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Original article

Ebm@school – a curriculum of critical health literacy for secondary school students: results of a pilot study

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Abstract

Objectives: Increasingly, patients and consumers are taking responsibility for their diagnostic and therapeutic decisions. This requires a certain amount of health literacy in order to critically assess the various procedures and products. The aim of this study was to develop and pilot test a curriculum of critical health literacy for secondary school students.

Methods: The curriculum is based on the concept of evidence-based medicine and consists of six modules. Development and pilot testing was performed with two classes of secondary school students (n = 45) in Grade 11. The Metaplan method was used to document feedback regarding teaching methods, worksheets, satisfaction and individually perceived benefits. Additionally, systematic observations by researchers were documented and students' presentations assessed. A sample of untrained students (n = 218) served as a control group. The Critical Health Competency Test was employed for evaluating competencies in critical health literacy. Data were analyzed qualitatively and person parameters were calculated.

Results: Overall, the pilot courses were well-accepted and have been proven to be feasible. Students' feedback guided revision of the curriculum. Trained students achieved significantly higher person parameters (± SD) than the control group: 597 (± 79) versus 483 (± 94), $p < 0.01$, indicating enhancement of critical health competencies.

Conclusion: Teaching critical health literacy to secondary school students is feasible and is likely to enhance the competence of critical health literacy. Further studies are needed to show the effectiveness of the intervention.

Keywords: **Evidence-based medicine – Curriculum – Education – Health education – Health literacy – School.**

Introduction

It is becoming more common for patients and consumers to take responsibility for their diagnostic and therapeutic decisions. Much effort goes into the dissemination of drug advertisements, media reports and patient information. However, informed decision making requires a level of critical health literacy that allows the patient/consumer to assess the various procedures and products.

The concept of health literacy was first defined in 1974 in the USA as "The degree, to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions."[1]

The extended definition underlying the World Health Organization's (WHO) healthy schools initiative characterizes the concept in the following manner: "Health literacy represents the cognitive and social skills, which determine the motivation and ability of individuals to gain access to understand and use information in ways which promote and maintain good health".[2,3] However, the WHO approach aims at compliance towards predefined objectives instead of informed choices and therefore remains paternalistic. This means that the person's own values or power to make decisions that directly affect them are not adequately addressed.

Evidence based medicine (EBM) may enhance consumers' autonomy regarding health, since it enables decisions, based on evidence and not only on experts' experiences and opinions.[4] Competencies originating from this new concept are referred to as critical health literacy.

A growing body of literature documents the problems people have in understanding health information, and especially risk information.[5–10] The target group addressed in the study (secondary school students in Grade 11) is particularly challenged, as they have just started to independently decide on health is-

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sues. Promoting health literacy, however, is regarded as a global challenge.[11] The National Academies in the USA demand the implementation of health literacy into the curricula of schools and kindergartens.[12] Nevertheless, existing projects from the World Health Organization, which have been implemented into schools across Europe and the United States are still based on the paternalistic paradigm and do not aim for critical health literacy.[2,3]

In the last decade, EBM has emerged as the dominant paradigm for medical decision making. Curricula that aim to achieve these competencies are already well known among medical doctors as well as other medical professionals. On the other hand, curricula designed to engage laypeople remain poorly developed. Individual projects in the USA and Great Britain have trained patients and advocates in critical health literacy.[13,14]

The ebm@school curriculum is internationally unique. The aim of this study was to develop and pilot test the feasibility of this novel approach for secondary school students between the ages of 16–18 in Grade 11.

Methods

The development and pre-testing of this curriculum covered two pre-defined phases. Therefore, the methods consist of two parts: curriculum development and pilot courses.

Part I: Curriculum development

Previous work: Published curricula on EBM[15,16] have targeted participants with academic training. In our own research we have focused on EBM curricula for different non-academic target groups. We have developed curricula for nurses,[17] diabetes educators (nurses and dietitians),[18] and consumers and patient representatives.[19] We have tested various course formats depending on baseline knowledge of the target groups. With diabetes educators with no prior knowledge in EBM we have pilot tested one to three day courses to introduce EBM and its principles. Five courses with a total of 121 diabetes educators have been carried out and evaluated. The majority of diabetes educators evaluated the course as important or very important and useful for their work, although participants felt that the course formats were too short.[18] For consumer and patient representatives we have performed five-day courses.[19] In summary, courses that address non-academic target groups are feasible to enhance competencies in critical health literacy. Consumer and patient representatives can achieve results comparable to university students. Based on these findings, we were encouraged to address secondary school students.

Box 1. Klafki's five questions on contents in curriculum development.[20]

1. What wider or general sense or reality do these contents exemplify and open up for the learner? What basic phenomenon or fundamental principle, what law, criterion, problem, method, technique or attitude can be grasped by dealing with this content as "examples"?
2. What significance does the content in question or the experience, knowledge, ability or skill to be acquired through this topic already possess in the minds of the children in my class? What significance should it have from a pedagogical point of view?
3. What constitutes the topic's significance for the children's future?
4. How is the content structured (which has been placed into a specifically pedagogical perspective by questions 1, 2 and 3)?
5. What are the special cases, phenomena, situations, experiments, persons, elements of aesthetic experience, and so forth, in terms of which the structure of the content in question can become interesting, stimulating, approachable, conceivable, or vivid for children of the stage of development of this class?

Didactic analysis

As a theoretical model, we used Klafki's five questions (box 1), which promote systematic reflection regarding aims and intentions of instruction as a prerequisite for the development process of the curriculum.[20] The modeling of the curriculum described in the following sections was performed according to these questions.

Preconditions of the target group (Klafki's second question)

The curriculum addresses secondary school students in Grade 11, who are between the ages of 16 and 18. Germany has four main types of secondary schools (Gymnasium, Gesamtschule (comprehensive school), Realschule and Hauptschule (lower secondary school)). Gymnasium and Gesamtschule offer a sixth form, leading up to the Abitur, a university entrance examination and diploma. Students, who finish Realschule, also have the option of continuing to the sixth form. Furthermore, vocational training schools also offer a Fachgymnasium, which offers different specializations e.g economics or health. Compulsory school attendance varies between 9 and 12 years de-

Table 1. Objectives of the modules.

Modules	Objectives
Module 1: Fallacies and misinterpretations of data representation: observational studies versus randomized controlled trials (RCT) – What are the differences?	(1) to differentiate between expert based and evidence based information, (2) to know misleading representation of health related information and consequences, (3) to know the fallacies of medical / health issues, (4) to be able to reconstruct study designs to generate evidence regarding the effectiveness of interventions, (5) to be able to define methodological and statistical terms, (6) to differentiate between absolute and relative risk reduction, (7) to calculate risk reductions.
Module 2: Critical appraisal of RCT's	(1) to acquire original articles (in German language) and scientific vocabulary, (2) to be able to define incidence, prevalence, bias, confounder, relative risk, absolute risk, p-value, confidence interval, correlation, odds, (3) to know the difference between surrogate parameters and patient relevant outcomes, (4) to know different examples of framing of data, (5) to understand relative risk reduction (RRR), absolute risk reduction (ARR) and number needed to treat (NNT), (6) to be able to formulate questions used in medical practices and information offices, (7) to know ethical criteria for clinical research.
Module 3: Informed choice in diagnostic tests	(1) to know possible test results (positive / false-positive; negative / false negative), (2) to be able to explain quality criteria of diagnostic tests (sensitivity, specificity, positive and negative predictive values), (3) to know the influence of prevalence on predictive values, (4) to be able to define precision and accuracy of diagnostic tests, (5) to be able to formulate questions used in medical practices and information offices (6) to know the ethical aspects of screening (7) to get to know benefit and lack of benefit and harm of screening, (8) to know about the framing of data in information on diagnostic tests.
Module 4: Understanding systematic reviews	(1) to know the methods and aims of systematic reviews, (2) to learn how to access systematic reviews, (3) to know criteria for analyzing systematic reviews.
Module 5: Searching the Internet and databases	(1) to search the internet and the MedPilot database, (2) to know and apply operators (AND, OR, NOT, NEAR), (3) to know and be able to apply limits, truncations, thesaurus and free text, (4) to draft a research question.
Module 6: Appraising Patient Information	(1) to know criteria for EBM information, (2) to be able to critically appraise patient information, (3) to know where to get EBM information, (4) to be able to differentiate between primary and secondary literature, (5) to learn where to access secondary literature, (6) to know about the benefit and limits of quality codes

pending on the regulations of the federal states. Legal regulations in Hamburg and Schleswig-Holstein require 9 years.[21,22] The proportion of students with migration background averages 16 % with a wide range of 1 % to 91 % between schools.[23] With regards to health promotion, the target group is mainly addressed by the Federal Center for Health Education, which is a specialist authority within the Federal Ministry of Health [BZgA]. The Federal Center for Health Education provides material on health subjects for teachers. The paradigm shift in medicine and health sciences from paternalism to participation has not yet been considered. Teachers who work in the general education system are not educated in health sciences.[24]
Since Germany has a federal structure comprising 16 federal states, curricula vary from state to state, as well as from school type to school type, but they all contain elements of health promotion.

Preconditions of the school as institution (Klafki's second question)
Schools need early planning of courses. The curriculum could be integrated as a week-long project, as well as sequences taught over a longer period of time. Most schools are well equipped with computers, internet, and media. However, access can be limited. Supplemental material is provided by the research project (workbook, flipchart paper, Metaplan, a card technique system for collecting ideas when a group is working together,[25] dictionaries, etc.).

Relevance of the subject for the target group (Klafki's third question)
Grade 11 students are increasingly taking responsibility for different kinds of health care issues. They use information centers and visit medical practices on their own. Furthermore, this target group is addressed by different campaigns for active marketing measures in regards to so-called "disease mongering", which describes a perceived attempt by pharmaceutical companies to promote public awareness of relatively minor conditions or diseases with the aim of increasing sales of medication.[5] Competencies to make informed choices are missing.
The overall objective of the curriculum is to enhance critical health literacy, which implies the recognition of the benefit of

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Table 2. Health topics of interest and perceived health risks of students (n = 138).

Health topics of interest	Entries (n = number of students)	Perceived health risks	Entries (n = number of students)
Diseases	62 (n = 32)	Environmental stress	93 (n = 72)
Nutrition	31 (n = 30)	Smoking	72 (n = 72)
Therapy and diagnosis	27 (n = 23)	Nutrition	53 (n = 53)
Drugs	20 (n = 17)	Alcohol	52 (n = 52)
Anatomy / Physiology	31 (n = 17)	Drugs	33 (n = 33)
Sports and Fitness	20 (n = 16)	Stress	30 (n = 27)
Prevention	12 (n = 12)	Lack of sport	18 (n = 18)
Risks	9 (n = 9)	Infectious diseases	18 (n = 13)
Medical fields	11 (n = 9)	Accidents	6 (n = 6)
Accidents / injuries in sports	6 (n = 5)	Deficits in health care	2 (n = 2)
Naturopathy	6 (n = 5)		
Genetic engineering	6 (n = 4)		
Sexuality	3 (n = 3)		
Health politics	3 (n = 2)		

independent acquisition and critical appraisal of information. This competence enables students to deal with multifaceted questions and to reflect chances and limitations of research in health sciences and medicine. The objectives of the single modules are shown in table 1.

Topics and complexity of the curriculum (Klafki's first and fourth question)

In a pre-study, we surveyed students' fields of interests in order to select relevant topics for the modules. Between September and October 2005, grade 11 students in Hamburg were asked to participate in our survey. Students were asked to state health topics of interest, as well as the perceived health risks. Data were surveyed using a questionnaire (print or online version). A total of 160 students were approached and 138 (86 %) returned a completed questionnaire. These students were not included in the pilot courses. Table 2 shows the expressed interests and perceived risks. Categorization of answers was based on 649 individual entries.

Results did not clearly indicate specific topics of interest, but rather reflected the content of existing curricula. We referred to the most frequently named fields of interest. The selection of the topics was also influenced by the didactic analysis. The topics had to be suitable to be used as examples in Klafki's sense. We selected vitamin substitution and smoking (covering nutrition, therapy and smoking), depression screening (covering diagnosis and prevention) and diagnosis in sports injuries (covering diagnosis, sports and fitness and injuries in sports).

The six modules comprise 22 lessons. All students received a workbook containing the six modules and corresponding worksheets, original publications and a glossary, with a total of 167 pages.

Consideration of teaching methods (Klafki's fifth question)

Pertaining to different teaching methods, the curriculum provides a wide range: lecture with discussion, brainstorming, class discussion, small group discussion, worksheets, flip charts, posters, overhead transparencies, Metaplan[25] and computer projections. The selection of a particular method was dependent on the defined aims for every single step of the curriculum and is documented in the workbook.

Additionally, part of the curriculum was developed to be taught using the project method, which is an educational enterprise in which children solve a practical problem over a period of several days or weeks. The projects were planned and executed by the students working independently in groups. Project work focuses on the application, rather than the imparting, of specific knowledge or skills and on improving student involvement and motivation, in order to foster independent thinking, self-confidence, and social responsibility.[26] Students in the pilot courses applied their knowledge and skills by critically appraising topics, such as information on Vitamin A (betacarotin) substitution for smokers and the efficacy of a probiotic drinking yogurt within the project lessons.

This part of the curriculum comprises 10–12 lessons.

Part II: Pilot courses

Two pilot courses in two different classes were planned to test the feasibility of the curriculum. In each pilot course, the entire curriculum was delivered. The study constitutes a phase 3 trial according to the "continuum of increasing evidence", which suggests five phases for developing and evaluating complex interventions.[27] Whereas in phase 1 relevant theories have to be explored, in phase 2 (the modeling phase) the components of the intervention are identified. Phase 3 consists of

	with competence training (n=37)	without competence training (n=218)
Mean age in years (±SD)	17.6 (±0.1)	17.4 (±0.1)
Female (%)	20 (56)	138 (64)
First language German (%)	28 (78)	182 (84)

Table 3. Characteristics of students.

exploratory trials, testing the acceptability and feasibility and preparation of randomized controlled trials (RCT's), which are essential to generate evidence on efficacy of interventions. Finally RCT's are conducted (phase 4) before long term implementation is recommended (phase 5).[27]

The curriculum was tested regarding the degree of difficulty, the complexity of each module and the acceptance by students and teachers. We compared pilot courses after training to untrained comparison classes, which were given regular lessons by the school teachers. This may help to specify further study hypotheses. Furthermore, the study aimed at exploring general conditions in schools to prepare a randomized controlled trial. Both pilot courses were carried out by AS and CH.

Sample: Parallel to the development of this curriculum, we also developed an instrument for assessing critical health competencies (CHC Test).[28] While preparing these studies, we built a network of 10 participating schools. Diversity of participating classes was the intention with regard to the mixture of students and pre-conditions of learning and proficiency level. From within this pool, two schools were selected, which fulfilled these criteria and offered their planned project weeks in April (1st pilot course n=20; Fachgymnasium) and June 2006 (2nd pilot course n=25; Gesamtschule). For the control classes, we selected all parallel classes from the pilot courses (n=4) and also additional classes (n=6) from the same pool of cooperating schools, resulting in a sample of 263 students.

Data collection, measures and analysis: Sample characteristics age, sex, first language, type of school and participation in training were surveyed using a questionnaire. Oral and written feedback was surveyed regarding teaching methods and worksheets of the first pilot course. Teaching methods and all of the material were revised for the second pilot course. Feedback related to the teaching methods and worksheets of the second pilot course was evaluated along the lines of the first pilot course.

Individually perceived benefits were surveyed by using Metaplan[25] and by asking students what benefit they believed they would take home from this course.

In addition, one of the researchers (CH or AS) systematically observed the lessons, according to a pre-structured sheet to document teachers' behavior towards students, students' reactions towards questions, worksheets, overhead transparencies, and power point presentations. Observations were documented in a workbook.

The Critical Health Competence Test (CHC Test)[28] was used to measure critical health competencies in trained and untrained students. All students who were present the day the tests were administered to the classes were tested (1st pilot course n=16; 2nd pilot course n=21). At that time, the instrument was still under development and testing within the first field test would have required 180 minutes for pre- and post test, which was disproportionate for a five-day pilot course. Therefore, the sample of untrained students (n=218) acted as control group. The test comprised 72 items embedded in four different scenarios. The test had to be completed within 90 minutes at the end of the course or at the end of the week, respectively. Results of the students' projects were also taken into account by assessing the research questions, their search procedures for literature, their critical appraisal, the reflections of results, and also the performance of the presentation. Within the project lessons, students will prepare a presentation of the topic they chose to work on. The assessment of the presentation was based largely on content.

Data analysis contains qualitative analyses of students' feedback and researchers' systematic observations. Feedback was gathered and sorted according to predefined categories: teaching methods, the degree of difficulty of the worksheets and complexity of modules. Every single feedback was thoroughly checked. Additionally, as part of the concept, the instruction was interrupted and replaced by a meta-level, to explore problems that were identified by the researchers. Students were involved in the discussion to help to understand the underlying problems and also in the decision on solutions. Revision was guided by these results as well as the systematic observations.

Person parameters were calculated from the CHC Test using WINMIRA 2001.[29] Differences of means of person parameters were compared by calculating impaired t-test with SPSS 15.0.[30]

Results

Sample characteristics are shown in table 3.

Descriptive results on students' and researchers' perception of the pilot courses are given in detail below.

Results according to teaching methods of the first pilot course led to the modification and/or specification of questions in the curriculum. The documentation of the observation of at-

tention given to individual students was discontinued after a couple of days since it worked constantly well.

Since the project phases enhanced motivation, enabled consolidation of module content and encouraged application of the modules through the formulation of research questions, the project phase in the second pilot course started earlier.

Although classes were rather heterogeneous, proficiency levels within the pilot classes did not allow for original English-language articles for most of the students. In order to confront the heterogeneity, worksheets were developed for extremely under-performing as well as for the high-performing students in the second pilot course, which allows internal differentiation of learning groups (e.g. provision of German abstracts instead of original full texts in English).

The students' responses to the question "What is your personal benefit of this week?" in the second pilot course are summarized in Box 2. All students who were present that day responded.

The documentation from the supervision of the classes was used to revise the workbook, in the event that any misunderstandings occurred, if it was too difficult or if supplemental material was needed. Additionally, it was used to modify the overall procedures, e.g. sequences of subjects or modification of introductions into subjects. Workbook revision will not be reported in detail.

The success of the project phases was assessed by the presentations of the study groups, which worked on their own research question. As expected, results were heterogeneous matching the heterogeneity of the students. The overall results indicated that students were able to transfer the content of the curriculum to their own projects in terms of formulating research questions, searching for literature, performing critical appraisal and reflecting the results.

According to the results, the following changes in framework of the curriculum were made:

1. Students do not necessarily receive grades for working in projects. Furthermore, projects are often scheduled shortly before the summer holidays and therefore the importance can be decreased. Therefore, the ebm@school curriculum embedded into a project will require a grade and also a documentation of the number of times absent. This was not possible within the framework of this feasibility study, as data were surveyed anonymously.

Box 2. Individually perceived benefits surveyed in the second pilot course (n = 21).

1. The difference between relative and absolute risk reduction.
2. Relative and absolute risk reduction.
3. Clarification of misleading framing of results in mass media.
4. I learned a lot and now I can ask my doctor questions more specifically to get better answers. That might help to decide on medications.
5. New knowledge on risks and research methods in medicine.
6. Reasoning about statistics, questions to ask my doctor and knowledge on medical terms.
7. I picked up a lot of new things, which do prepare for visits to my doctor as well as to understand medical research papers. Thanks a lot.
8. A critical view on medical information; the specific reckoning of statistics.
9. Next time I go to the doctors I will listen carefully and ask questions if I do not understand.
10. Medpilot.de; the workbook
11. Critical view on statistics; I'll take the workbook with me.
12. I will ask my doctor more questions and I will look for more information on prescriptions of medicine, before I take it or do not take it. Now after this course, I know where to get this information.
13. I will read package inserts of drugs more carefully, if I want to take anything. I learned a lot during this week.
14. Better understanding of medical issues, especially research and studies.
15. I know better how to interpret studies and I can mistrust percentages. I found it interesting to get to know how studies are conducted. Now I can better understand package inserts of drugs regarding side effects.
16. I learned a lot this week. I liked the different materials we got. The workbook is very well designed, so I can refer to it at home.
17. I hate to work with computers.
18. Nothing.
19. Nothing.

2. The decision to begin the project phases at the very beginning requires that the module "Searching the Internet and Databases" be addressed earlier. Furthermore, project learning will require access to the internet during the week, which can be solved by laptops with wireless LAN.
3. Teachers will be integrated into the phases of project learning, in order to become familiar with the curriculum and to enhance the further implementation of the curriculum.

As for the quantitative analysis, trained students (n=37) achieved higher mean person parameters (±SD) of 597 (±79) compared to untrained students in the control group (n=218) achieving 483 (±94), $p < 0.01$. This comparison does not allow statements on efficacy, but is helpful in estimating the expected effects in further prospective controlled studies. The hypothesis that the curriculum for Grade 11 students will enhance the competence critical health literacy was generated.

Discussion

We developed and tested a curriculum for secondary school students in Grade 11. The curriculum has been shown to be feasible and well accepted within the target group. Students convincingly specified their perceived personal benefit. Furthermore, quantitative results support the hypothesis that the implementation of the curriculum will increase the competence of critical health literacy.

Limitations exist in the small number of pilot courses. The fact that the curriculum changed in response to the feedback from the first pilot course also represents a limitation in the interpretation of the grouped evaluation data.

There are also important strengths to the study. Pilot courses were conducted in secondary schools with students who, in comparison to the gymnasium, where rather under-performing. Furthermore, conditions for the second pilot course were rather difficult, since there were no more lessons before summer holidays for the parallel classes, which therefore lead to lower motivation. Nevertheless, results show that the curriculum is feasible even under such difficult conditions. In addition, it is the first study in the field of health education that measured competencies as an outcome measure. Within further studies to confirm effectiveness, an increase of 100 in mean person parameters would be regarded as a relevant difference. Dickersin et al. initiated structured courses in clinical epidemiology that addressed breast cancer activists (non-experts) and achieved an increase in critical appraisal skills, knowledge and confidence.[13] Brodies' initiative addressed common people through mass media,[31] since mass media are Americans' primary source of health information. However, the initiative focused on health information in general, rather than evidence based information specifically, which might be even more difficult to present. Results showed an increase in knowledge post-intervention, but the effect did not last.[31] Recently, a rather interesting approach was made by Woloshin et al. who developed an educational booklet to teach the skills needed to understand risk.[32] Results showed effectiveness of the primer.[32] These different approaches can complement one another.

Educational interventions could also harm by leading to disillusion. In a follow-up study (still unpublished) we have addressed students again. Within the first year after the pilot courses we have asked them to participate in a study to explore potential harms of the curriculum. There was no indication of harm. These results correspond to the findings of Kasper et al.[33] who tested understanding and perception of evidence based information about treatment of multiple sclerosis. No adverse emotional responses could be shown, although study participants understood the risk information.[33]

Conclusion

Initiatives to improve critical health literacy, the prerequisite for informed decision making, should start with young people.

Teaching critical health literacy to secondary school students is feasible and may enhance the competence of critical health literacy. Randomized controlled trials are needed to confirm effectiveness before phase 5 implementation studies can be conducted. Furthermore, research is needed to explore the effects on decisions in health care.

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