Section 2. Mathematics and Language

HISTORICAL MEANINGS OF VOCABULARIES IN CHINESE MATHEMATICAL CURRICULUM

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Abstract: *Vocabularies or terms in Chinese Mathematical Curriculum referring to the characters, words and phrases that indicate the mathematical objects. However the ambiguity situation of some vocabularies including fuzzy and transformation would be the obstacles relevant to the understanding of mathematical concepts. In a word, involving in the humanities could be beneficial to mathematics learning.*

Mathematical terms are defined as some words and phrases that indicate the mathematical objects. For example, the term "质数(zhishu, prime number)" is an integer which is greater than or equal to 2 and has exactly two distinct natural number as divisors, including 1 and the integer itself. It uses the word "质(zhi, prime)" to confine prime number to the whole numbers. Another phrase"几何（ji he, geometry）"refers to a subject named "Geometry" which focuses on shapes. Terms like this in Chinese are named related to a subjective point of view, which is hardly known by modern people.

Mathematical terms in Chinese Curriculum

In teaching and learning of mathematics, there have been lots of problems around the meanings of the terms from primary school teachers and children. Take one example, in English, the mathematical term "equation" also has the meaning of "equivalency" which is exactly the nature of "equation". While in Chinese, the Mathematical term does not reveal any of the features of "equation". Since the Chinese name of "equation" was named for quite a long time and the meaning of every word had been changed with the changing of history. Besides, this "unreasonable term" makes learners hardly comprehend its definition and its nature. Tracing back to its history, the origin of the Chinese term "equation" indeed has a very close relationship with the development of the Mathematics history in China, and the name of it in Chinese is also with logic. Another case is "decimal" in English, also suggesting "decimal system" which is the core factor to differ with integer. However, decimal in Chinese is called "small number" which give a deep-rooted impression to learners that decimal is actually small number. This cognition is usual but far away with the mathematics meaning.

Metaphor is a language phenomenon in the field of linguistic. Actually, mathematical terms are just indicating the mathematics objects whose mathematical meanings are the metaphor of general meaning. Take Prime Number as an example. It uses the word "prime" to confine integer number, to make "prime" as the core and basic of numbers by using metaphor. The conception of prime number originated from the ancient Greek Euclid's Elements. At that time, people hold the philosophical view of atomism. They thought the complicated world was made up of the smallest elements or atoms which are the nature and principles of the world. These kinds of atoms are as tiny as possible, and most importantly, they cannot be divided anymore. Just like the numbers, they are infinite, while the core and the essence of them are permanent and indivisible. Numbers with these characteristics are prime number. “Prime” has the meaning of nature therefore it is the metaphor of nature. Prime number is also called “the root of numbers” or “simplest number”, all of them implied the meaning of “the simplest and indivisible”. However, in Chinese, Prime Number is usually thought to be “plain number” or a kind of new number system according to its Chinese name. Teachers should help them to realize that the Chinese word of Prime Number “Zhishu” also has the meaning of “simplest and root” in the old times. Therefore, students could understand its definition clearly and find connection between its name and its feature of Prime Number.

Similarly, Fraction, Composite number, Odd number, Even number, The difference, Area, Volume, Square, Rectangle, Parallelogram as well as Triangle, these mathematical terms are very close to the general meaning of the objects. These terms are easy to understand and to grasp for students, because they can make connection naturally by themselves between the general meaning in daily life and mathematical meaning in Mathematics.

Mathematical term, as technical term, always make learners feel inexplicable and couldn’t make connection between the definition and its Mathematical term which is an usual phenomenon in China. Since Chinese can always conjecture the meaning of a word according to the pictograph writing system, they do so also on Mathematical term. However, things are not always that easy in technical term. When the ambiguity situation of Mathematical terms is fuzzy or the meaning of it had changed with its history, learners may have difficulty in understanding or even make misunderstanding of it. In this case, study from the history and make clear of these Mathematical terms, make connection between general meaning of Mathematical term and its technical meaning are essential.

The History of Ambiguous Vocabularies

These kinds of ambiguity as showed above implied that learners are hard to think of the mathematical meaning merely according to the general meaning of the terms, mainly because of their lack of the history of these terms which would be mentioned as follows.

The first example is “方程(fang cheng, equation)”,which is thought to be “square measurement” in Chinese. It makes no sense to make a connection between the Mathematical meaning with the term “equation”. However, this term shows an equal relationship which includes the unknown number in a sentence. In ancient China, the meaning of the character“程(cheng)”means measuring.This meaning is widely used in mathematical terms, such as “路程(lu cheng, distance)” which means measuring the moving distance. There is also an instance“程者，权衡丈尺斛斗之平法”(QianSima，1999)in which regards “程(cheng)”as a method that can balance different measurement tools. Historical records show that “方程(fang cheng, equation)” firstly appeared in the eighth chapter of The Mathematics on*<Arithmetic in Nine Section>*. The writer of this book, mathematician HuiLiu in the old times of China explained “方程(fang cheng, equation)”like this: if there are several unknown numbers, we need to formulate them separately but considering together—two unknown numbers formulate two and three formulate three, this is equation(Shiran Du,1956).“方(fang)”means the shape of permutation .While “程(cheng)”means the measuring method. Also in another chapter of this book, it explains “方程(fang cheng, equation)” as to equip the coefficient to the formulation in order to balance it which is similar with the modern meaning(JiminLi,1998). Similar examples are as follows.

In multiplication,"乘(cheng)" means multiplying, while the common meaning in daily life is "take a bus". It is also very hard to see the connection with its mathematical meaning of summing several same numbers. The original meaning of the character"乘(cheng)"is someone stand on the top of a tree, and the extended meaning is rising to a higher position. Multiplication is summing the same numbers just like this process, and this is the relation between mathematical meaning and common meaning.

There are also some mathematical terms in division. According to the modern Chinese dictionary, the Chinese character"除(chu)"means reduction or dividing which is the inverse operation of multiplication(Modern Chinese Dictionary,1978). One problem is the order when we read the equation "6÷2=3" like "6除以2(6 chuyi 2)" or "6除2(6 chu 2)" . Young learners usually want to follow the order of multiplication or addition, however, read in different order may result in different sentence. That's why educators emphasis to read it in a proper way. Actually we can find it as a kind of rhetoric in historical Chinese which means using 2 to divide 6 or 6 is divided by 2. Similar example is the way of reading fraction. We read fraction"三分之二(san fen zhi er)",actually it should be"分三之二(fen san zhi er)"according to the grammar, means dividing one thing into three same pieces and picking up two of them, which has the similar meaning with the meaning of fraction nowadays.

In Chinese, we call the quotient, the result of division as "商(shang)". Considering the common meaning of this word is "discussion" or "business", obviously, it has little relation with the result of division. However in ancient China, there is a timer called "漏壶(louhu)" which looks like a pot, inside of it, there is something floating on the water, we call it"漏箭(loujian)"(Tongxu Hua,2003). People need to observe the graduation to know the time. In the book*<ZhengZiTong·Kou Bu>*, it defines"商(shang)" as the position of the floating thing(Qichang Shao,1998), in other words, "商(shang)" is the graduation, and graduation is the standard that is for measuring. The meaning is quite similar to the equal division that learned in primary school: knowing the total quantity and the number of parts needed to be divided, then working out the "standard". In this way, we build the bridge between general meaning and mathematical meaning.

Transformation of the Meaning

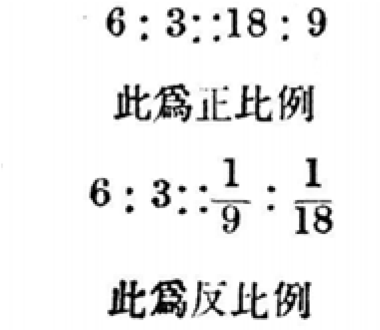
The second kind of metaphor in mathematical terms is the transformation of the meaning of metaphor objects. Take the prime number as an example. "Number" is qualified by "prime" so there is a special group of numbers called prime number. The meaning of the word "number" has not changed after the qualification. However, there are some terms whose meaning has been changed after being transferred sometime. It is this kind of terms that is difficult for understanding and always making a misunderstanding of its mathematical concepts. For instance, the phrase "几何(ji he, geometry)"is rarely used in daily life in modern society of China, so the students even could not know the general meaning of the phrase, let alone the mathematical meaning. In this situation, students have to recite those terms with instrumental understanding. However, the ancient people couldn't name a term without any reason. A term must follow with its technical features or philosophical thoughts, there should be a reason for the term. "几何(ji he, geometry)" in Chinese is used for asking "how much or how many", the word would be originally used in the *<Elements of Geometry>* when GuangqiXu from Ming dynasty translated it into Chinese, cooperating with the Italian missionary Matteo Ricci. There are two explanations for choosing the phrase. The first one is that, the English word "geometry", pronounced like "几何(ji he)" in Chinese, especially for the first three letters "geo". The second explanation is considering the meaning of “geometry”, a word from Greek “*geometria*” measurement of earth or land (Jie,1959). This has exactly the meaning of figuring out “how much”, therefore we use“几何(jihe, geometry)” to define this concept(Songcun Yongfu,1951).

Like what we have talked about in the above, “decimal”, if we translate it word by word, then it should be like“small number(小数)” in Chinese. And also “function”, being translated is “Containing number（函数）”.

In modern Chinese, “小”means small or young, so learners are tend to think that“Small Number(xiaoshu)” stands for the very tiny number. In fact, it is said in<*Li Ji·NeiZe Di Shi Er*>that there are two ways to calculate numbers(XuanZheng,1999). “Small Number”and“Big Number” in the old times means the rates between different place value. So “Small Number”stands for the rates which is smaller than 1. And in decimal system when the rate is 0.1, the number is called decimal number.

As for the term “函数(function)”,when we first know it, we may think that it’s a kind of new number because the last character of the phrase means number. However the term has little relationship with numbers, while it stands for a kind of relationship between different quantities. The Chinese word “函数(function)”first appeared in the translation edition of Shanlan Li (Qing dynasty) of <*The Elements of Algebra*> written by Augustus Demorgan. He defined that function is any expression which contains x in any way then is called a function of x. Thus, a+x and a+bx are functions of x(The Elements of Algebra,1837). So according to this meaning, Shanlan Li named function as“函数(function)”(Xuemin Yan,2006).And the character“函” means contain. In another book that he wrote <*Elements of Analytical Geometry and of the Differential and Integral Calculus*>, the explanation is ‘one variable is called a function of another variable when the first is equal to a certain algebraic expression containing the second, which is closer to the Chinese meaning of function (Augustus Demorgan. Elements of Analytical Geometry and of the Differential and Integral Calculus,1865). Generally speaking, “函数(function)” stands for the relationship not only between variables but also between sets which is similar to the original meaning.

Proportion is a very important concept in mathematics and is called “abreast gist(比例)” in Chinese. According to the book <*ShuoWenJieZi·Ren Bu*>, both “比(bi)”and“例(li)”means ratio, so the mathematical metaphorical meaning of“比例”is two equal ratios(Shen Xu,1963). Proportion means the relationship between two equal ratios. Like “1:2=2:4”,it is called geometrical proportion in nineteenth century in Europe. At that time, there is another kind of proportion called arithmetical proportion which means the difference of two equations are the same (Elements of Arithmetic,1839). An important property of arithmetical proportion is that if we arrange four numbers in order, the sum of the first number and the last number is equal to the sum of the middle two. For instance,“19-7=127-115”and “19+115=7+127”, so“19-7=127-115”is called the arithmetical proportion. This property is similar to the geometrical proportion that the multiplication result of the outer term is equal to the inner. Also, “正比例(zheng bi li, direct proportion)” and “反比例(fan bi li, inverse proportion)” are two concepts in proportion. The characters“正”and”反”are words with opposite meanings. The definition of direct proportion is that if the ratios of numbers are always the same, it is the direct proportion. And if the results of multiplication of the numbers are the same, it is called the inverse proportion. We can see from the definitions, that the two proportions are applied to describe the relationship between quantities instead of two proportions. However in ancient Chinese mathematics textbook: If “a:b”is regarded as direct ratio, then “b:a”is the inverse ratio, so there are two different inverse proportions matching a same direct proportion. The first one is called the inverse ratio and the second is called the reciprocal ratio. In the book *<Shi Fan Jiang Xi She Shi Fan Jiang Yi>*of late Qing dynasty, there is an example to explain the saying in the above.


$6 : 3 : : 18 : 9$

此爲正比例

$6 : 3 : : \frac{1}{9} : \frac{1}{18}$

此爲反比例

Figure1. Teaching materials of Qing Dynasty

From this picture, we know that direct proportion and inverse proportion are corresponding concepts. They appeared in pair and both of them are a special kind of ratio which is different from what we realized today.

Conclusion

Nowadays in China, Mathematics has become a very important and independent subject, the differentiation of the subjects in school lead to a result that the mathematical lessons become more and more formalized and instrumental, lacking of the content of humanistic and mathematical history.Many teachers and students think mathematics is only a subject about calculating and problem solving. However they ignored the human nature of mathematics.

For mathematical knowledge, it should not be taught and learnt only by discussing in groups or solving problems in daily life, but also should be communicate with history, languages as well as traditional culture.

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COMMUNICATION VIA TEXT MESSAGES – THE NETWORK BETWEEN MATHEMATICS AND LANGUAGE

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Abstract: *The combination of Mathematics and German Language Education is said to be very unusual. C. P. Snow even talked about "The Two Cultures", that are so different from each other that communication between the two disciplines is difficult.*
In order to meet these challenges, it is fundamental to be open for the other discipline but also to be aware of the own discipline's limits. This is required for a successful network between mathematics and language. In school context, it is important to already connect these disciplines that are less related at an early stage.
In the following paper we will show basic principles for interdisciplinary lessons of Mathematics and language. Therefore we will describe three network levels: the level of organization, the level of concept and the level of didactical arrangement. We will then illustrate these levels by the example of text message-communication. It will be pointed out in which way mathematics and language can be connected in order to gain advanced expertise in both disciplines.

1. Framework

The network between Mathematics and German Language Education is still considered to be unusual. It is not uncommon to read that both subjects only have few points of contact (Abraham/Launer 2002). A glance at the history also strengthens this perception (Rommel 2001): In his well-known essay Snow (1959) speaks about "the two cultures" that are so divers that a common understanding is impossible. However, if we take the demand for interdisciplinary lessons seriously we should also think about interdisciplinary lessons of non-obvious subjects (Kämper van den Boogaart 2003). In order to be successful, it is required to be open for the other subject and also to be aware of the limits of the own subject (Golecki 1999, 28f.). Furthermore, it is important to be confident that unusual connections like the one between Mathematics and German Language Education can lead to particularly creative results.

Interdisciplinary lessons can be located on three levels: on the level of *organization*, the level of *concept* and the level of *didactical arrangement* (see Figure 1). On the level of *organization* lessons are settled between interlinked lessons (e.g. projects) and subject-related lessons (e.g. specialized classes) (Peterßen 2000). The level of *concept* refers to different forms of interdisciplinary lessons: real interdisciplinarity is more than the addition of single parts (Kämper van den Boogaart 2003). Starting and ending point is not the single subject but the overall theme. On the third level, the level of *didactical arrangement*, one decides what methods, media and social forms are to be used, as they have to be adapted to the skills/competences that are to be imparted (Peterßen 2000). Thereby interdisciplinary lessons have to be theme-related and integrative.

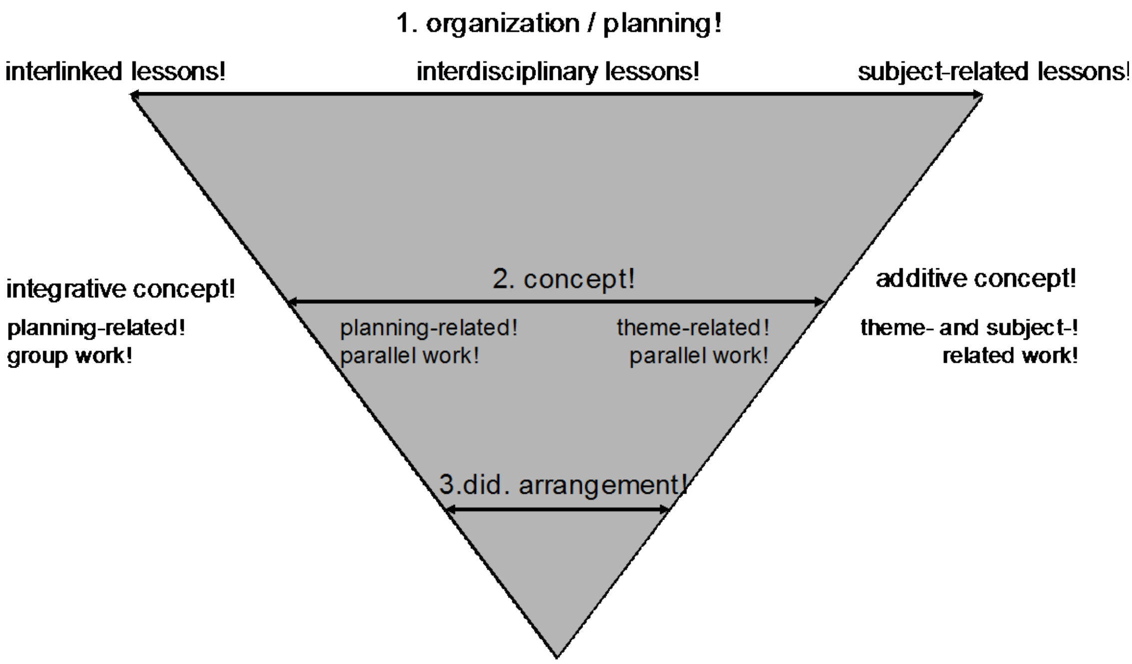


Figure 1. Interdisciplinary lessons can be located on three levels

2. Competencies in Mathematics and German Language Education

Lessons in German Language Education teach competencies in the areas of reading skills, writing skills, language use, orthography and grammar (KMK, 2005a). Methods and techniques are assigned to each of these competence areas. In Mathematics we distinguish between process-oriented mathematical competencies (problem-solving, communication, argumentation, modeling and representation of Mathematics) and content-oriented mathematical competencies (numbers and operations, space and shapes, patterns and structures, measurement and measuring as well as data and probability) (KMK, 2005b) (see Figure 2). On the one hand process-oriented mathematical competencies arise in dealing with Mathematics, on the other hand they are acquired through dealing with mathematics.

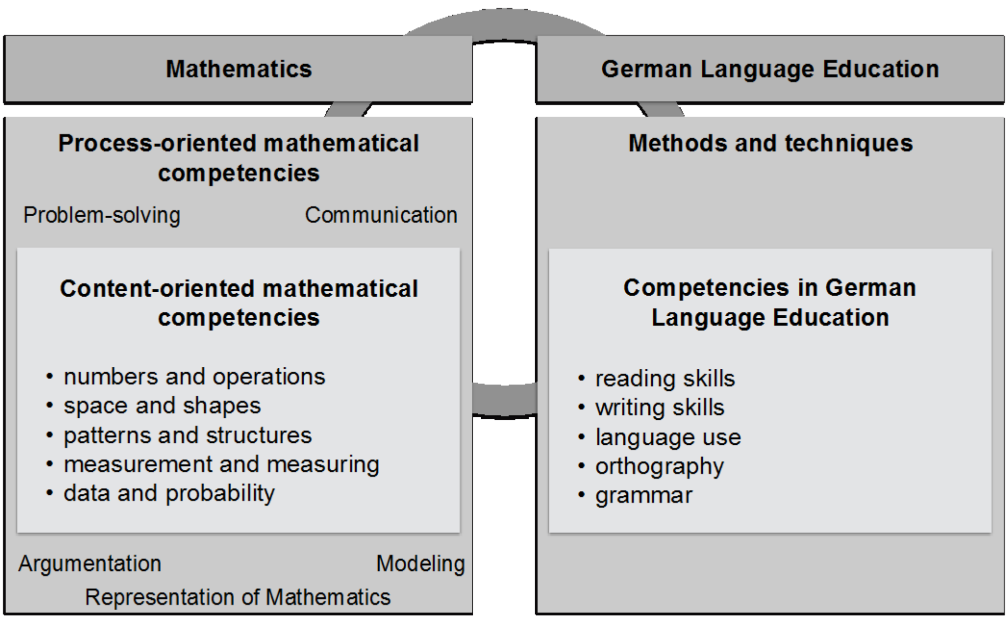


Figure 2. Competencies in Mathematics and German Language Education

The aim of interdisciplinary lessons in Mathematics and German Language Education is to be made aware of the various connections between the competence areas of both subjects: It is striking to see that the process-oriented competencies in Mathematics are reflected in the competence areas of German Language Education. E.g. modeling in Mathematics means for example that the children are able to extract relevant information from factual texts and other representations from everyday life – this is a competence that is fundamental for the competence area of reading skills. Talking about communication as the ability to describe the own approach, to understand different kinds of solutions, to reflect solutions or to use technical language purposefully we can see that all these aspects are valid for all competence areas of German Language Education. In other words: Competencies in German Language Education are the basis for the development of mathematical competencies. These connections are mostly explored in Mathematics (e.g. see Bezold 2009, Fetzer 2009, Fröhlich/Prediger 2008, Götze/Hunke 2014, Götze 2010, Hussmann/Leuders/Barzel 2011, Schreiber/Klose 2014). In this sense didactics of German Language Education often uses the term ‘service function’ (“Dienstleistungsfunktion”) (it has to be noted that also Mathematics can play this role for German Language Education: a lot of forms of representations or analysis techniques in the subject German Language Education require mathematical competencies). But these are not interdisciplinary lessons in the proper meaning of the word. In most of these examples lessons remain subject-related. Here Mathematics is the leading subject and the competencies of the other subject – in this case German Language Education – are the basis for the development of mathematical competencies.

It is a greater challenge to develop interdisciplinary situations that arise in ‘planning-related group work’ („planungsbezogener Gemeinschaftsarbeit“ [Beckmann 2003]) and can be described as integrative concepts on all three levels (the level of organization, the level of concept and the level of didactical arrangement). In all these situations the competence areas of German Language Education lessons as well as the process-oriented and the content-oriented mathematical competencies have to be considered. Only if we succeed in doing this we can talk of a real connection of both subjects and gaining expertise in both disciplines.

3. Communication via text message

Communication via text message plays an important role in the life of children and cannot be deleted from everyday communication. Children are very imaginative in writing text messages: neologisms, abbreviations, emoticons – these are only few aspects of significant characteristics of the text type “text message”. Children use these special features as a matter of course and mostly unconsciously. It might be the position between oral and written culture that makes text messages particularly flexible for creative linguistic modifications (Koch/Oesterreicher 1985; Dürscheid 2006).[6]

For interdisciplinary lessons in Mathematics and German Language Education especially the modifications of linguistic norms (e.g. orthography or grammar) that are a mixture between mathematical and linguistic signs are very interesting. Very inventive creations can arise in such cases, e.g. “M3554G3”, “cu2” or “l8er”. Signs are fundamentally important for learning and understanding of Mathematics (see e.g. Radatz/Schipper 1996) and German Language Education (see e.g. de Saussure 1916; Eco 1977 or Derrida 1976). Thereby the identifier has to be distinguished from the designation (see – for Mathematics – Lambert 2003, 91f.). When

6 Koch/Oesterreicher (1985) developed a model of communication that distinguishes medial phonic and medial graphic communication and communicative immediacy and communicative distance. From this linguistic perspective the text message as a text type can be characterized as follows: It is medial graphic and communicatiive immediacy.

a child is for instance counting some objects that are lying in front of him and says “one, two three”, the child names the objects, i.e. he identifies them. Vice versa the sign (in this case the object) is assigned to a term with that it gets a meaning. The meaning of the designation (in this case the numeral or numeral digit) may vary. “Three” can signify the object counted as the third in a row (ordinal aspect of numbers), but “three” can also stand for the counted quantity (cardinal aspect of number). Beside these two kinds of meaning Mathematics distinguishes more aspects of numbers: the measured value aspect (numbers describe a value), the operator aspect (describes the multiplicity of an action), the calculating aspect (numbers are used to calculate) and the coding aspect of numbers (numbers are used to identify something, e.g. telephone numbers) (Krauthausen/Scherer 2007). All these aspects do not play a role in the usage of examples like „M3554G3, cu2 or l8ter“. Instead numbers in text messages can serve three other functions:

(1) Phonem/pronounciation-oriented usage of numerals: In these cases the numerals (e.g. 2 in combinations like “cu2” or 8 in “w8”) do not refer to a certain quantity or to a pictorial representation but they replace parts of a word or even the whole word in the typeface, e.g. children connect the numeral sign “8” with the numeral word “eight”. Therefore in “w8” as typical abbreviation of a text message the part “ait” in the word “wait“ is replaced by the numeral digit. The pronunciation of “w8” and “wait” is identical, whereas the typoface is different. The writing of “w8” is faster and does not take up as much space. Both are very important for writing text messages because we want to communicate as much information as possible with as little signs as necessary. The chart shows examples for a phonem/pronunciation-oriented usage of numerals: A numeral can replace a phoneme, a syllable or an entire word.

Numeral – phoneme/syllable	numeral – word	pronounciation	examples
1 – [wʌn], e.g. *on*		[wʌn]	1drfl – wonderful no1 – noone
	1 – one	[wʌn]	nice1 – nice one
	2 – two, too	[tu:]	cu2 – see you too
2 - [tu:], e.g. *to*			2mro – tomorrow
	4 – four, for	[fo:r]	4u – for you 4ever – for ever
8 – [eɪt], e.g. *ait*		[eɪt]	l8er – later w8 – wait
	8 – eight, ate	[eɪt]	I 8 up all

(2) *Typoface-oriented usage of numerals*: In a lot of text messages numeral signs do not replace parts of a word or whole words but graphemes that share a similar calligraphy. The letter sign “E” for example has similarities with the numeral sign “3”. When children replace graphemes with numeral signs, the aim is not to safe time – as in (1) –, but to change words creatively. The readability does not suffer – particularly with regard to older children – as studies on the development of reading competencies show (see e.g. Rosebrock/Nix 2014; Bertschi-Kaufmann 2007): If this connection becomes subject of discussion, the space position can be focused on and made aware for the children. The following chart shows a comparison of numerals signs in accordance with letter signs:

numeral	letter	examples
0	O	0UR, Y0UR
1	I	M1ND, 1N
2	Z	AMA21NG
3	E	TH3, 3V3N
4	A	C4N, R34D
5	S	M3554G3
7	T	7H1NK, W17H
8	B	83, A8OUT

(3) *Ideograph-oriented usage of signs*: If mathematical signs are used in an ideographically way in text messages, combinations like “T+“ (“Think positive“) or “T + A = ♥“ may arise. The role of such signs can be very different: Some of them – in terms of (1) – save time and space (e.g. T + A = ♥, instead of “Timo and Anna love each other.“), other again create more or less creativity and are to some extent difficult to decrypt (e.g. ƀ -, instead of “Don´t be negative.”).

sign	meaning	examples
+	positive	T+
-	negative	ƀ -
=	is equal	T + A = ♥

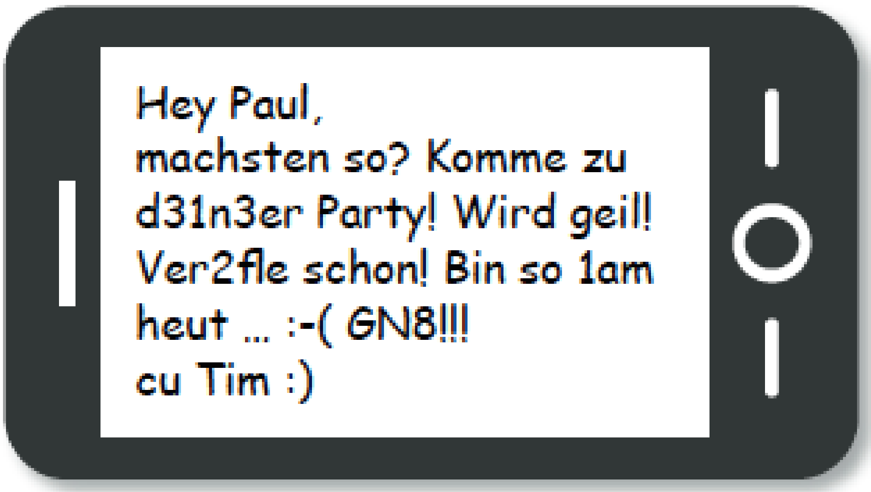
4. Example (Kihm/Knopf/Ladel 2015)

The following lesson of 60 minutes was carried out in a German primary school with third graders. The teacher had been instructed before and the 24 pupils (14 boys, 10 girls) had the chance to get to know the teacher before the actual survey. A class with heterogeneous surroundings was chosen. There are 7 children with immigration background and 2 children with special educational needs in the class. The children were at ages 9 to 10.

The aim of this little survey was to discover, to what extent children this age, are able to write and understand text messages that are composed of mathematical and linguistic signs. Keeping the developed categories (cf. chapter 3) in mind, they have to analyze and reflect these messages before they start developing their own creations in the same way. Therewith, didactical competencies in Mathematics as well as German Language can be developed (cf. further explanations).

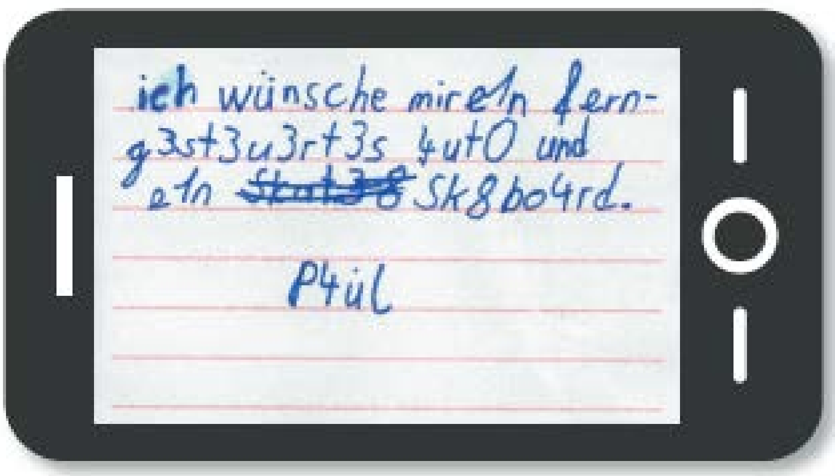
The children already had basic knowledge of morphology, according to the competency of language use of the scholastic standards. This includes in particular the competencies in the field of word composition (prefix, root, suffix) and flection or flection categories (declination and conjugation). At the same time, the children experienced and have worked with nubers in different contexts and in different aspects before the lesson was carried out. All these competencies are the basis for a comprehensive analysis of the text messages and enable a reflection of the peculiarities of these messages.

The lesson was activity- and production-oriented (cf. firstly Haas et al. 1994) at all times.
Starting point of the testing was the encrypted message “S31 8sam! GN8!” that was presented on a poster. In trying to translate the message the children recognized that number signs and letter signs had been mixed up. It was a big challenge for the children to read the message aloud and they only succeeded if they captured the principle behind the message. “S31” is based on (2), “8sam” and “GN8” are based on (1). If the children captured the principle, they got to see a text message from Paul, who invited his friends via text message to his birthday. Pauls’ friend Tom answers in an encrypted text message that was analyzed by the children in three groups. The task had been coped with in group cooperation as it was then possible to fall back because it is then possible to fall back on the knowledge of all persons involved.

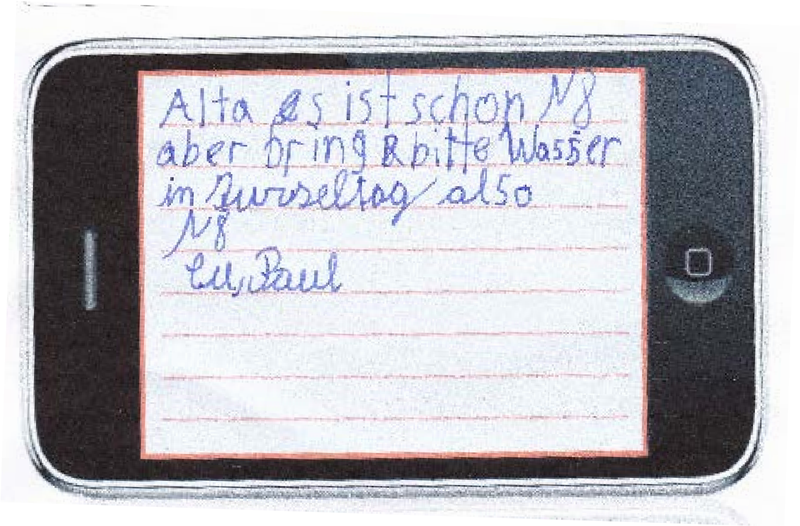


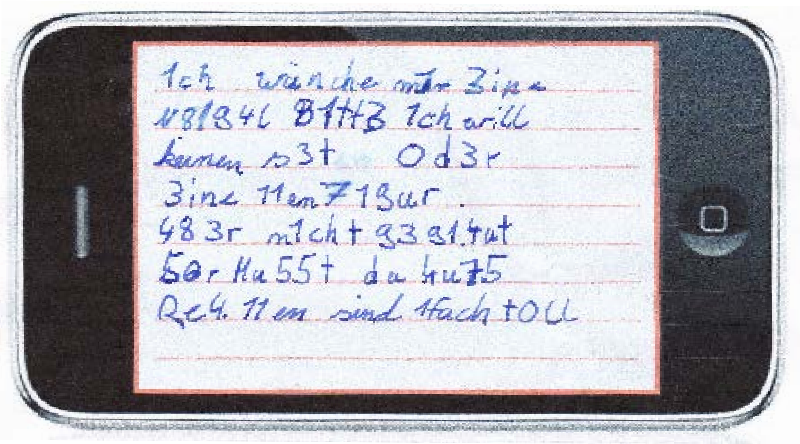
The learners name and paraphrase their observations, e.g. they can work out that all the numerical digits looks like a letter or that a number sign sounds like a word or like a part of a word. Of course there are a lot more peculiarities that can be worked out. The following key features can be deduced, for example: On the level of morphology there are e.g. abbreviations (e.g. cu), omission of words (e.g. „machsten so?“, instead of „Was machst du so?“), especially function words, contractions (e.g. „machsten“ instead of „machst du denn“), apocope (e.g. „heut“ instead of „heute“). On the level of syntax the children notice ellipses (e.g. „Wird geil!“ instead of „Das wird geil“) or missing punctuation. Finally on the level of text, the children can capture that gestures, mimic art or intonation can be replaced by symbols (“emoticons”).

To deepen the discoveries the pupils should encrypt own messages as creatively as possible. They can choose to either answer Pauls’ friends’ text message via text message or to write from one of his friends’ point of view. Hereby the learners develop characteristics and experiment especially with linguistic and mathematical signs. The following text message resulted within the scope of the tested unit:

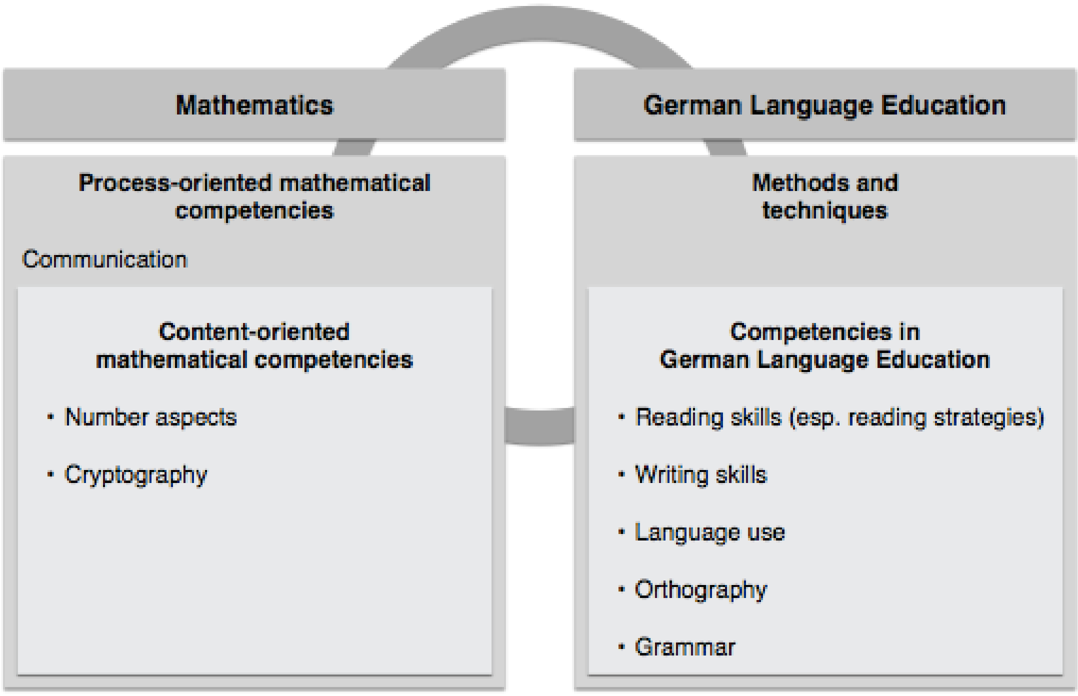


It is especially notable that the children mix aspect (1) and (2) as a matter of course, i.e. they write „words“ where figures replace graphemes (e.g. „G3ST3U3RT3S“). This example emphasizes that in German text messages, English parts of words are replaced by numerical digits (e.g. „SK8 “ – [eɪt]) and that even two principles can be mixed within one word (e.g. in „SK8BO4RD“: „SK8“ – [eɪt] / pronunciation-oriented usage of numerals; „BO4RD“ – „BOARD“ – typoface-oriented usage of numerals). The following examples show how 10-year old pupils adapt the acquired knowledge





The examples show how competencies of two different subjects can be encouraged by analyzing communication via text message:



5. Findings and Discussion

The motivation of learners during the fictive text messaging is not limited just participating in the communication but the children are also motivated to reflect on language. This requires competencies in Mathematics as well as in German Language Education. The children are caught up by the very high relevance to everyday life and by the gate to a world full of signs they really want to understand.

These first positive results should be used for further lessons. Nevertheless, it became clear that the extent of the developing process as well as the results of the individual children varied widely. Underachieving children needed more examples during the lesson until they understood the pattern of the text messages. In situations like that, it can be helpful to only look at one function (phonem/pronunciation-oriented usage of numerals) and to focus on this one function also during the writing task. Only when the children have an idea of the function, a further function should be introduced.

Furthermore, an analysis of all results of the class showed that underachieving children stick more to the given patterns and rarely build their own creations. In these cases, several revisions were needed, where the children had minor impulses (cf. the considerations of Baurmann 2002 or Becker-Mrotzek 2006). Sometimes, the teacher already provided assistance during the planning and writing phase. In the end, it was helpful to compare the first tries of the text messages and the final versions. Seeing the differences, the children were motivated in a particular way (esp. for new writing experiments).

For further lessons, there are different possibilities to enlarge upon the acquired knowledge: It can, for example, be useful to look for messages (or character combinations) on the internet that are made of mathematical or linguistic signs (e.g. on zzzebra.de). These messages can then be collected and decoded or paraphrased. A digital publication of all the text messages made by the children can foster the individual competencies: Only with the disposal of all the results, the children receive a number of examples. They see, how other children solve the task, extend their vocabulary and in the end, they have a broad knowledge that they can use for further writing tasks.

Another challenge is to not only put one text message after another but to tell a story with them, i.e. to create a plot. Here, the children can look for pictures and include them into their messages. This can be done in an analog and digital way (e.g. with the application iBooks Author). Such an approach also fosters the text competencies of the children.

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