



Maps and Map Skill Progression in Primary Geography in International Comparison

Karten und Progression in der Kartenkompetenz in der Grundschule im internationalen Vergleich

Mapas y habilidades cartográficas en al educación primaria en comparación internacional

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Zusammenfassung Dieser Beitrag geht der Frage nach, wie Schulbücher der Grundschule Karten einführen und die Progression in der Erlangung einer Kartenkompetenz implementieren. In Anlehnung an das Modell der Kartenkompetenz (HEMMER ET AL. 2010), wurde ein Mixed-Methods-Ansatz gewählt, um zwölf katalanische (*Ciències Socials*) und vier Berliner (*Sachunterricht*) Grundschulbücher zu analysieren. Die Ergebnisse deuten auf eine allgemeine Erosion des kartographischen Inhalts hin, der von einer sehr heterogenen Kartengrundlage getragen wird. Die Aufgaben zur Förderung der Kartenkompetenz folgen keiner erkennbaren Progression. Dabei liegt der Schwerpunkt oft im Bereich des Dekodierens und der Kartenproduktion. Karteninterpretation und -evaluation fanden in keinem der analysierten Schulbücher Berücksichtigung. Die wesentlichen Unterschiede liegen in der Chronologie, Typologie und Hierarchie der Karten und Kartenkompetenz fördernden Aufgaben.

Schlüsselwörter Kartenkompetenz, Geographie, Grundschule, Schulbuch

Abstract This paper explores how primary textbooks introduce maps and progressive map skill acquisition and development. Against the background of the Map Skills Model (HEMMER ET AL. 2010), this study applied a mixed-methods approach to a sample consisting of twelve Catalan (*Ciències Socials*) and four German (*Sachunterricht*) textbooks. The results uncovered an overall erosion of cartographic content and a varying diversity of map types included in the textbooks. Tasks fostering map skill acquisition lack a clear concept of progression and mainly focus on map decoding and production, with interpretation and evaluation missing from all textbooks. The case studies also showed differences in the chronology, typology, and hierarchy of maps and map-related tasks.

Keywords map skills, Geography, primary education, textbook

Resumen El artículo explora las vías a través de las que los libros de texto introducen el lenguaje de los mapas y el desarrollo y adquisición progresiva de habilidades ligadas al mismo. Siendo el Modelo de Habilidades Cartográficas (HEMMER ET AL. 2010) un referente indispensable, este estudio ha aplicado una metodología mixta a una muestra de doce libros de texto en catalán (*Ciències Socials*) y otros cuatro en alemán (*Sachunterricht*). Los resultados descubrieron una pérdida profunda de contenido cartográfico y la consideración de una amplia diversidad de tipos de mapas en los manuales analizados. Las actividades que promueven la adquisición de habilidades cartográficas han mostrado la ausencia de una idea clara de progresión y se centran, principalmente, en la producción y decodificación, mientras que las actividades de interpretación y evaluación brillan por su ausencia. El trabajo también estudia diferencias evidentes en la cronología, tipología y jerarquía de mapas y actividades relacionadas con éstos.

Palabras clave habilidades cartográficas, Geografía, educación primaria, libro de texto

1. Introduction

Maps continue to shape our daily lives in many ways. Apart from being a valuable means of orientation in space, they also represent a unique cultural technique and product to represent the world. With the rise of artificial intelligence, map reading skills primarily serving orientation purposes have shifted. Nonetheless, the ability to decode and encode maps equips students and, in doing so, future adult citizens with a particular set of skills that allow them, along with continuous text, images, and numbers, to gain yet another access to our world.

Given school Geography's valuable and continuous contribution to map skill acquisition and development, map-related research in Geography Education looks back on a rich tradition. Nonetheless, several blind spots become evident when revising the literature.

Some of these are the lack of focus on progression in map skills, the modest dedication to research on textbooks and educational media, the limited consideration of Geography's role within compound subjects, such as Social Studies or *Sachunterricht*, and the limited number of (international) comparative studies. These shortcomings are even more pronounced in primary education. Consequently, this paper examines how Catalan and German primary textbooks introduce maps and consider tasks dedicated to progressive map skill acquisition and development. Following a brief outline of its theoretical framework, the paper turns to the methods and sample used before describing the key findings. After a comparative discussion, concluding thoughts round up the article.

2. Map Skills, Textbooks, and Progression

Tackling the objective of this contribution requires, on the one hand, the review of previous work on map skills in textbooks. On the other hand, progression in Geography Education constitutes a second component requiring consideration.

Along with alternative educational media, textbooks combine different types of discontinuous text (e.g., maps, pictures, graphs, tables, drawings) with continuous text. Traditionally, large-scale studies, such as PISA, refrained from differentiating between continuous and discontinuous text. However, early research (OGRISSEK 1970) already highlighted that individuals process pictographic discontinuous text, such as pictures and maps, more easily and rapidly than they do with continuous text. As opposed to continuous text, maps, and other discontinuous text elements can be saved directly as mental models without the necessity of an initial recoding from descriptive into depictive mental representation (DOWNS & STEA 1982; SCHNOTZ 2001). In addition, the cognitive processing of a map rests on analog structural imprinting as opposed to continuous text relying on symbolic structure analysis. In doing so, the two forms of concep-

tual structure not only maintain continuous interaction they also complement each other. In contrast to its descriptive counterpart, depictive representation works as a concept-led analysis at the transition area between comprehension and perception. Consequently, the higher number of analogies between data and representation an individual recognizes by activating suitable cognitive structures, the better their results in map understanding.

Two relevant theoretical models tackle continuous and discontinuous text decryption, namely the PISA Model of Reading Literacy and the Integrated Text-Image-Understanding Model.

At the core of the PISA Model of Reading Literacy lies how individuals understand, use, and reflect on continuous and discontinuous text (BAUMERT ET AL. 2001). The Model categorizes maps as discontinuous text along with tables, graphs, and diagrams. However, given the limited number of tasks dedicated to maps, PISA tests have de facto equated map interpretation with reading literacy. Furthermore, the Model also takes subsidiary reading comprehension performances, such as decoding (BAUMERT ET AL. 2001), as given and

views them as the independent variable of reading velocity.

As HÜTTERMANN (2007) points out, there are several reasons why a clear differentiation between continuous and discontinuous text, particularly in the case of maps, is mandatory. SCHNOTZ and BANNERT's (1999, 2003) Integrated Text-Image-Understanding Model links the processing of continuous text to images. In the authors' reading, continuous text entails descriptive and symbolic representations, namely data that carries explicit incorporated structural information expressed in explicit signs marking relations, such as prepositions (e.g., the city center lies north of the harbor). In contrast, discontinuous text, such as maps, consists of iconic and depictive representations lacking signs marking any relation. However, they contain intrinsic structural features that comply with the structural characteristics of the data to be represented (SCHNOTZ & KÜRSCHNER 2008).

Both theoretical models entail essential elements for map interpretation. Moreover, specific components of the PISA model are transferable on continuous text entailing images and are, thus, representable in the Integrated Text-Image-Understanding Model. Nevertheless, both theoretical models' suitability for map interpretation remains limited. For example, decoding is an essential map skill that, for the PISA model, is only one independent variable. However, LIBEN and DOWNS (1989) delivered empirical evidence that map decoding is more complex than text decryption. In their study, the authors distinguished between symbolic (title, legend, and cartographic symbols) and geometric transformation (orientation, scale, gradation, and position determina-

tion) along with generalization—a process requiring neither symbolic nor geometrical transformation.

Given the limitations of both theoretical models, HEMMER ET AL. (2010) developed the Map Skills Model (cf. Fig. 1), which divides map reading skills into three dimensions, namely (a) graphical decoding, (b) use of information primarily from within the map, and (c) use of additional, external information originating from other sources as the map itself. Unlike the PISA Model, the Maps Skills Model defines decoding (a) as an independent dimension consisting of the three sub-skills: generalization, symbolic transformation, and geometric transformation. The two remaining dimensions (b) and (c) rely on the PISA Model. This also applies to the two sub-skills constituting dimension (b) use of information primarily within the text, namely a focus on individual elements of the map and the relations between different elements of the map. The Map Skills Model breaks down drawing upon external knowledge, the third dimension (c), into a focus on content and structure.

Overall, the seven sub-skills lead to the four skill areas decoding, description, interpretation, and evaluation. Thereby, two skill areas strongly rely on the PISA Model. On the one hand, map description replaces information retrieval for individual map elements and spatial structures, as information extraction also happens during decoding. On the other hand, map interpretation equates to the PISA Model's understanding relationships within the text and generally requires information from both within the map and drawn from additional sources. However, given the nature of maps, evaluation also requires external infor-

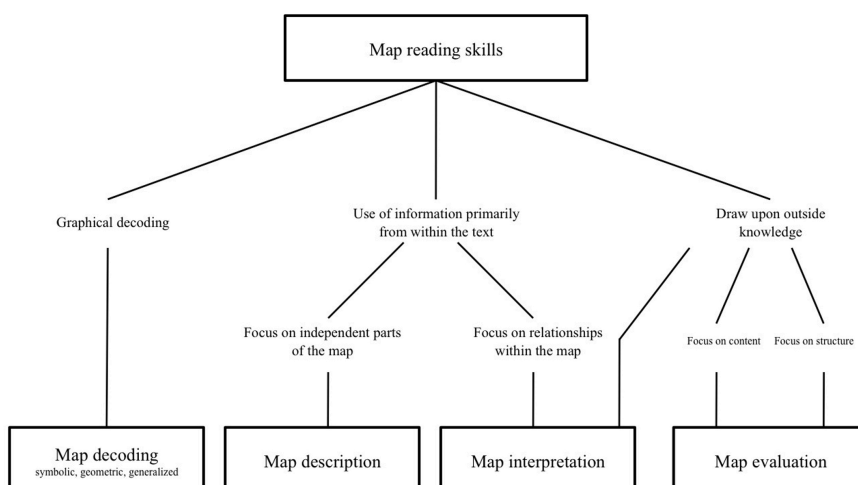


Fig. 1. Map Skills Model (source: BAGOLY-SIMÓ & HEMMER 2012, p. 295, adapted)

mation and a focus on content and structure. Map evaluation primarily views maps as constructs when focusing on subject-specific aspects, such as structure and form.

While PISA remains the only source of systematic empirical results, scholarly work on the four map skill areas featured in the Map Skills Model, namely decoding, description, interpretation, and evaluation.

The most popular skill area by far is map decoding. Studies repeatedly reported that individuals struggle with symbolic transformation (cf. BARTZ 1965; SANDFORD 1979; GERBER 1984; MONMONIER 1996; WIEGAND 2002; ELG 2003; CATLING 2018, 2020). Nevertheless, the studies also revealed differences between qualitative and quantitative symbols, with participants encountering more significant difficulties when decoding quantitative symbols.

Geometric decoding also challenges individuals. Studies uncovered difficulties in handling scale and scale bars (TOWLER & NELSON 1968; BARTZ 1971; GERBER 1981; BOARDMAN 1988), navigating the 2D-3D divide (BOARDMAN 1983; HARWOOD & JACKSON 1993; LIVNI & BAR 1998; DOVE ET AL. 1999), understanding contour lines (BOARDMAN 1988; LIBEN & DOWNS 1989—particularly concerning children aged 11-14), correctly orienting their maps and using cardinal points during navigation (BOARDMAN & TOWNER 1979; HEMMER ET AL. 2007), and understanding the graticule and projection of small-scale maps (BARTZ 1965; SANDFORD 1980; HARDWOOD & RAWLINGS 2001).

Several studies (cf. SANDFORD 1981; BUTTERFIELD & MCMASTER 1991) found that generalization particularly challenges secondary school students. However, HERZIG ET AL. (2007) showed that even students enrolled in higher education programs encountered difficulties when working with generalization, scale, and geomorphologic representations.

Looking beyond decoding, only a limited number of studies dedicated attention to map description and interpretation. According to VAN DER SCHEE ET AL. (1992), many students struggled or failed to link two independent variables depicted in maps, and they also exhibited overall challenging map analysis strategies. A study by DICKMANN and DIEKMANN-BOUBKAER (2007, 2008) showed that the complexity of maps strongly challenged students when working on spatial relations and dynamics, while JAHODA (1962) and HARWOOD

and MCSHANE (1996) came to contradictory conclusions concerning the comprehension of spatial hierarchy.

Empirical studies on map evaluation similar to those exploring decoding, description, and interpretation are yet to be carried out. This also applies to studies focusing on textbooks and map skills.

Textbooks are complex enactments of the formal curriculum that may be considered, in a way, the hidden curriculum (BAGOLY-SIMÓ 2021). Given the involvement of authors, editors of educational media publishers, and educational policy stakeholders approving them, textbooks are an important seismograph of a school subject's teaching and learning vision bridging the past and present.

Studies on map skills in Geography textbooks tend to follow diagnostic purposes in the aftermath of curricular reforms (BAGOLY-SIMÓ 2021). In a systematic evaluation of map skills and the Map Skills Model, BAGOLY-SIMÓ and HEMMER (2012) reported that Romanian lower secondary Geography textbooks focus on map description followed by interpretation and decoding. A comparative study by HEMMER ET AL. (2013) reached similar conclusions. A comparative study of Czech, German, and Hungarian secondary Geography textbooks reached similar conclusions.

The studies also point out the necessity to consider a more consistent progression (MUÑIZ SOLARI ET AL. 2017). Both scholarship and conceptual work in Primary Geography looks back on a long tradition concerning map skills and progression. While early work (cf. RUSHDOONY 1968) suggested possible ways of gradation of map-reading skills, CATLING (2018, 2020) has not only continuously broadened variables and dimensions of progression in map skill acquisition, but also integrated children's map acquisition into the broader framework of Children's Geographies. Progression models that emerged within the UK (e.g., OWENS 2021) and the US setting (e.g., MOHAN ET AL. 2014) rest on scholarship from Geography Education and, in some cases, also other relevant fields dedicated to maps and map skill acquisition.

Against the background of the primary-secondary continuum, the Map Skills Model (HEMMER ET AL. 2010) and BAGOLY-SIMÓ and UHLENWINKEL'S (2017) conceptualization of progression and performance levels, this pa-

per explores, how Catalan and German primary textbooks introduce maps and consider

tasks dedicated to progressive map skill acquisition and development.

3. Method and Sample

Mixed methods served to explore the types of maps and map-related tasks included in primary textbooks. The first step consisted of software-assisted in-vivo coding of all maps and map-like representations (i.e., cartograms, satellite imagery, sketch maps), leading to four categories, namely physical maps, thematic maps, city maps, and other representations. During the second step, in-vivo coding identified all textbook tasks dedicated to maps and map-related representations along with the categories of the Map Skills Model. Subsequently, the tasks underwent a second coding focused on the targeted performance levels. Finally, data quantification and comparison completed data collection and processing.

The sample consisted of Catalan and German primary textbooks for grades 1-4 (students aged 6-11 years). In both countries, Primary Geography is part of compound subjects. In Spain, Social Science (*Ciencias Sociales* in Spanish, *Ciències Socials* in Catalan) combines content from Geography, History,

and Civics in a spiral curriculum. Despite the decentral Catalan educational system, the common core curriculum only grants certain liberties to the autonomous communities. The present study focused on textbooks published for the autonomous community of the Balearic Islands. In most German states, *Sachunterricht* combines Social Science and Science content in a compound subject that simultaneously lays the ground for both large areas. Given the pronounced curricular diversity across the German federal states, for this study, textbooks for the subject *Sachunterricht* in Berlin and Brandenburg served as a case study.

The Catalan subsample consisted of twelve textbooks encompassing the first four volumes for *Ciències Socials* by the publishers Anaya, Santillana, and Vicens Vives. Its German counterpart encompassed four volumes (grades 1/2 and 3/4) by the publishers Klett and Schroedel/Westermann (cf. Textbooks on pp. 226-227).

4. Results

This section first introduces the results according to the individual publishers to subsequently turn to their comparison within the Catalan and German subsample. An overall comparison highlights the present study's main findings.

4.1 Catalan Primary Textbooks

The three publishers produced textbooks that follow different strategies concerning map skills.

The textbook series ***Ciències Socials*** by Santillana consists of six volumes, the first four of which are part of this study's sample. Along with the continuous text, each textbook features different types of discontinuous text (Fig. 2).

With a total of 42 maps and 33 map-like representations scattered across three volumes, maps represented eight percent of all discontinuous text elements (Fig. 3). While the-

matic maps account for the highest share, the textbooks also include physical maps and city plans. A few blind maps round up the map typology. Concerning their chronology, thematic maps introduce maps as the first type of cartographic representation students are confronted with, followed by physical and city maps. Over the grades, thematic maps remain the most frequently used maps.

Tasks supporting map skill acquisition and development account for five percent of all tasks. While the second-grade textbook entails the lowest share of tasks (2.18 %), their absolute number increases over the grades. Third-grade tasks achieve a higher share than their counterparts designed for grade four despite the higher absolute numbers.

Each of the three volumes that featured tasks dedicated to map skills emphasizes map reading (89%) followed by production (11%).

Publisher	Grade	Pictures	Drawings	Maps*	Tables	Graphs	n
Santillana	1	24	76	0 (0)	0	0	459
Santillana	2	35	63	2 (1)	1	0	400
Santillana	3	50	40	5 (4)	0	1	244
Santillana	4	55	27	8 (7)	0	3	297
Anaya	1	22	77	0 (0)	1	0	536
Anaya	2	43	56	0 (0)	0	0	329
Anaya	3	57	27	10 (3)	2	1	263
Anaya	4	69	24	2 (1)	3	0	297
Vicens Vives	1	78	21	0 (0)	1	0	480
Vicens Vives	2	85	14	0 (0)	1	0	561
Vicens Vives	3	75	20	3 (1)	1	0	432
Vicens Vives	4	74	43	11 (2)	3	2	494

*map-like representations in brackets

Fig. 2. Share of discontinuous text types in the Catalan textbooks in relative values (%) (source: authors)

Publisher	Grade	Physical map	Thematic map	City map	Other	n
Santillana	1	0	0	0	0	0
Santillana	2	0	67	33	0	3
Santillana	3	25	50	25	0	12
Santillana	4	17	63	8	13	24
Anaya	1	0	100	0	0	2
Anaya	2	0	100	0	0	3
Anaya	3	13	74	13	0	31
Anaya	4	64	27	0	9	11
Vicens Vives	1	0	0	100	0	1
Vicens Vives	2	0	33	67	0	3
Vicens Vives	3	21	43	21	14	14
Vicens Vives	4	4	82	4	11	28

Fig. 3. Share of map types in the Catalan textbooks in relative values (%) (source: authors)

Broken down into the dimension of the Map Skills Model, decoding (77%) is on the forefront, followed by description (13%, cf. Fig. 4).

Concerning the targeted performance levels (cf. Fig. 5), three-quarters of all tasks remain

within reproduction, with the remaining 26 percent aiming for reorganization and transfer. The four textbooks lack any tasks dedicated to problem-solving (PL3). The distribu-

Publisher	Grade	Decoding	Description	Interpretation	Evaluation	Production	Tasks (n)
Santillana	1	0	0	0	0	0	206
Santillana	2	100	0	0	0	0	274
Santillana	3	59	29	0	0	12	240
Santillana	4	83	4	0	13	13	358
Anaya	1	50	0	0	0	50	228
Anaya	2	50	0	0	0	50	249
Anaya	3	88	2	0	0	10	338
Anaya	4	88	0	0	0	12	301
Vicens Vives	1	100	0	0	0	0	155
Vicens Vives	2	100	0	0	0	0	188
Vicens Vives	3	81	0	0	0	19	419
Vicens Vives	4	78	19	0	0	4	494

Fig. 4. Distribution of tasks according to the Map Skills Model in the Catalan textbooks in relative values (%) (source: authors)

Publisher	Grade	Performance Level (PL)			Tasks (n)	All Tasks (n)
		1	2	3		
Santillana	1	0	0	0	6	
Santillana	2	83	17	0	17	274
Santillana	3	59	41	0	24	240
Santillana	4	83	17	0	47	358
Anaya	1	100	0	0	2	228
Anaya	2	100	0	0	2	249
Anaya	3	94	6	0	48	338
Anaya	4	88	12	0	17	301
Vicens Vives	1	100	0	0	1	155
Vicens Vives	2	89	11	0	9	188
Vicens Vives	3	74	26	0	27	419
Vicens Vives	4	89	11	0	54	494

PL1: reproduction; PL2: reorganization & transfer; PL3: problem-solving

Fig. 5. Distribution of tasks according to performance levels in the Catalan textbooks in relative values (%) (source: authors)

tion of the tasks across the grades showcases the lack of progression.

Anaya also published a textbook series for **Ciències Socials**. The first four of its six volumes are part of this study's sample. Each vol-

ume displays a unique mix of continuous and discontinuous text elements (Fig. 2).

The 34 maps and 14 map-like representations account for three percent of all discontinuous text elements. Their uneven distribution shows

a peak in grade three (Fig. 3). Thematic maps represent, with a share of two-thirds, the most frequent map type followed by physical maps (23 %) and a few city maps and other map types. The textbooks for the first two grades only entail thematic maps, with the third- and fourth-grade textbooks diversifying their map content by adding physical and city maps. In addition, the textbook for grade four shifts its primary focus on physical maps.

Map skill-based tasks account for 6.18% of the 1,116 tasks. The share of tasks fostering map skill acquisition in the first two grades (0.88 % and 0.80 % respectively) is modest, with a clear peak in third grade (14.20 %), followed by considerably lower values in grade four (5.64 %).

At the core of most tasks (87 %) lies map reading, followed by map production (13 %). Map evaluation tasks are missing from the Anaya textbooks. Considering their distribution across the competencies of the Map Skills Model, most tasks focus on decoding, with only a few contributing to map description. Interpretation is missing from the textbooks (cf. Fig. 4). The share of map production tasks, though limited, shows an increasing tendency in the first three grades.

The distribution of the 69 tasks across the three performance levels (cf. Fig. 5) is unbalanced. The overwhelming majority (93%) of the tasks supports students in reproduction (PL1), while the remaining tasks mainly focus on reorganization (PL2). Both transfer (PL2) and problem-solving (PL3) are missing from the textbooks. Despite their unbalanced distribution, a tendency to gradually move from PL1 to PL2 becomes apparent in the textbooks for grades three and four.

The third textbook set constituting the Catalan subsample consists of the first four tomes of Vicens Vives' six-volume **Socials** series. Maps are one of the various discontinuous text elements (Fig. 2) accompanying continuous textbook text.

Two-thirds of the 71 maps and 15 map-like representations featured in the four analyzed textbooks are thematic maps, followed by city maps, other cartographic representations, and physical maps. Over the grades, the absolute number of maps increases continuously (Fig. 3). City maps are the first cartographic representation students get acquainted with in the first grades. During second grade, thematic

maps complement the typology of maps followed by physical and other maps in grades three and four. While city maps have lost importance over the years, thematic maps have become the main representation format. Physical maps only display a peak in third grade. The number of other maps and cartographic representations shows a moderate increase in grades three and four.

On average, seven percent of the tasks focus on map skills. Over the years, the share of map-skill-related tasks continuously increases from under one percent to eleven percent.

With 92 percent of all tasks dedicated to map skills, map reading constitutes the main focus of the textbook series. The remaining eight percent fall onto map production, whereas map evaluation is missing from the tasks. Viewed in light of the Map Skills Model, decoding (81%) remains at the heart of most tasks, followed by map interpretation (11%). In chronological order, the first three grades solely focus on decoding. The fourth-grade textbook opens up the tasks towards map interpretation (cf. Fig. 4). Map production plays an essential role in third grade, with its importance decaying in fourth grade.

The 91 tasks foster two of the three performance levels to a different degree (cf. Fig. 5). The majority (85%) of the tasks remain within reproduction (PL1), while the remaining tasks are dedicated to reorganization and transfer (PL2). Problem-solving (PL3) is missing from the textbooks. Concerning their distribution across the grades, PL2 only enters the textbooks in grade two, enjoys increased importance in third grade only to fall back in fourth grade.

3.2 German Primary Textbooks

The textbooks by two German publishers follow diverging strategies regarding map depiction as well as map skill acquisition and development.

When developing the **Zebra** series, Klett decided on two volumes spanning the content for grades 1-4, with the first volume (Zebra 1/2) being dedicated to grades 1-2 and the second one to grades 3-4 (Zebra 3/4). Both volumes entail various discontinuous text elements, with maps accounting for less than four percent of them (Fig. 6).

Almost three-quarters of the 27 maps featured in the two volumes are thematic maps, followed by other representations and an

Publisher	Grade	Pictures	Drawings	Maps*	Tables	Graphs	n
Klett	1/2	46	54	0 (0)	0	0	473
Klett	3/4	56	40	3 (0)	0	1	768
Schroedel	3	32	66	0 (1)	2	0	760
Schroedel	4	38	56	1 (4)	1	1	577

*map-like representations in brackets

Fig. 6. Share of discontinuous text types in the German textbooks in relative values (%) (source: authors)

Publisher	Grade	Physical map	Thematic map	City map	Other	n
Klett	1/2	0	0	100	0	2
Klett	3/4	8	76	33	16	25
Schroedel	3	0	25	0	0	0
Schroedel	4	0	75	0	0	4

Fig. 7. Share of map types in the German textbooks in relative values (%) (source: authors)

Publisher	Grade	Decoding	Description	Interpretation	Evaluation	Production	Tasks (n)
Klett	1/2	0	80	0	0	20	289
Klett	3/4	72	14	0	3	10	659
Schroedel	3	0	0	0	0	0	289
Schroedel	4	100	0	0	0	0	659

Fig. 8. Distribution of tasks according to the Map Skills Model in the German textbooks in relative values (%) (source: authors)

Publisher	Grade	Performance Level (PL)			Tasks (n)	All Tasks (n)
		1	2	3		
Klett	1/2	40	60	0	5	289
Klett	3/4	93	7	0	29	659
Schroedel	3	0	0	0	0	289
Schroedel	4	25	75	0	5	659

PL1: reproduction; PL2: reorganization & transfer; PL3: problem-solving

Fig. 9. Distribution of tasks according to performance levels in the German textbooks in relative values (%) (source: authors)

equal share of physical and city maps. The map types show an unbalanced distribution across the grades. While volume one only entails one city map, volume two contains all other types of maps except for city maps (Fig. 7). City maps are the first cartographic representation students encounter; however, there

is no progression given their absence from the second volume.

Overall, under four percent of the tasks included in the two volumes address map skills. Both the number and share of these tasks increase over the grades from under two percent to 4.40%.

Tasks target not only map reading but also map production and evaluation. Nevertheless, with a share of 86%, reading tasks remain dominant. Broken down along the categories of the Map Skills Model, most tasks target decoding (62%) followed by description (24%), production (12%), and evaluation (3%). Concerning their distribution in time, the first volume focuses on description and production, with the volume for grades 3/4 expanding its scope onto decoding and also evaluation (cf. Fig. 8). Both volumes dedicate attention to map production, although its importance decreases during the last two grades.

The unbalanced distribution of the 34 tasks across the two volumes also applies to their contribution to the three performance levels (cf. Fig. 9). Most tasks (85%) focus on reproduction (PL1), while the remaining tasks foster reorganization and transfer (PL2). In chronological terms, the first volume emphasizes PL2, while the textbook for grades 3/4 shifts its focus on PL1.

5. Discussion

The results show a few similarities and a range of differences both within the two subsamples and between them. Therefore, this section first discusses the findings along the subsamples and proceeds to a comparative glance as part of the subsequent section.

5.1 Catalan Perspectives

The three Catalan textbook series showed that maps, despite their variability and diversity, play an insignificant role compared to other discontinuous text elements and face difficulties regarding their integrability into the overall structure of the discontinuous text. Concerning map skill acquisition, the textbooks only focus on map reading (with an emphasis on decoding) and production mainly within reproduction (PL1) without displaying a clear concept of progression.

Despite the explicit visual culture implemented by the three publishers, *maps as discontinuous text* play an insignificant role. Both quantitative and qualitative data prove that publishers favor pictures and drawings over maps and numeric resources to design the

Only the last two of the four volumes constituting the *Pustebblume* series by Schroedel feature maps and turn to map skills. The volumes for grades three and four combine continuous text with different types of discontinuous text (Fig. 6).

The two textbooks contain five thematic maps accompanied by 28 map-like representations. While the volume for grade three only features one thematic map, the fourth-grade textbooks contain four additional thematic maps (Fig. 7). Thematic maps are the only cartographic representation students encounter when working with Schroedel products.

Less than a half percent of all tasks focus on maps and map skills, all of which are part of the fourth-grade textbook. Furthermore, the tasks only foster map reading, and any tasks dedicated to map production or evaluation are missing from the textbook series. Mirrored in the Map Skills Model, the textbook series limits its tasks to decoding (cf. Fig. 8).

Three of the four tasks foster reorganization

discontinuous text of their textbooks. In quantitative terms, despite an increase in number and, in some cases, share, maps and map-like representations remain in the background of the textbooks' visual architecture dominated by pictures and drawings. Regarding the qualitative aspects, even a limited number of maps and map-like representations may play an important role, provided the interplay between the continuous text and other discontinuous text elements attributed particular importance to maps as a unique way to represent the world; however, such an emphasis was missing from all textbooks.

The visual architecture showcased by the distribution of the discontinuous text elements also indicates challenges concerning the *integrability of maps*. While originating in imagery of different types (i.e., satellite, aerial) or a combination of drawn and numeric data (as a result of topographic survey), maps indirectly represent space. The habitual pedagogies of map skill acquisition (HÜTTERMANN 1998) rest on the Piagetian tradition (cf. CATLING 1978), tracing individuals' cognitive development from an image-based topologi-

cal phase through projective phases toward Euclidian representations based on a triple coding (colors, symbols, and geometry). Except for Vicens Vives, the Spanish publishers primarily focus on drawings in the first two years to shift to pictures and maps in the subsequent two years. However, leading students from their pictographic reality towards different representation formats, such as drawings, numbers, and maps, is essential both for map skill acquisition and for every other alternative format of representation other than movies and pictures. Despite providing a favorable visual architecture, the textbooks by Vicens Vives fail to attribute the required qualitative and quantitative relevance to maps and map-like representations.

With physical, thematic, and city maps included on their spreads, the three textbook series are *diverse* enough to enable an adequate introduction of cartographic knowledge and map skills. However, the *distribution of the different map types* and their *order of introduction* shows that the textbook series lack a clear and consistent concept of progressive map introduction. While Santillana and Vicens Vives gradually increase the number of maps across the grades, Anaya includes most maps in its third-grade textbook. Also, Santillana only considers maps starting with grade two. All three publishers share the decision to only include physical maps in grades three and four. However, they followed very different strategies concerning the dramaturgy of map type introduction. Santillana begins with thematic and city maps in second grade, Anaya only uses thematic maps in the first two grades, while Vicens Vives only includes city maps in the first-grade textbook to slowly open up the map variety by printing thematic maps in the subsequent grade and all other map types in the third grade. Habitual pedagogies of map skill acquisition (HÜTTERMANN 1998) traditionally use city maps and simple representations followed by physical maps. Thematic maps and other representations tend to be the last map types introduced in the early years.

Map skill acquisition based on tasks only addresses *map reading and production* and *lacks any progression*. Viewed against the background of the Map Skills Model (HEMMER ET AL. 2010), all three series dedicate the highest number of tasks to decoding. Map de-

scription is only featured in a few tasks of the third- or fourth-grade textbooks. The three series deal differently with map production, given that Anaya is the only publisher considering it across the four grades, with the remaining two publishers only introducing map production in the two upper grades. Therefore, a clear progression from decoding through description to interpretation is missing from all textbooks.

Moreover, task distribution according to the three performance levels also emphasizes reproduction with very few exceptions of reorganization and transfer (PL2). Higher-order tasks aimed at problem-solving (PL3) remain outside the three textbook series' task structures dedicated to maps. On the one hand, textbooks fail to gradually build tasks requiring students to reorganize their knowledge and transfer it to another context (PL2) on introductory and advanced tasks securing the reproduction of knowledge (PL1) within the individual grades. On the other hand, the three textbook series also fail to shift their focus from lower-order tasks towards higher-order tasks across the grades. For example, the Anaya series drastically reduces reproduction tasks on map decoding in grade four but fails to expand the number of tasks requiring students to reorganize and transfer their knowledge (PL2).

5.2 German Perspectives

Maps remain outside the forefront of core discontinuous text elements depicted in primary textbooks for the German federal state of Berlin. The two publishers attribute varying importance to map variety and specialize in a few map skills mainly limited to reproduction.

Apart from two exceptions in Zebra 1/2, both textbook series considered maps for grades three and four. Compared to pictures and drawings, in quantitative terms, both publishers attribute a *secondary role to maps* in the hierarchy of discontinuous text elements. This also applies to the qualitative importance of maps as a different form of spatial representation. While both publishers feature methodological support on map reading, the quality of cartographic content remains of secondary importance.

The visual architecture of discontinuous text elements reflects different approaches the

publishers implemented. While Klett first emphasizes drawings that morph into a dominance of pictures, Schroedel's textbooks for grades three and four favor drawings. Therefore, the *integrability of maps* (CATLING 1978; HÜTTERMANN 1998) seems more manageable in the case of Schroedel, particularly in light of the different map-like representations complementing the drawings.

Both *map typology* and the *chronology* of their introduction show diverging solutions but also stress a common *lack of progression*. Klett uses city maps only in Zebra 1/2 to replace them with thematic and physical maps, along with other representations in the volume for grades three and four. In contrast, Schroedel only features thematic maps in both volumes. Thus, despite well-established and widely used pedagogies of map skill acquisition (HÜTTERMANN 1998), only Klett uses city maps as the first type of cartographic representation but fails to connect them to other map types, such as physical or thematic maps. In contrast, Schroedel only includes very few thematic maps as the only type of cartographic representation during the first four primary school years.

Very few tasks assist students during map skill acquisition and development. The two textbook series follow *heterogeneous paths* that lack a genuine concept of *progression*. Klett covers all three competencies (map reading, evaluation, and production), while Schroedel only looks into map reading. Following the Map Skills Model (HEMMER ET AL. 2010), both publishers emphasize decoding; however, Klett also features tasks on map description. In terms of progression, it is surprising that textbooks by Klett first look into map description and production to turn to the basic step of decoding subsequently. A similar inconsistency in progression arises from the distribution of tasks according to the performance levels in Zebra 1/2, with reorganization and transfer (PL2) exceeding the number of reorganization tasks (PL1). This also applies to the fourth-grade textbook by Schroedel featuring a higher number of tasks fostering PL2 as those requiring students to reproduce (PL1).

5.3. Comparative Perspectives

The Catalan and German textbooks mirror the particularities of two educational systems con-

cerning map skill acquisition. Taking into account the differences in the normative frameworks, canons of subjects, and approaches of organizing skills-based education, the comparison of the ways Catalan and German primary textbooks introduced maps and formulated tasks dedicated to progressive map skill acquisition and development revealed six challenges.

First, publishers seem to handle cartographic content concerning map typology very heterogeneously. While Catalan publishers include more diverse types of maps, some German publishers leave standards of cartographic content (HÜTTERMANN 1998) unconsidered.

However, limiting the diversity of maps leads to the second challenge, namely the inability to implement sound pedagogies of map skill acquisition (CATLING 1978; HÜTTERMANN 1998). Map skill acquisition and development requires transferring knowledge to various representations surrounding students in their daily lives and beyond. Deciding against city (Schroedel) or physical maps (Schroedel) deprives students of alternative ways to decode and encode/represent the world they inhabit.

Third, all textbooks display a surprisingly modest contribution to map skill acquisition. While the emphasis on map decoding is both necessary and understandable in the early years, the publishers fail to deliver convincing arguments why they fail to provide students with tasks to progressively (BAGOLY-SIMÓ & UHLENWINKEL 2017) acquire map description, interpretation, and evaluation skills (HEMMER ET AL. 2010). Studies on German (HEMMER ET AL. 2013) and Romanian (BAGOLY-SIMÓ & HEMMER 2012) lower secondary textbooks showed a more pronounced variety of map skills. Overall, textbook authors and publishers seem to underestimate young children's capabilities and potential when it comes to acquiring map skills. Consequently, in their current presentation, the analyzed textbooks fail to enable primary school students to reach their potential and develop their capabilities, let alone equip them with the basic skills required in secondary education. Overall, the textbooks mirror an impoverished sense of primary education and young students.

Fourth, the textbooks fail to provide convincing concepts of progression across performance levels. With the majority of tasks stuck in reproduction (PL1), rudimentary reorganiza-

tion and transfer (PL2), and missing problem-solving (PL3), students are deprived of the possibility to apply their knowledge and use it to solve problems. Failing to provide a concept of progression (BAGOLY-SIMÓ & UHLENWINKEL 2017) deprives students of another way of decoding and encoding the world through maps and map-like representations.

Fifth, despite its modest representation, map production (FRANK ET AL. 2010) remains an essential skill in Catalan textbooks. Their German counterparts either rejected their inclusion (Schroedel) or reduced their relevance to an absolute minimum. Nevertheless, learn-

ing to encode the world through maps is an essential skill and a prerequisite to evaluating maps and map-like representations along with structural or content-related criteria.

Finally, the two case studies showed the erosion of both cartographic content and map skills when Geography is part of a compound subject. While the Catalan subject *Ciències Socials* carries on with a more geographic tradition both regarding Cartography and map skills, the German subject *Sachunterricht*, despite Geography being one of its six catering disciplines, seems to have decided to deprive students of cartographic knowledge and map skills.

6. Concluding Thoughts

Maps, map skills, and improving children's experience during map skill acquisition has been on the agenda of Geography educators for decades. As early as the late 1960s, first suggestions of possible ways to graduate map skills (cf. RUSHDOONY 1968) emerged. The heterogeneity of map skill acquisition models shows the broad interest in the topic across the globe (e.g., HEMMER ET AL. 2010; MOHAN ET AL. 2014; OWENS 2021).

Despite an increase in the role of digital media, the Covid-19 pandemic reinforced the relevance of (analog and digital) textbooks for Geography education, particularly for low-income households (BAGOLY-SIMÓ ET AL. 2019). Traditionally, in most countries, textbooks represent the most widely used concretization of curricular prescriptions. Therefore, textbooks also serve as a seismograph of innovation implementation into formal education. Carefully curated textbooks implement research from both Geography and Geography Education.

Consequently, the present study used Catalan and German textbooks to explore how primary textbooks introduce maps and consider tasks dedicated to progressive map skill acquisition and development. Given the disheartening findings, future work on map skill acquisition may require a broader framing sensitive to five main aspects.

First, compared to the theoretical models, textbooks seem to underestimate young learners' capabilities and potential when designing cartographic content and implementing map skill acquisition tasks. There seems to be a necessity to explore the knowledge of textbook

editors and authors concerning minimal and average standards for primary education.

Second, maps and map skills belong to the most traditional core of geographical knowledge in formal education. Therefore, praxeological knowledge suggesting suitable ways of map skill acquisition is as abundant as scholarly work in the field. Textbooks seem to be caught between praxeological and empirical perspectives. Therefore, an important endeavor is revisiting such knowledge pieces and their effects particularly in the field of map skill acquisition.

Third, conceptions of progression display the tension emerging from mixing praxeological and scholarly work. Most models only consider scholarly work, neglecting the vast praxeological knowledge textbook authors bring to the table when writing educational materials. Therefore, future studies might look into stakeholders' knowledge and decision-making processes.

Fourth, most progression models are normative and only corroborate empirical and theoretical work from selected fields. Few models actually rest on skill acquisition modeling and testing. It seems advisable to take a closer look at the individual models, their origins, and their applicability to curriculum making and educational media design.

Fifth, as highlighted in this study, reaching beyond the limits of Geography as a school subject and looking into compound or interdisciplinary subjects sheds a new light on ways of embedding maps and map skill acquisition into alternative disciplinary settings.

Concerning the limitations of the present study, future work should strive for a larger sample size, a more detailed exploration of the ties between continuous and discontinuous text, and looking closely into the distribution of map and map-skill-related tasks in the chapters primarily targeting content on History, Civics, and, in Germany, even Biology, Physics, and Chem-

istry. A more delicate task taxonomy might shed a different light on concepts of progression this study left undiscovered.

Despite its limitations, the present study offers six specific fields textbook authors, editors, and publishers may address to improve students' access to cartographic representations of the world.

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