

On the Effective Dissemination and Use of Learning Objectives Catalogs for Health Information Curricula Development

Oliver J. BOTT^{a,1}, Ursula BERGER^b, Nicole EGBERT^c, Carolin HERRMANN^b,
Birgit SCHNEIDER^d, Björn SELLEMANN^c, Cord SPRECKELSEN^d,
Brigitte STRAHWALD^e, Julian VARGHESE^f and Alfred WINTER^d

^a*Working Group Curricula of Medical Informatics of the German Association for Medical Informatics, Biometry and Epidemiology (GMDS) e. V., Germany*

^b*Working Group Teaching and Didactics of Biometry of the International Biometric Society - German Region (IBS-DR) and GMDS e. V., Germany*

^c*Working Group Nursing Informatics of the GMDS e. V., Germany*

^d*SMITH - Joint Expertise Center for Teaching (SMITH-JET), Germany*

^e*Working Group Teaching in Epidemiology of the GMDS e. V., Germany*

^f*Working Group Medical Informatics Education in Medicine of the GMDS e. V., Germany*

Abstract. Catalogs of competency-based learning objectives (CLO) were introduced and promoted as a prerequisite for high-quality, systematic curriculum development. While this is common in medicine, the consistent use of CLO is not yet well established in epidemiology, biometry, medical informatics, biomedical informatics, and nursing informatics especially in Germany. This paper aims to identify underlying obstacles and give recommendations in order to promote the dissemination of CLO for curricular development in health data and information sciences. To determine these obstacles and recommendations a public online expert workshop was organized. This paper summarizes the findings.

Keywords. learning objectives, competencies, catalogs, scientific societies, medical informatics, biometry, epidemiology, medicine, nursing informatics, curricula

1. Introduction

Competencies, in the form of statements of the desired knowledge or skills a student should possess upon completion of a course, or learning objectives, which focus on the broad goals of a course, are common elements of course design. In what follows, we use LO as an abbreviation for competence-based learning objectives. LO Catalogs (CLO) have been introduced and promoted as a prerequisite for high-quality, systematic curriculum development [1]. Since the introduction of the National Competence-Based Catalogue of Learning Goals in Medicine (NKLM), medical study programs in Germany have been following this approach with increasing commitment. There are also national initiatives to promote CLO in the fields of epidemiology, biometrics, medical

¹ Corresponding Author: Oliver J. Bott, E-mail: oliver.bott@hs-hannover.de.

informatics, biomedical informatics, and nursing informatics of the German Society for Medical Informatics, Biometry, and Epidemiology (GMDS) [2]. A prominent international example is the recommendations on Education in Biomedical and Health Informatics of the International Medical Informatics Association (IMIA) [3].

While CLO-based curriculum development is used effectively in medicine [4], the consistent use of CLO for Biomedical and Health Informatics, Biometry and Epidemiology still needs to be improved. Furthermore, using CLO merely as bureaucratic checklists undermines their function as a tool for learner-centered teaching, which has sparked debates in the past [5]. Thus, in using CLO in curriculum development, the promising opportunities are countered by some general obstacles as well as some that are likely to be specific to health data and information sciences.

The aim of this paper is to systematically identify such obstacles and derive recommendations in order to strategically promote the dissemination and use of CLO in the GMDS subject areas with a focus on their use in curricular and module development.

2. Methods

We organized a public online workshop as part of the annual conference of the GMDS 2022 to explore these obstacles and develop recommendations. The workshop consisted of three steps, the presentation of best practices by invited keynote speakers and two working sessions, described in more detail below and are illustrated in figure 1.

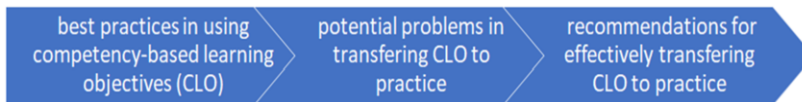


Figure 1. Three steps for bringing CLO to practical use

The workshop started with three keynotes on international experiences with the implementation of CLO in curricula. These lectures focused on the opportunities of recommendation based interprofessional courses in health informatics, the experiences and success factors of implementing the IMIA Recommendations 2010 [6] in a certified master program, and the use of a curriculum information system for transparent, comprehensible and verifiable planning of teaching [7].

The following first working session aimed to identify potential issues in CLO transfer and was conducted using an interactive online whiteboard (Miro) and a videoconferencing tool (Zoom) with the capability of opening breakout rooms, in which the following three topics have been discussed: (1) how do knowledge-oriented and competency-oriented catalogs differ or complement each other, (2) importance and role of scientific societies in the establishment of CLO and (3) individual and structural barriers to using CLO in curricular development with a focus on support and resources.

The second working session began with reports on the status quo and the experiences made so far in implementing their CLO in curricula from five working groups (WG) of the GMDS and the SMITH - Joint Expertise Center for Teaching (SMITH-JET), all of them considered with CLO development and dissemination in Germany: The *WG Medical Informatics Education in Medicine* focuses on competences of medical informatics for medical students, which resulted in a CLO in 2020 [8]. The *WG Teaching and Didactics of Biometry* developed a CLO for teaching biostatistics in medicine in the years 2020-2021 [2]. The *WG Teaching in Epidemiology* published a CLO in 2018 to facilitate planning and implementation of courses in epidemiology [2]. The *WG Nursing*

Informatics published recommendations for core competence fields in nursing informatics in 2017 for use at all levels of educational measures in nursing [2]. The *WG Curricula for Medical Informatics* published a CLO for bachelor programs in (bio-)medical informatics and medical information management in 2021 [2] based on the IMIA Recommendations 2010 [6]. Within the SMITH project of the German Medical Informatics Initiative (MI-I [9]), three master degree programs were developed based on the IMIA Recommendations 2010 [6], the NKLM-MI [8] and the BMHI learning objectives catalog [10] developed by SMITH-JET.

This second working session was carried out technically like the first, but aimed at the development of recommendations for the effective transfer of CLO using the following topics: (1) requirements for the structure, scope and content of CLO with regard to their usability for the development of curricula, (2) recommendations on the role of the scientific societies when establishing CLO and (3) incentives and individual or structural requirements to be created for the use of CLO in curricular development.

3. Results

Identified obstacles and challenges of CLO use in curricular development:

- Differences of knowledge-oriented and competency-oriented catalogs.
 - (1) Both approaches complement each other usefully. (2) Competency-based catalogs are more difficult to use for the development of specific training programs if the addressed range of competencies is not clearly defined.
- Importance and role of scientific societies (SCS) in the establishment of CLO.
 - (1) SCS often underestimate the human and technical efforts and corresponding costs for the development, maintenance and distribution of CLO.
- Individual and structural barriers to using CLO in curricular development with a focus on support and resources.
 - (1) The limited amount of dedicated teaching hours of the medical curricula at many university sites makes it impossible to cover all aspects of a CLO. (2) There is often a lack of training courses, advisory support and suitable tools for the use of a CLO. (3) Learning objectives in existing CLO are often too abstract to be assigned to specific courses or course units. (4) Lecturers and deans of studies often are not convinced of the benefits of CLOs. (5) Regularly changing CLO creates pressure to prematurely change the curricula derived from it.

Identified recommendations for implementing CLO-oriented curriculum development

- Requirements for the structure, scope and content of CLO with regard to their usability for the development of curricula.
 - Teachers perspective: (1) CLO should be consistently divided into levels and LO should be described in a differentiated manner. (2) Competency levels should be clearly separated and competency descriptions should be clearly assigned to a competency level. (3) LO should be formulated in a way that it is possible a) to verify whether they are considered adequately in curricula or module descriptions and b) to measure their achievement. (4) CLO should be accompanied by recommendations for their application. (5) The usability of CLO would benefit from the provision of best practices resp. implementation examples and teaching materials. (6) Curricula

- should reference a CLO in a way that it is possible to compare the courses based on a CLO with regard to the spectrum of competencies they address.
- o Students perspective: (1) By entering LO in search fields, it should be possible to find corresponding course offers (also Europe-wide). (2) To achieve this, an automated assignment to the elements of a CLO should be offered when describing a degree program or a course. (3) The results of student evaluations should accompany the development of LO and their implementation in courses and curricula. The evaluation of the implementation should include assessments of the learning success.
 - o Employers perspective: (1) Employers should be able to create job advertisements based on CLO. (2) Courses should be searchable for employers using CLO-based profiles (also Europe-wide).
 - o Miscellaneous: (1) LO descriptions should be individually accessible and usable (linked open data). (2) Visual representation methods should be offered to ease understanding and implementing a CLO. (3) When developing a CLO, a pragmatic approach should be taken with only a few levels of verb-driven competencies.
- Recommendations on the role of the scientific societies (SCS) when establishing CLO.

(1) SCS should be aware of their responsibility for providing CLO and actively support their development, maintenance and quality assurance as well as promote their use through suitable, in particular communicative, measures. (2) For this purpose, fixed contact persons should be determined to whom the organization of regular maintenance and support of the CLO is delegated over time. (3) For the development and maintenance of CLO as well as the provision of suitable tools for their maintenance, dissemination and application, the provision of sufficient human, technical, and financial resources by the SCS is necessary. (4) The SCS must decide whether the CLO should be normative, recommendatory, or descriptive in nature. (5) SCS should actively engage in community building to ensure adequate participation of the scientific community during CLO development, e.g. by commenting on CLO drafts. (6) SCS should focus on subject-related training, advanced training and further education in particular to strengthen the importance of the specialist disciplines. To this end, they should take an active part in negotiating the scope of subject-specific teaching, with reference to CLO. (7) SCS should offer or mediate advice on the use of a CLO. (8) The provision of tools for the maintenance and use of CLO should be flanked by SCS by offering training for their application.
 - Incentives and individual or structural requirements to be created for the use of CLO in curricular development.

(1) For the didactically sound implementation of CLO by teachers and program managers, training courses and advisory services should be created. (2) Further training should be focused on the range of available CLO and their application in the discipline concerned. (3) In addition, suitable tools for the CLO-based development of curricula and modules should be provided, that allow to view and search the CLO and map the learning objectives or competencies to modules. Corresponding developments, e.g. the German MI-I [9] should be considered. (4) These tools should also be easy to use and time-efficient. In this respect, they should be regularly evaluated. (5) For efficient and effective use of the tools, appropriate training courses should be provided for teachers and

program managers. (6) Tools such as act-e [7] should primarily be used in the (re-)design of curricula. To avoid rejection of CLO and tool support, their use for monitoring teaching should not be the main focus. (7) It should be invested in measures to increase acceptance that make the effort and benefits of using a CLO and the supporting tools transparent (e.g. by providing best case studies).

4. Discussion

The recommendations developed, while generally not specific to health care, focus on the current development of CLO in this field. That country-specific strategies are particularly needed for effective dissemination of CLO in curriculum development is highlighted in, for example, [3] and [11]. The recommendations developed are based on individual experiences of a limited number of experts, which we gathered in a workshop. In order to gain further insights into the application of CLOs, problems that arise and possible solutions, further empirical research is needed based on techniques like modified RAND or Delphi. This is all the more important as CLO play an increasingly important role - whether as part of legal regulations e.g. in the education of physicians, or in the context of accreditation of educational programs by international scientific societies like EFMI and IMIA. The international perspective is especially important in Europe in order to achieve a Europe-wide comparability of educational programs. For CLO, this means that a simple translation of national CLO is not sufficient, but that semantic references to internationally agreed CLO must be established. This challenge must be met by national and international scientific societies.

References

- [1] High Level Group on the Modernisation of Higher Education: report to the European Commission on improving the quality of teaching and learning in Europe's higher education institutions, Publications Office, 2014, <https://data.europa.eu/doi/10.2766/42468>
- [2] GMDS. Lernziel- und Kompetenzkataloge der GMDS [Internet]. GMDS e. V. [cited 2023 Jan 2]. Available from: <https://www.gmds.de/aktivitaeten/fachbereichsuebergreifend/lzk-curricula/>
- [3] Bichel-Findlay J., Koch S., Mantas J, et al. Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics: Second Revision, *Int. J. Med. Inform.*, Volume 170, 2023, 104908, ISCSN 1386-5056, <https://doi.org/10.1016/j.ijmedinf.2022.104908>.
- [4] Lammerding-Koeppel M, Fritze O, Giesler M, et al. Benchmarking for research-related competencies – a curricular mapping approach at medical faculties in Germany. *Medical Teacher*. 2018;40(2):164–73.
- [5] Loughlin C, Lygo-Baker S, Lindberg-Sand Å. Reclaiming constructive alignment. *European Journal of Higher Education*. 3. April 2021;11(2):119–36.
- [6] Mantas J, Ammenwerth E, Demiris G, et al. Recommendations of the International Medical Informatics Association (IMIA) on Education in Biomedical and Health Informatics. First Revision. *Methods Inf Med*. 7. January 2010;49(2):105–20.
- [7] Teaching & Learning Centre (TLC) of the Amsterdam UMC (location AMC). act-E [Internet]. act-E | Unravel your curriculum. [cited 2022 Dec 3]. Available from: <https://www.act-e.nl/>
- [8] Varghese J, Röhrig R, Dugas M. Which competencies in medical informatics are required by physicians? An update of the catalog of learning objectives for medical students. *GMS MedInform Biom Epidemiol*. 2020;16(1):Doc02. DOI:10.3205/mibe000205
- [9] SMITH [Internet]. Smith.care. [cited 2022 Nov 30]. Available from: <https://www.smith.care/>
- [10] BMHI learning objective catalogue, Version 5. Available from: <https://lern-z.imib.rwth-aachen.de/hilona/index.php/BMHI-Version-5>
- [11] Jaspers MW, Mantas J, Borycki E, Hasman A. IMIA accreditation of biomedical and health informatics education: current state and future directions, *Yearbook in Medical Informatics* 26 (1) (2017) 252–256. <https://doi.org/10.15265/IY-2017-011>.