

Terminology and Microlearning: Contrasting Their Respective Methods and Content

Terminija ir mikromokymasis: metodų ir turinio sugretinimas

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ABSTRACT

In the field of terminology, a distinction is made between terminological science and its methods on the one hand and terminology (or terminologies) in the sense of terminological data on the other. Concerning microlearning you can make a similar distinction between Microlearning as a subject field with its methods and microlearning objects in the sense of information objects for teaching and learning. The two fields are stemming from totally different roots. Their practical results, viz. terminological entries and microlearning objects (microLO) – especially if they represent scientific or technical concepts – have much in common when comparing their metadata. Different communicative roles distinguish terminological entries – which are concept-based by default – from concept-based microlearning objects (CBmicroLO).

From a microcontent perspective, Blanca Stella Giraldo Pérez (2022) proposes a generic approach to achieve comprehensive content interoperability between terminological entries and CBmicroLOs, which both are different kinds of concept-based microcontent entries (CBmicroCE), though with different communicative roles. Under this perspective, they have much in common and could largely benefit from improved content interoperability. The generic approach proposed may also apply to other kinds of CBmicroCEs, especially in Linked Open Data (LOD) environments. In this connection, the application of the FAIR Guiding Principles (findability, accessibility, interoperability, and reusability of structured content) is essential. To achieve this aim, the authors propose standardization activities to arrive at a harmonized methodology for all kinds of CBmicroCEs – including the harmonization of the metadata (especially the core metadata) involved.

KEYWORDS: terminology, microlearning, microcontent, concept-based microcontent entry (CBmicroCE), concept-based microlearning object (CBmicroLO), qualified terminological entry (QTE), content interoperability, core metadata, FAIR Guiding Principles.

ANOTACIJA

Terminologijos srityje skiriami terminologijos mokslas ir jo metodai bei terminija (arba terminijos) terminologinių duomenų prasme. Kalbant apie mikromokymąsi, galima panašiai atskirti mikromokymąsi kaip dalykinę sritį su jos metodais ir mikromokymosi objektus kaip mokymo ir mokymosi informacinius objektus. Abi sritys yra skirtingos prigimties. Jų praktiniai rezultatai, t. y. terminologiniai įrašai ir mikromokymosi objektai – ypač jei jie atstovauja mokslinėms ar techninėms sąvokoms – turi daug bendro lyginant jų metaduomenis. Skirtingi komunikaciniai vaidmenys išskiria terminologinius įrašus, kurie pagal nutylėjimą yra pagrįsti sąvokomis, nuo sąvokomis pagrįstų mikromokymosi objektų.

Iš mikroturinio perspektyvos Blanca Stella Giraldo Pérez (2022) siūlo bendrą koncepciją, kaip pasiekti visapusišką turinio sąveikumą tarp terminologinių įrašų ir sąvokomis pagrįstų mikromokymosi objektų, kurie abu yra sąvokomis pagrįsti mikroturinio įrašai, tik skirtingo tipo, nors ir atlieka skirtingus komunikacinius vaidmenis. Atsižvelgiant į tai, jie turi daug bendro ir galėtų iš esmės gauti naudos iš geresnio turinio sąveikumo. Siūloma bendroji koncepcija taip pat gali būti taikoma kitų tipų sąvokomis pagrįstiems mikroturinio įrašams, ypač susietųjų atvirųjų duomenų (LOD) aplinkoje. Šiuo atžvilgiu labai svarbu taikyti pagrindinius FAIR principus (surandamumas, prieinamumas, sąveikumas, pakartotinis struktūrinio turinio naudojimas). Siekdami šio tikslo, autoriai siūlo standartizacijos veiklą, kad būtų sukurta suderinta visų rūšių sąvokomis pagrįstų mikroturinio įrašų metodika, įskaitant metaduomenų (ypač pamatinių metaduomenų) suderinimą.

ESMINIAI ŽODŽIAI: terminija, mikromokymasis, mikroturinis, sąvokomis pagrįstas mikroturinio įrašas, sąvokomis pagrįstas mikromokymosi objektas, kvalifikuotas terminologinis įrašas, turinio sąveikumas, pamatiniai metaduomenys, pagrindiniai FAIR principai.

1. MOTIVATION AND BASIC CONCEPTS

This contribution is motivated by the increasing need for content reusability, content integration, and content interoperability, especially for those kinds of structured content (Galinski, Giraldo Pérez 2012) that are also called microcontent.

According to various sources (analysed and cited in Giraldo Pérez 2022), microcontent was originally defined as:

- a general term indicating content that conveys one primary idea or concept,

- a generic term being represented by an addressable structured indivisible self-contained piece of digital information,
- being characterized by format, focus, autonomy, structure, addressability,
- addressable through a single definitive URL or permalink.

Different types of *microcontent entities* also occur in various kinds of unstructured content but constitute elements of such content.

Microcontent entities are created as database entries structured according to metadata to be reusable. In line with the original definitions of microcontent, these entries can be called concept-based microcontent entries (CBmicroCE). In this sense, terminological entries in terminology databases (TDB) are a typical kind of CBmicroCEs. The same applies to well-structured lexicographical entries. It could also apply to certain kinds of learning objects, if they are focused on one concept or meaning, thus becoming concept-based microlearning objects (CBmicroLO), another kind of CBmicroCEs.

If the core information to be conveyed by a CBmicroLO refers to a scientific-technical concept, it has much in common with the terminological entry representing the same concept. Thus, CBmicroCE is an umbrella concept including among others:

- Terminological entries (if possible, qualified terminological entries: QTE),
- CBmicroLOs referring to scientific-technical concepts,
- Lexicographical data, which can be used or reused in both, terminological entries and CBmicroLOs (incl. CBmicroLO for language teaching/learning).

This raises the questions: What is the difference between the terminological approach (and terminological entries) on the one hand and the microlearning approach (and CBmicroLOs) on the other, and how can content interoperability between various kinds of CBmicroCEs be achieved despite different approaches?

The ensuing question is: How can the microcontent approach improve findability, accessibility, interoperability, and reusability, as well as issues of content quality and content curation given the huge amounts of microcontent entities that can be found on the Internet?

To reassess the impact of the proposed generic approach on practical implementation, this article is structured into the following sections:

- Contrastingly describing terminological entries and CBmicroLOs (2),
- Contrastingly describing the summarizing the terminological approach and the microlearning approach (3),
- Analytically comparing the metadata of QTEs and qualified CBmicroLOs (QCBmicroLO) (4),
- Contemplating linking approaches needed to fulfil the requirements of comprehensive content interoperability also enhancing data quality (5),
- Contemplating an identification system for concepts and their representations (6).

2. TERMINOLOGICAL ENTRIES AND CBMICROLOS

According to the original definition of microcontent, microcontent entities should be “concept-based” by default, but unfortunately, most of them are currently implemented in theory- and methodology-poor system design. This requires separating the wheat from the chaff of microcontent and applying – preferably internationally standardized – commonly used metadata and data modelling principles to any kind of CBmicroCEs to be considered qualified. This is especially important concerning terminological entries and CBmicroLOs which belong to the most prominent CBmicroCEs representing scientific or technical concepts of a domain or subject.

Quality of content is fundamental but difficult to achieve, as it depends on several factors which, combined, result in qualified CBmicroCEs (QCBmicroCE). Applied to terminology entries, they result in QTEs; applied to CBmicroLOs they become QCBmicroLOs.

Moreover, lexicographical data cannot be avoided in QTEs and are even more necessary in QCBmicroLOs. In terminological entries, information for instance on noun gender, singular and plural forms, etc. are either neglected, because they can be taken from lexicographical data, or must be made explicit if they deviate from usage in general language.

The goals and formats of qualified lexicographical entries (QLE) in CBmicroCE-format – i.e. focusing on one idea or concept – are more varied than those of QTEs and thus:

- focus on one lexicographical entry for each “meaning” represented by one or more words, complex words, word combinations, or multi-word entities,
- occur in communication acts using general language,

- can provide explanations of the “meaning” of lexical entities,
- may indicate correct general language vocabulary use (depending on the proficiency level of the user).

The main communicative role of lexicographical entries in the CBmicroCE format is “general language communication”, which also may have various sub-categories. To non-experts of a domain or subject, the content of lexicographical entries in a dictionary might look like that of terminological entries:

Table 1. Example of the content of a lexicographical entry (constructed by the authors)

DATA:	METADATA:
claw hammer	headword / lemma
technology	domain / subject
noun	part of speech
<i>/language indication clear from context or structure/</i>	language (explicit in the database)
~ are designed primarily for carrying out carpenters’ woodwork but can also be used for most of the other functions of hammers (see: “hammer”). For woodwork, especially for extracting nails or similar objects out of wood or other materials one end of the hammer’s head is shaped as a claw.	definition / explanation (incl. cross-references, depending on the design)
<i>/one or more images of typical claw hammers/</i>	non-linguistic representation
(Source: <i>/constructed by the authors/</i>)	source (explicit in the database)

It could be debated whether the data of the lexicographical entry above can be seen as a kind of specialized lexicographical data. In any case, there is more variation in lexicographical entries than in QTEs, which are seen as part of the concept system to which a QTE belongs. The distinction of entities of specialized lexicography seen by some as terminological data and by others as lexicographical data would cease to matter if their communicative role were made explicit.

2.1. Terminological entries

The main objective of QTEs is:

- to focus on scientific and technical concepts and their representations, as well as their conceptual relations to neighbouring concepts, and therefore:

- = one terminological entry is provided for each concept
- = falling under a slot in a knowledge ordering system
- = can be represented by one more designations (incl. synonyms, different modalities)
- = can provide designations (equivalents) in other languages
- = should provide one concise definition (or explanation)
- = can, if necessary, provide localized representations for non-linguistic data
- to be primarily used by expert-level users or knowledgeable users (incl. specialized translators, technical writers, etc.)
- to meet the requirements of authoritativeness, conciseness, and correctness
- to be compliant with pertinent methodology standards

In a word, the main “communicative role” of terminological entries is knowledge representation for the sake of specialized communication. It may have sub-categories depending on the kind of domain knowledge, the communication modality, etc.

There are different kinds of terminological entries, even among the purely concept-based ones. If content comprehensiveness and precision are required, the data of terminological entries should or even must be based on one or the other kind of concept system. Especially in prescriptive terminology work, the resulting terminological entries are concept-based by default and usually managed according to harmonized international standards. The application of these standards most likely results in qualified terminological entries (QTE).

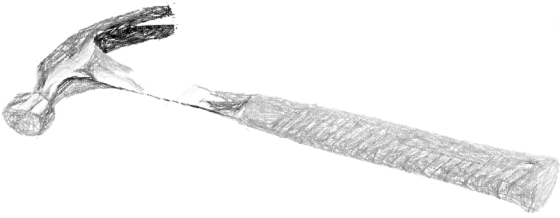
The concept of a terminological entry is represented by:

- a *designation*, defined in ISO 1087 as “a sign which denotes [the concept] in a *domain* or *subject*”, whereby the designation can be a *term* including *appellations*, a *proper name* or a *symbol*,
- a *definition*, defined ibidem as “an expression that describes [the concept] and differentiates it from related concepts”.

Concerning the representations indicated above, both can be linguistic and non-linguistic – in practice even the definition – depending on the subject or modality used.

Example for a terminological entry (constructed):

Table 2. Example of the content of a terminological entry (constructed by the authors)

DATA:	METADATA:
claw hammer	designation
<carpenter tools>	domain / subject
en	language identifier
<u>hammer</u> primarily used in carpentry for <i>driving nails</i> or other fasteners into or pulling nails from wood	definition
<u>hammer</u>	superordinate concept
	non-linguistic representation (a concrete presentation may be subject to copyright)
Note 1: A typical claw hammer has a metal head with a pair of downward-curving V-shaped claws on one side which are used for prying and extracting nails or other fixtures from wood.	additional information
Source: /various sources combined by authors/)	source

The terminological entry of the superordinate concept might look like:

hammer, n.
en
<striking tools> <i>hand tool designed for delivering repeated blows on or pounding a small area of an object</i>
Note 1: Hand hammers consist of a handle and striking head, with the head often made of metal with a hole in the centre to receive a wooden handle.
Note 2: Hammers are used for various purposes, including driving objects such as nails into wood or other materials, breaking objects into smaller pieces, shaping or forming metal, adjusting or assembling parts, and demolition work.
(Source: /constructed by the authors/)

The microcontent approach could bridge the theoretical-methodological gap between terminological approaches and lexicographical approaches (Budin 2004) given the fact that:

- experts of all sorts cannot avoid aspects of correct grammar use, embedding of terminological entities in specialized texts (incl. terminological phrasemes) and general texts (incl. collocations), “vulgarization” of terminological entities depending on the audience, etc.,

- lay people cannot avoid using precise terminology in more and more communication situations,
- teachers and learners of a specialized language cannot avoid the combined use of general language and terminology.

This coincides with “old” indications that there is no clear-cut borderline between terminological entries and specialized lexicographical entries on the one hand, and specialized language and general language on the other hand.

2.2. CBmicroLO entries

Seen from a microcontent perspective (i.e., based on an idea or concept), CBmicroLO entries are also CBmicroCEs. They can comprise the following information **didactically presented for teaching and learning**:

- Scientific-technical concepts represented by terminological information,
- Individual objects represented by proper names and object properties,
- Topics or themes,
- Some kinds of facts,
- General language units, such as words, word elements, complex words or collocations, short utterances, etc.

Currently, didactic categories in most CBmicroLOs are not systematically applied or explicit. Often, they occur as part of larger LOs or of a microlesson. When they are extracted for reuse or re-purposing, they mostly lose the data of didactic categories. Thus, they are not findable by the didactic category and therefore not reusable as desired.

The following data of a CBmicroLO is geared towards children to get familiar with the concept of “hammer” and some of its uses (e.g., as kids’ toys), types and characteristics:

Table 3. Example of the content of a CBmicroLO for children

DATA:	METADATA:
hammer	name of tool
(use of handheld tools)	(application)
<i>/language indication clear from context or structure/</i>	language (explicit in the database)

This is a hammer (+ visualization) This is also a hammer (+ visualization) This too is a hammer (+ visualization) hammers belong to useful tools (+ visualization) Hammers are useful for many things: - to fix something (+ visualization) - to destroy something (+ visualization) - to repair something (+ visualization) - to bend something (+ visualization) - ... Hammers are heavy – so be careful! (+ visualization)	Explanations
(Source: /constructed by the authors/)	source (explicit in the database)

The following CBmicroLO representing the concept of “claw hammer” is geared towards youngsters or novices for learning about claw hammers and how to use them (e.g., for carpenters’ woodwork):

Table 4. Example of the content of a CBmicroLO representing the concept of “claw hammer” for youngsters or novice learners

DATA:	METADATA:
claw hammer	name of handheld tool
handheld tools	subject
<i>/language indication clear from context or structure/</i>	language (explicit in the data-base)
claw hammers are a kind of hammer especially for woodwork by carpenters (+ visualization of a typical kind of claw hammer) There are different kinds of claw hammers for different purposes (+ visualization) Like most other hammers it consists of a handle and striking head, with the head often made of metal with a hole in the centre to receive a wooden handle. (+ visualization) If it is used like other hammers, it can be used for striking (+ visualization) One side of the claw hammer is V-shaped for extracting nails or similar objects. For this purpose, hold the claw hammer like this (+ visualization) If you want to use it for fixing objects, take the claw hammer like this (+ visualization)	Explanations
(Source: /constructed by the authors/)	source (explicit in the database)

There are lots of well-designed QCBmicroLOs geared towards high-level experts – e.g. in fields of medicine and health – for teaching purposes and for personal look-up to check state-of-the-art knowledge.

2.3. Commonalities and differences

As for the content of QTEs, QLEs and QCBmicroLOs, many metadata are the same or equivalent. In analogy to other applications like in eBusiness or eCommerce, one could identify “core metadata”, by which these QCB-microCEs can be made content interoperable.

Table 5. Contrasting the potential core metadata of different kinds of QCBmicroCEs

QCB-MICROCE:	METADATA	COMMUNICATIVE ROLE:
1 QTE	1.1 Designation (term), designative concept representation	Specialized communication among experts (multilingual representations facilitated by the terminology approach)
	1.2 Language indication	
	1.3 Domain, subject, field of specialized application	
	1.4 Definition, descriptive concept representation	
	1.5 Explanation	
	1.6 Additional information	
	1.7 Source (of entry or individual data)	
2 QLE	2.1 Headword / lemma, designative concept representation	General language communication (can follow monolingual or multilingual approaches)
	2.2 Language indication	
	2.3 Subject, topic, or field of application in everyday life	
	2.4 (Definition:) descriptive concept representation	
	2.5 (Simplified) explanation	
	2.6 Additional information	
	2.7 Source (of entry or individual data)	

3 QCBmicro-LO (specialized communication)	3.1 Designation (term), designative concept representation	Teaching and learning of specialized knowledge (can follow monolingual or multilingual approaches)
	3.2 Language indication	
	3.3 Domain, subject, field of specialized application	
	3.4 (Definition), descriptive concept representation	
	3.5 Didactic explanation	
	3.6 Additional information	
	3.7 Source (of entry or individual data)	
4 QCBmicro-LO (general language communication)	4.1 (Headword/lemma), designative concept representation	Teaching and learning in / of general language communication (can follow monolingual or multilingual approaches)
	4.2 Language indication	
	4.3 Subject, topic, or field of application in everyday life	
	4.4 (Definition:) descriptive concept representation	
	4.5 Didactically simplified explanation	
	4.6 Additional information	
	4.7 Source (of entry or individual data)	

From the table above it is clear that any of the QCBmicroCEs needs a kind of “designation” to be addressed and made findable. If the content refers more to specialized knowledge, it would be a term (or another verbal kind of designation) or non-verbal designation. This applies to both, QTEs and QCBmicroLOs geared towards specialized communication. If the content refers to everyday life knowledge, such as in QLEs and QCBmicroLO focused on general language communication, the “designation” would rather be a word (or other verbal-like entity) or a non-verbal form of designation. It may be necessary to find a generic term for the different “designations”, such as “designative concept representation”, or extend the existing standardized terminological entry towards other kinds of CBmicroCEs. The distinction will remain but made transparent by indicating the communicative role of the respective CBmicroCE.

The following kinds of data (applied to designative and descriptive concept representations) are the same:

- Language indication,
- Additional information,
- Source (of entry or individual data).

Furthermore, multilingual data are more and more used in QCBmicroLOs, while they have been a common phenomenon in QTEs and QLEs.

The domain, subject, or field of specialized application occurs in both, QTEs and QCBmicroLOs focused on specialized communication, whereas everyday life topics or applications are more important in QLEs and QCBmicroLO focused on general language communication. The nature and form of the definition or other kind of descriptive concept representation vary greatly among the QCBmicroCEs dealt with here. It might become necessary to find a generic term for the different “definitions/explanations”, such as “descriptive concept representation”, or extend the existing standardized terminological entries for “definition” and “explanation” towards other kinds of CBmicroCEs. The distinction will remain but made transparent by indicating the communicative role of the respective CBmicroCE.

The same metadata names assigned to those kinds of data that differ do not matter if the metadata name is further specified by the communicative role of the respective QCBmicroCE. In any case, it would enhance the findability of any of the above (and maybe also other kinds of) QCBmicroCEs.

3. TERMINOLOGICAL AND MICROLEARNING APPROACHES

Different methodologies and (content management) systems have been developed for the two types of data in focus: terminology management systems (TMS) and a plethora of microlearning tools – both widely applied in the respective fields of application. Both have been developed for the respective data that can be considered as small items of structured content – also called “microcontent”. On the other hand, the field of microcontent has largely developed apart from the fields of terminology and microlearning. However, for example, industry is increasingly requiring the integration and interoperability of all kinds of structured content including terminological data and microlearning approaches, a generic approach to all kinds of microcontent. This is because the cost of data maintenance and updating in different systems is increasing exponentially over time – not to mention the huge duplication of efforts needing different skills of staff and users in general.

Terminological entries and CBmicroLOs belong to the most prominent CBmicroCEs representing scientific or technical concepts of a domain

or subject. However, they have been developed according to specific approaches, which impedes content interoperability and reuse. The following two sections focus on these two approaches to CBmicroCEs with the aim to improving their findability, accessibility, interoperability, and reusability following the FAIR Guiding Principles.

3.1. The terminological approach

There is a difference between terminology science and the terminological data both called “terminology” in the past. Terminological entries constitute the structured content found in terminology databases. Terminology science is a multifaceted discipline influenced by the theoretical and practical approaches in which it is rooted. Thus, **terminology science** refers to the “science studying *terminologies*, aspects of *terminology work*, the resulting terminology resources, and terminological data” (ISO 1087:2019, 3.1.12). On the other hand, **terminology/terminologies** refers to a “set of *designations* and *concepts* belonging to one *domain* or *subject*” (ISO 1087:2019, 3.1.11). Note 2 to entry reads: “A designation can be a term including appellations, a proper name, or a symbol¹. Each terminological entry represents one concept according to the most common TMS.

As terminology represents special knowledge at the level of conceptual knowledge, the number of terminological entities increases exponentially in line with the growth of special knowledge. Moreover, due to the increase of interdisciplinarity, terminology is usually shared by several different subjects or applications. All-in-all, terminologies constitute the knowledge backbone of scientific research and technical applications.

The terminological approach is a systematic approach characterized as interdisciplinary, transdisciplinary, and multidisciplinary, focusing on special knowledge, special language, and special communication. Due to the focus on one concept, it is also seen as language-independent and potentially multilingual. It is principally amodal, i.e., fit for any communication modality, which is particularly important for eAccessibility. Technology today allows the presentation of terminological data in virtually all languages and scripts, media and language/communication modalities, as well as the customization and personalization according to the preferences of the user.

¹ Cross references in the definition to other terminological entries omitted by the authors.

Terminology is essential whenever specialized information or knowledge is created (e.g., in research and development), communicated (e.g., in the medical or economic area), processed, recorded and maintained (e.g., in databases), transferred (e.g., through teaching and training), or accessed (e.g., supported by indexing, using browsers on the Internet, etc.)² “The basic aim of terminology is a transfer of [special] knowledge at different levels of professionalism <...>” (Picht 2011). Thus, terminologies are paramount for all educational activities on the one hand, but for practical teaching and learning, they mostly lack didactic features. Furthermore, terminology is often called differently – e.g., “vocabulary” – and used with a variety of approaches in the field of education. Nevertheless, terminology is indispensable for teaching and learning especially the fundamental concepts that constitute a scientific or technical discipline.

3.2. Microlearning approaches

Microlearning can be understood as the act of learning in small steps through small entities of content aiming to acquire knowledge or skills. From the microcontent perspective, microlearning “does not represent a new conceptualization of learning, but rather targets the aspect of granularity of the learning episodes by a content model” (Scholl 2011: 12), which is expected to be individually referable, self-contained, reusable, and re-combinable. Microlearning probably has been used from the very beginnings of knowledge transfer in humankind thousands of years ago, especially through teaching and learning activities (Giraldo Pérez 2022: 108). Microlearning approaches can be applied to the teaching/learning of special knowledge as well as of general language vocabulary irrespective of the terminological or lexicographical approaches.

From a technical development viewpoint, microcontent in connection with learning activities led to early ideas of microlearning (Lindner 2006, 2007; Hug 2010; Buchem & Hamelmann 2010, Souza & Do Amaral 2014). Today, microlearning refers to an educational approach that offers small learning **units** with just the necessary amount of information to help learners achieve a goal step by step. These small pieces of knowledge are usually based on Web resources whose major learning channel often takes place in mobile environments (Corbeil et al. 2021). Except for language learning,

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microlearning so far takes place mostly in a monolingual way and shares similar characteristics with mobile learning. However, increasingly micro-content entities – also called microlearning objects – are developed with a multilingual approach to be used in different language communities. If so, they are focused on a concept or idea more similar to terminological approaches.

Microlearning objects are generally expected to be consumed in a short time (from a few seconds to about 15 minutes). They are most of the time developed system dependent, although “[i]n principle, ‘microlearning’ is pedagogically **agnostic** <...> is about *pragmatically designing microlearning user experiences*” (Lindner 2007). Due to the high degree of system orientation, many different approaches emerged in the field of microlearning, which do not support the reusability and interoperability of microlearning objects. It also lacks a unified theory and methodology like terminology science and its applications.

3.3. Similarities and differences of the fields of terminology and microlearning

The main distinction between the CBmicroCEs above lies in their different communicative role. Terminological entries represent conceptual knowledge for the sake of knowledge representation and knowledge transfer by special communication. Ideally, there is only one terminological entry for a concept with all terminological data in whatever language or modality. Although one of the main aims of teaching and learning is knowledge transfer, terminological entries are usually not primarily intended and applicable for educational purposes. CBmicroLOs are characterized by didactic elements supporting the learning process. Therefore, they include instructional design presentations for different educational purposes aimed at various end users. Thus, there may be many CBmicroLOs referring to the same concept. Due to the inherent didactic needs of microlearning, there is a strong focus on the **presentation** of information in CBmicroLOs. QTEs usually do not comprise any metadata for didactic features.

Many CBmicroLOs verbally representing a concept or meaning are monolingual. But this is not compelling, as multilingual CBmicroLOs are increasingly required and created. The latter is most common for CBmicroLOs used in language learning, foreign language learning, including special language learning.

Qualified CBmicroCEs are structured according to metadata and share most of the essential characteristics such as structure, focus, being “small”, being elementary (whether “primitive” or “composite”), being self-contained stand-alone entities, encompassing a certain completeness of information, and providing conceptual context. As for QTEs, providing conceptual context as well as using and referring to authoritative sources, belongs to the requirements of being considered “qualified”. On the other hand, the appropriateness of the didactic features applied for a given purpose and user type is a main qualifying requirement for CBmicroLOs. Common to both is the fact that true CBmicroCEs are more likely to be reusable and interoperable than other kinds of microcontent – especially when they are QTEs or QCBmicroLOs.

Concerning the degree of theoretical and methodological maturity, the field of terminology is very advanced as proved by the existence of a large set of international standards geared towards different applications. The field of microlearning shows a lower degree of maturity among others evident by the lack of international standards. One of the reasons for this fact could be their relative lack of visibility (and therefore findability) in the field of eLearning, as they are often embedded in larger learning objects. The great variety of approaches and applications in the field of microlearning is not conducive to reaching a higher degree of maturity seen from the viewpoint of reusability and interoperability. Thus, the field of microlearning could benefit considerably from adapting or adopting aspects of the terminological approach. Despite their different communicative role and the additional set of metadata necessary for CBmicroLOs, these two types of CBmicroCEs are highly complementary. If their approaches could be harmonized, both would lead to a higher degree of comprehensive content interoperability – the same most likely could apply to other kinds of CBmicroCEs.

Further to the above, any CBmicroCE can occur in all kinds of texts, media, documents, or modalities (of human communication). Therefore, the development of a “generic approach” to all kinds of CBmicroCEs involved many aspects hitherto considered unrelated. The potential advantages and benefits of cross-fertilization for the whole field of microcontent made it worthwhile to reexamine existing data models – starting with a comparison of their metadata.

4. METADATA OCCURRING IN QTES AND QCBMICROLOS

Below, major metadata needed for structuring QTEs and QCmicroLOs are grouped, analysed and contrasted under the viewpoint of their importance for content interoperability. The term “data category” is used in terminology management, but data categories are also metadata – and metadata can also be seen as CBmicroCEs. The selection is by far not complete, as it is intended to prototypically show how the linked data approach could fulfil the intentions of a generic approach.

The metadata to which attention is given here does not consider those referring to global information (GI) defined in ISO 26162-1, clause 3.2.5 as “technical and administrative information applying to the entire *terminological data collection*”. GI comprises for instance the title of the terminological data collection, revision history, owner or copyright information, which for a more sophisticated search might also become significant under the viewpoint of reusability and interoperability. The same applies to some other administrative and technical data occurring in individual terminological entries or sections thereof.

4.1. Metadata for designative concept representations

Concepts are not only designated by terms but can also be designated by other designative concept representations, such as “*terms, names, signs, and symbols. There can be terms and names (and their abbreviated forms) in different modalities (and grammatical structure, depending on the language), (visual, audio and audio-visual) sign and symbol systems, as well as combinations of all kinds of verbal and non-verbal elements. Furthermore, conventions in various domains and subjects differ – not to mention competing names for the same “thing” even within the same language or societal environment.*” (Giraldo Pérez 2022: 217)

The metadata for designative concept representations can be grouped into the following subgroups:

- Terms and term-like representations,
- Letter symbols,
- Graphical symbols,
- Other audio-visual symbols,
- The above in any communication modality.

It is important to recognize that QCBmicroLOs, too, can focus on any of the above. If they refer to the same scientific or technical concept, the metadata are also the same as in QTEs, but the communicative role is certainly different.

4.2. Metadata for descriptive concept representations

Definitions, or concise descriptions or explanations of concepts are critical in the field of terminology to differentiate one concept from its neighbouring concepts. Well-chosen or well-constructed non-verbal descriptive concept representations, as well as contexts or examples, can be used instead of or in addition to verbal descriptive concept representations. Non-verbal descriptive concept representations are significantly more needed as didactic features in QCBmicroLOs to convey information about a concept for educational / didactic purposes.

In line with the above, metadata for descriptive concept representations can be grouped into the following subgroups:

- Verbal descriptive concept representation,
- Non-verbal descriptive concept representation,
- The above in any modality (of human communication).

Again, it is important to recognize that all the above can be used in QCBmicroLOs. But it is more likely that didactic features are applied to definitions, concept descriptions or other kinds of descriptive concept representation (including other modalities). Moreover, one or more examples, exercises, test questions, etc. may need to be added. In any case, checking the QCBmicroLO's content – especially the descriptive concept representations – against the respective QTE can be reassuring to the user, whether the instructor or the learner.

4.3. Metadata for conceptual context

According to Giraldo Perez (2022:159), “[t]he conceptual context in terminological entries refers to the microstructure of knowledge (i.e., conceptual micro-context) if it indicates the relation of a concept to neighbouring concepts or its position in a concept system; or to the macrostructure of knowledge (i.e., conceptual macro-context) if it indicates the domain or subject to which it belongs.” Thus, the metadata for conceptual context can be grouped into conceptual micro-context and macro-context.

At the level of conceptual micro-context there can be verbal or non-verbal conceptual micro-context relations to one or more of the following:

- Superordinate concept,
- Broader concept,
- Coordinate concept,
- Otherwise related concept.

At the level of conceptual macro-context, there can be verbal or non-verbal macro-context concept representations (in the form of [elements of] *theme classification* by Wüster 1971) including:

- Classes of domain or subject classification,
- Thesaurus terms (descriptors, non-descriptors, etc.),
- (macro-context concepts represented by) Indexing terms,
- Other kinds of macro-context concept representations.

Again, it is important to recognize that the above also plays a role for QCBmicroLOs though probably not as strict as in terminology management. If they refer to the same concept, the metadata are also the same as in QTEs, but their communicative role is different. In addition, smaller or younger domains or subjects could consider that they cannot be adequately represented in existing large knowledge ordering schemes and must develop their own.

In any case, the knowledge ordering aspect will require further consideration in future standardization activities. ISO/TC 37 is currently revising the ISO/TS 24634 technical specification, which is focused on TermBase eXchange (TBX) and may not be universally applicable to other kinds of structured content.

4.4. Metadata for didactic information in CBmicroLOs

Didactic categories refer to universal aspects of didactics used in teaching and learning to combine instructional and learning processes for attaining learning goals. They are linked to learning theories and related pedagogical techniques whose approaches aim to impact learners' motivation and engagement, and to foster their learning interest.

The explicit indication of didactic categories according to harmonized metadata would highly enhance the findability and reusability of CBmicroLOs. Giraldo Pérez (2022) identified the following didactic categories from pertinent literature:

- pedagogical approach
- learning context
 - = domain or subject³
 - = type of learner
 - = educational level
 - = didactic exploitation
 - = accessibility level
- learning objective
- learning strategies
- learning activities
- learning styles

Some of the above may need to be further differentiated by specific metadata.

An indication of the existence of information on the respective didactic category would enhance the findability and reusability of a CBmicroLO for teaching / learning purposes. The work on finding harmonized metadata for each didactic category still needs to be done. Anyhow, the metadata potentially needed to describe didactic categories are unique to QCBmicroLOs. They are not used in terminology, as the objective of terminology differs from that of microlearning. For data modelling, the metadata describing didactic categories should be developed systematically and be transparent to users, whether they are instructors or learners.

4.5. Metadata for complementary and secondary information

Even though called complementary or secondary information, some of this information is by no means unimportant, among others under the perspective of the FAIR principles.

According to ISO 26162-1:2019, 3.2.6, ***complementary information (CI)*** “includes among others the indication of domain hierarchies, institution descriptions, bibliographic references, and references to text corpora <...>”. Taking bibliographic references as an example, the shortest form for a reference can be found in the standardized numbering systems for all kinds of publications. Thus, an ISBN is the unique identifier of a reference to a published book. Using these numbers avoids overcharging CBmicroCEs with bibliographic data and supports processes of linked data.

³ Domain or subject could coincide with the metadata referring to conceptual macro-context.

Secondary information according to ISO 10241-1 can refer to grammatical information, status information, language or script code (or both), geographical use, pronunciation, etc. They can be directly assigned to individual data field content, sections of a record or the whole record. Language identifiers for instance are highly relevant to indicate the language not only of certain data like verbal designative and descriptive concept representations, but also of any kind of content, as well as of user interfaces of electronic devices, etc. They are usually taken from the ISO 639 language code⁴, which itself is a system of QCBmicroCEs.

Certainly, the above also applies to CBmicroLOs, although its use has not been formalized as it is in QTes. In QCBmicroLOs, additional complementary or secondary information could be used, such as the educational co(n)text in which a CBmicroLO occurs.

5. LINKING DATA WITHIN AND BETWEEN QCBMICROCES

In computing, linked data is structured data which is interlinked with other data so it becomes more useful through semantic queries. *“Structured data refers to data that is organized and formatted in a specific way to make it easily readable and understandable by both humans and machines. This is typically achieved through the use of a well-defined schema or data model, which provides a structure for the data. Structured data is typically found in databases and spreadsheets, and is characterized by its organized nature. Each data element is typically assigned a specific field or column in the schema, and each record or row represents a specific instance of that data”* (GeeksforGeeks). The links between data in an entity are often defined by relationships that exist between different data elements and can be established through various mechanisms, such as keys and references (ERD). Together this constitutes the data model of the respective database records. Within a database, the structured data entities are physically connected through the database structure. After listing many advantages, the above source (GeeksforGeeks) notes: “Structured data accounts for only about 20 % of data but because of its high degree of organisation and performance make it the foundation of Big data to read Differences between Structured, Semi-structured and Unstructured data”. However, some disadvantages

⁴ Following ISO 639:2023 *Code for individual languages and language groups*.

are also listed, such as: “The structured nature of the data can sometimes lead to missing or incomplete data or data that does not fit cleanly into the defined schema, leading to data quality issues.”

Linking structured data entities with other entities in different databases adds a dimension to linked data that would have a great impact on the Internet. This involves first and foremost structured data in the form of CBmicroCEs whose structure – including the internal links – allows for a semantically significant, and thus effective linking – especially if QCB-microCEs are involved. However, “It’s important to note that the nature and complexity of these links can vary greatly depending on the specific requirements of the data model and the nature of the data itself” (Geeks-forGeeks).

The vision of turning the Internet into a global database by linked data across all kinds of structured content entities was first outlined by Tim Berners-Lee in a design note about the Semantic Web project in 2006 in which he formulated basic principles that were later paraphrased as follows:

1. All conceptual things should have a name starting with HTTP.
2. Looking up an HTTP name should return useful data about the thing in question in a standard format.
3. Anything else that that same thing has a relationship with through its data should also be given a name beginning with HTTP.⁵

Simple as it may be there are obstacles in the way to realize the 2006 vision: “<...> *to make the Web of Data a reality, it is important to have the huge amount of data on the Web available in a standard format, reachable and manageable by Semantic Web tools. Furthermore, <...> relationships among data should be made available, too, to create a Web of Data (as opposed to a sheer collection of datasets).*” W3C But Berners-Lee hinted at a potential solution to overcome some of the obstacles through Linked Open Data (LOD) which, he defined already in his 2006 design note as “Linked Data which is released under an open license, which does not impede its reuse for free.”

According to Giraldo Pérez (2022) only certain relationships within CBmicroCEs, which could also be regarded as links within the entries under the most general definition of linked data, and certain links to the same or different kinds of CBmicroCEs in other databases, can be

5 “Tim Berners-Lee on the next Web”. Archived from the original on 2011-04-10. Retrieved 2009-03-15.

considered as links between data elements falling under core metadata to enhance findability and interoperability between CBmicroCEs – and may ultimately lead to new methods of validating and enhancing the quality of individual CBmicroCEs.

Starting with the CBmicroCE internal relationships, the most important for findability and interoperability are links between the identified concept and:

- Each of its (verbal or non-verbal) designative concept representations,
- Its neighbouring concepts, such as superordinate concept, coordinate concepts, or otherwise related concepts – constituting the micro-context,
- A link between the identified concept and the indication of a domain or subject, indicating the location of the concept in its macro-context.

The above allows for language-independent (viz. multilingual), amodal (viz. largely multimodal), and system-design-independent (viz. somehow system-agnostic) designative concept representations. Moreover, the indication of the existence of one or the other descriptive concept representation would be useful, if not necessary. Characteristics of the concept in a descriptive concept representation are also concepts. In this connection, the systemic nature of the underlying concept system needs a minimum of consistency and coherence. This could be enhanced by links between each characteristic of the identified concept and the CBmicroCE representing the concept of the characteristic – especially in prescriptive terminology approaches, such as terminology standardization.

Links between different kinds of CBmicroCEs with different communicative roles can occur at different levels such as:

- links from an identified concept to the same or very similar concepts in other CBmicroCE resources, possibly with a different communicative role,
- links between each characteristic of the identified concept and each CBmicroCE representing the concept of such a characteristic.

The latter would enhance and facilitate the curation of the underlying concept system – especially in prescriptive terminology approaches, such as terminology standardization characterized by the need for a higher degree of semantic and semiotic consistency and coherence.

In addition to the above, references or links to external content resources are needed for various administrative, validation or other purposes, such as:

- Indication of the language of a verbal designative concept representation to the ISO 639 language code, which is a system of language identifiers and their language data elements,
- Indication of the kind of non-verbal designative concept representation possibly residing in a repository of authoritative similar non-verbal designative concept representations,
- Links from coded source indications (such as ISBN, ISSN, DOI, etc.) added to data elements in a CBmicroCE to the full bibliographic description of the respective code element.

The latter would allow constant or periodical evaluation of the authoritative nature of the data source through one or the other emerging Semantic Web tool, thus facilitating data curation. However, according to Giraldo Pérez (2022:194), *“The questions here are: Who develops and promotes the standard format Berners-Lee is referring to? Who designs the necessary Semantic Web tools? Who establishes the relationships among data? All this does not come around by itself.”* It certainly needs further standardization activities preferably at the international level. In this connection, it can be asked, whether the Semantic Web approaches and existing regulatory (re. standardization) aspects are sufficient to realize Berners-Lee’s vision. Giraldo Pérez (2022) explains that some fundamental theoretical and methodological issues must be addressed and resolved first before technology and standardization can take over. One of these issues refers to the kind of links and references mentioned above – others to the question of how to formalize the indication of the above-mentioned links, which necessitates unique IDs for concepts and their representations.

6. UNIQUE IDENTIFIERS FOR CONCEPTS AND THEIR REPRESENTATIONS

Further to the above, each concept should be uniquely identified – e.g. according to ISO/TS 29002-5 adapted for this purpose. The methodology of this technical specification adapted to terminological methodology would be the baseline for achieving content interoperability and reusability across different kinds of CBmicroCEs complementary to data exchange standards in terminology management. The present standard aims to enable the smooth *“exchange of characteristic data, e.g. in product catalogues or*

product libraries ... primarily based on the exchange of <concept identifier, value> pairs: the concept identifier uniquely determines the concept that describes the meaning of the value". In the case of QTEs and QCBmicroLOs the <concept identifier, value> pairs would be composed of the unique concept ID and one designative concept representation (or its identifier) as the value. For search purposes – also enhancing findability/discoverability – it would be necessary to add the indication of the communicative role to each <concept identifier, value> pair as well as the indication of the domain or subject, under which the concept in question falls. This necessitates more than one metadata for

- the data composing the unique concept ID,
- each designative concept representation ID,
- the indication of the domain or subject.

It is necessary to bear **in** mind that the full information about the concept in question would **not** be contained in a <concept identifier, value> pair, but be defined externally in the respective QTEs or QCBmicroLOs. The respective metadata for the elements of the <concept identifier, value> pairs must be internationally standardized and freely accessible to enable the implementation of the generic approach.

In a linked open data environment, additional information could be taken from the respective CBmicroCE. This would enhance findability/discoverability not only through links within QCBmicroCEs but also between QCBmicroCEs of various kinds. The generic approach complies with and supports the FAIR Guiding Principles: findability, accessibility, interoperability, and reusability as defined by GO FAIR. Giraldo Pérez (2022) indicates that QCBmicroCEs are more suitable for allowing compliance with the FAIR principles.

To avoid the present situation where FAIR principles are differently applied by various user communities – thus impeding content interoperability – international standardization activities are necessary. Terminology management based on terminological theory and methods, is highly advanced and largely harmonized through international methodology standards. As for microcontent, there are many practical approaches to managing microcontent usually governed by purpose-oriented system design. This hardly facilitates data interchange, data integration and interoperability across applications without serious loss of information – or worse, only creates unnecessary information, if not garbage.

7. CONCLUSIONS AND OUTLOOK

This article summarizes and further develops the findings of previous studies, as well as the results of ongoing standardization activities. Today, it can be assumed that different kinds of CBmicroCEs have much more in common regarding their metadata than hitherto considered. Present methodologies leading to non-interoperable data need to be adapted under linked data approaches and internationally standardized (incl. metadata). An additional layer of metadata could be applied to existing resources of QCBmicroCEs so that they comply with the FAIR Guiding Principles:

- Findability: The first step in (re)using data is to find / discover them by using machine-readable metadata that are assigned a globally unique and persistent identifier.
- Accessibility: Once users find the required data, they need to know how they can be accessed, possibly including authentication and authorisation.
- Interoperability: To allow reusability (including content integration) of data, they must be able to interoperate with applications or workflows for analysis, storage, and processing.
- Reusability: To achieve reusability, metadata and data should be well-described so that they can be replicated and/or combined in different settings.

These principles, however, also need a few extensions at least for CBmicroCEs, such as:

- Identification and standardization of the set of core metadata which are crucial for achieving FAIR,
- Broadening “accessibility” towards eAccessibility and eInclusion,
- Broadening “interoperability” towards comprehensive content interoperability,
- Adding re-purposability to reusability.

The field of terminology would largely benefit from being integrated in terms of theory, methodology and practical terminology work into the larger framework of CBmicroCEs. The field of microcontent would largely benefit from the terminological approaches and experiences in terminology standardization. The application of new developments, such as OpenAI especially to QTEs and QCBmicroLOs could be made more effective. New very large user groups in the educational sector could be engaged in their

interest in processes of continuous data curation, thereby enhancing the overall quality level of QCBmicroCEs. Thus indirectly, the quality of many information products, in which CBmicroCEs occur, would also be raised. Finally, new businesses and services would emerge out of this development.

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TERMINIJA IR MIKROMOKYMASIS: METODŲ IR TURINIO SUGRETINIMAS

Santrauka

Straipsnyje aptariami terminologinio požiūrio (ir terminologinių įrašų) ir mikromokymosi požiūrio (ir mikromokymosi objektų) skirtumai ir keliamas klausimas, kaip galima pasiekti turinio sąveikumą tarp įvairių tipų mikroturinio įrašų, nepaisant skirtingų požiūrių. Jame remiamasi bendra visų rūšių mikroturinio, ypač sąvokomis pagrįstų mikroturinio įrašų, turinio koncepcija sąveikumą.. „Mikroturiny“ vartojamas pradinė prasme kaip struktūruotas turinys, perteikiantis vieną pirminę idėją ar sąvoką, kuri tapo neryški dėl daugybės mikroturinio sistemų (dažniausiai nesuderinamų) techniniais formatais, dėl ko daugėja nepatikimo mikroturinio. Bendra koncepcija orientuota į sąvokomis pagrįstus mikroturinio įrašus, o tai padidina surandamumo, prieinamumo, sąveikumo ir pakartotinio naudojimo galimybes (pagal pagrindinius FAIR principus).

Visuose skirtingų tipų sąvokomis pagrįstuose mikroturinio įrašuose galima atskirti metodologiją ir duomenis, pavyzdžiui, terminologijos srityje – terminologijos mokslą (t. y. terminologijos principus ir metodus) ir terminologinius įrašus, o mikromokymosi srityje – mikromokymąsi kaip edukacinį metodą ir sąvokomis pagrįstus mikromokymosi objektus. Įdomu tai, kad visų rūšių sąvokomis pagrįsti mikroturinio įrašai potencialiai gali tapti sąvokomis pagrįstais mikroturinio objektais pritaikius didaktines savybes (pagal didaktines kategorijas).

Palyginus skirtingų tipų sąvokomis pagrįstų mikroturinio įrašų metaduomenis, ypač terminologinius įrašus ir sąvokomis pagrįstus mikroturinio objektus, matyti, kad yra daugiau panašumų, nei galima atpažinti iš jų skirtingo (techninio) atvaizdavimo ir (suvokiamų) pateikimų. Per pastaruosius 30 metų buvo sukurti išsamūs metodologiniai standartai, susiję su terminų duomenų mainais ir pakartotiniu jų naudojimu, kad būtų

įrodyta terminų tvarkybos nauda. Panašios standartizacijos pastangos, susijusios su metaduomenų, ypač sąveikumą palengvinančių pamatinių metaduomenų, identifikavimu ir aprašymu, reikalingos ir kai kurioms kitoms sąvokomis pagrįstų mikroturinio įrašų rūšims. Siūloma bendrąja koncepcija siekiama pagerinti surandamumą, prieinamumą, sąveikumą ir pakartotinį naudojimą, taip pat išspręsti mikroturinio kokybės ir turinio kuravimo problemas, ypač terminologinių įrašų ir sąvokomis pagrįstų mikroturinio objektų.

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