. However, the classroom pedagogical praxis of teachers and students raises a new problem since, although the documents of the study affirm that they are not prescriptive, they are inextricably linked to outcome-based accountability (such as teacher assessment or school effectiveness funding mechanisms). Therefore, this tension allows us to reveal the need that changes in the discourse of the curriculum must imply broader educational changes. If not, a new curriculum remains an isolated element, once again dissociated from the structural problems experienced in school.

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