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Relevance of Social Medicine Skills and the Role of Teaching Formats in the Perception of Medical Students: A Retrospective Trend Study

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Abstract

During medical school, students in Germany acquire knowledge, abilities, competencies, and skills in social medicine. The aim of this study was to investigate how human medicine students perceive the relevance of selected social medical issues and their knowledge gain depending on different teaching formats. The study was designed as a retrospective trend study. Included were four semester cohorts (n = 597 students). Five topics were selected as seminar subjects: work incapacity, rehabilitation, (long-term) care level, graded return to work, and assistive technology for activities of daily living. A new teaching format based on problem-based learning (PBL) and peer teaching (PT) was implemented. In the seminars, each student worked on one topic by him/herself (PBL; for this topic, the student is counted within group PBL in the statistical analysis). Through the presentations of fellow students, a student received information regarding other topics (PT; for these topics, the student is counted within group PT in the statistical comparison with group PBL). 550 students completed a standardized questionnaire at the end of the seminar, rating (a) their perceived relevance of these social medical topics with regard to clinical practice and (b) the personal knowledge gain regarding all topics. The results in group PBL tended to be better than those in group PT, indicating that active engagement with socio-medical topics increases the perception of their relevance. The students benefit more from working on topics themselves than from oral presentations or lectures: the probability of stating a notable knowledge gain regarding the respective topic was significantly higher for all topics in group PBL compared with in group PT (Work incapacity: OR: 1.3 (95%-CI: 1.07; 1.58), Rehabilitation: OR 1.8 (95%-CI: 1.41; 2.20), (Long-term) care level: OR: 1.6 (95%-CI: 1.25; 1.94); Graded return to work: OR: 1.95 (95%-CI: 1.57; 2.42), Assistive technology for activities of daily living: OR: 1.8 (95%-CI: 1.45; 2.31)). Medical students can be sensitized to the clinical relevance of social medicine, particularly when they experience its practical implications via appropriate activating teaching formats. The results suggest that PBL formats are preferable for increasing awareness of socio-medical issues.

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Keywords: social medical skills; student's perspective; problem-based learning; peer teaching; work incapacity; rehabilitation; long-term care level; graded return to work; assistive technology for activities of daily living

1. Introduction

1.1. The Role of Social Medicine

Social medicine is concerned with people's social environment. The central question in this context is what role the social environment plays in the development, prevention, and treatment of diseases. Accordingly, social medicine is less concerned with individuals than with groups of people or entire populations. Like all medical disciplines, its goal is to contribute to the protection, preservation, improvement, and restoration of the health of the population (Holtz et al., 2006; Bhugra, 2006; Worringen et al., 2016; Graf et al., 2025). The increasing social and health inequalities underscore the necessity of this discipline (Bhugra, 2006; Stonington & Holmes, 2006). Physicians treat a patient in the individual context that influences the etiopathogenesis and course of a disease (Ortega et al., 2023). In clinical and in outpatient medical care, socio-medical competence can counteract the negative influencing factors from the social environment, deficits in communication and in the coordination of the health care system, which affect the health status of patients (Simoes et al., 2016), e.g., in the field of women's health (Simoes et al., 2015; Prakash, 2005). In practice, the need for such competence arises from the requirements of social law. In the context of the German health care system, physicians' responsibilities include, among others, identifying work incapacity status (e.g., in patients with acute illnesses), rehabilitation needs (e.g., after accidents), long-term care (LTC), graded return to work (e.g., in cancer survivors), and provision of assistive devices to support activities of daily living (ADL) (e.g., walkers or wheelchairs) and providing appropriate care to patients (Ortega et al., 2023; Schliehe, 2005; van Muijen et al., 2015; Baumann et al., 2001).

1.2. Social Medicine in Teaching

Since physicians are supposed to contribute to reducing health inequalities through their practical work, they need basic knowledge and competencies in social medicine. They should gain such knowledge and skills during their studies (Vanderbilt et al., 2016) as the WHO explicitly demands (World Health Organization, 2010). When in 2003 the new catalog of learning objectives in the socio-medical sciences for the German Medical Licensing Regulations came into force, parts of social medicine became independent subjects (Brennecke et al., 2006). The importance of socio-medical competencies was further emphasized during the development of the German National Competence-Based Catalogues of Learning Objectives in Medicine (NKLM) (Medizinischer Fakultätentag der Bundesrepublik Deutschland e. V., 2015), published as NKLM 2.0 (Medizinischer Fakultätentag der Bundesrepublik Deutschland e. V., 2021). The relevance of socio-medical competencies is also evident in the "CanMEDS model", which assigns the role of "health advocate" to the physician (among others) (Frank, 2005). To meet these increased requirements and to provide students with targeted social medical knowledge and skills, a new teaching format was developed and implemented in 2013 by the Institute of Occupational and Social Medicine and Health Services Research at the Medical Faculty in Tübingen (Hildenbrand et al., 2014; Völter-Mahlknecht et al., 2014). By further developing the socio-medical teaching program at the institute (Simoes et al., 2012), the new seminar format was based on the teaching technique of problem-based learning (PBL) combined with peer teaching (PT). PBL is an instructional approach that has been used in multiple disciplines for over 50 years (Savery, 2015). It

is a form of teaching/learning in which learners are expected to independently develop solutions to a given complex problem. The focus is on self-directed learning, which can be based on case studies. Learners are expected to analyze the topic, ideally find material themselves, and come up with a solution. PBL aims to engage students in active learning and increase the perceived relevance of what they learn (Woodward, 1996). PT is a learning format in which students learn facts themselves and teach this expert knowledge to their fellow students. What makes it special is that the students are both learners and teachers. Davari et al. (2021) showed that in the field of theoretical surgery, students who were taught using PBL performed significantly better in a multiple-choice test taken two weeks after the lesson than students who were taught using lecture-based learning. The authors also state that PBL is more interesting and motivating for most students.

Studies dealing with teaching social medical skills in medical school are still very rare. Some studies focus on the content, others special teaching formats (Siegel et al., 2018; Dharamsi et al., 2011; Doobay-Persaud et al., 2019; Hoffman et al., 2016; Westerhaus et al., 2015). Studies addressing the evaluation of learning outcomes and the perception of the subject's relevance are especially rare in the area of social medical skills (Symons et al., 2009; Long-Bellil et al., 2011; Goyal et al., 2021; Muschalla et al., 2022).

1.3. Aims

The aim of the study was to investigate how human medicine students perceive the relevance of selected social medical topics and to assess their theoretical and practical knowledge gain depending on different teaching formats and the change in their attitude towards social medical issues. Group-specific effects concerning the teaching methods' impact on knowledge gain and problem awareness were subjects of interest. Another focus of interest was whether targeting the awareness towards defined socio-medical issues increases their relevance rated from the students' perspective. The present analysis is part of a larger collaborative study initiated by some of the authors in Tübingen and conducted jointly with the Institute of Social Medicine, Occupational Health and Public Health, University of Leipzig. Comparative results will be the subject of a subsequent publication. The study was based on the following research assumptions:

1. In all subject areas, social medicine teaching leads to a self-assessed increase in knowledge.
2. PBL is superior to PT in terms of student competence growth.

2. Materials and Methods

2.1. Study Design

The study was designed as a retrospective trend study. The evaluation results of four semester cohorts of tenth-semester medical students at the University of Tübingen were analyzed. Overall, the study was conducted in four consecutive semester cohorts over a period of two years, as the study duration was designed to achieve a cohort size of at least $n = 90$ per topic. In Tübingen, approximately 180 students in their 10th semester complete the course each semester, and a questionnaire response rate of 60% was expected, which explains the selection of four semester cohorts.

Trend studies (also called replicative surveys) represent the third subtype of longitudinal analyses (in addition to cohort and panel studies). In a trend study, data is sampled from different groups of persons at different points in time, but the individuals find themselves in the same situation and belong to the same population. These studies are also used increasingly in evaluating teaching and examination formats in medical curricula (Graf et al., 2017). In each semester, the seminar was conducted with five subgroups of students from the respective semester cohort, separately. According to the guidelines

of the responsible ethics committee, no ethics proposal had to be submitted, since only students and no patients were interviewed, and all of the surveyed data would be analyzed anonymously (information provided by the Ethics Committee at the University Hospital and Medical Faculty of Tübingen—project number 697/2014VF).

2.2. Characteristics of the Teaching Format

A new teaching format that combined methods of PBL and PT was developed for a detailed seminar on social medicine topics (Hildenbrand et al., 2014; Völter-Mahlknecht et al., 2014). The lecturers selected five practically important social medicine topics and designed the seminar with the aim of providing relevant knowledge and practical skills. The seminar lasted 2.25 h and there were always two lecturers present. One of the lecturers briefly introduced the course of the seminar. After that, the 34 students were divided into five subgroups, each working on one of the following topics with a PBL approach:

- Topic 1: work incapacity
- Topic 2: rehabilitation
- Topic 3: (long-term) care level
- Topic 4: graded return to work
- Topic 5: assistive technology for activities of daily living

This format was implemented for about 90% of the students, who participated in larger groups of 34. 10% of the students participated in smaller groups of 15. Because these groups were so small, students could only choose from these three topics for the PBL approach:

- Topic 1: work incapacity
- Topic 2: rehabilitation
- Topic 4: graded return to work

All four semester cohorts received the same topics and materials. Students could choose the topic they wanted to work on themselves, but the number of participants for each topic was limited. Working on a specific topic, first the students were provided with patient vignettes along with a task description as a learning aid. The patient vignettes were designed to illustrate the practical relevance of the specific topic. Key questions and selected literature as working aids were offered [e.g., excerpts from the underlying Social Code, guidelines, and flyers from the Joint Federal Joint Committee (G-BA, the highest decision-making body of the joint self-government of physicians, dentists, psychotherapists, hospitals, and statutory health insurers in Germany).

Based on these circumscribed information materials, the students answered the key questions in the group itself according to the PBL approach. At the end of the processing phase, groups were expected to have correctly answered the key questions and completed a reporting form on the topic. This approach should also encourage teamwork. Before presenting the group results in plenary, the teachers discussed the results with the students and reviewed them for correctness. During the final oral presentation, all groups presented their findings followed by a discussion in plenum. Thus, each student worked on one topic by him/herself (for this topic, the student is counted in group PBL in the statistical analysis). In addition, through the presentations of fellow students in a peer teaching approach (PT), he/she also received information on the other topics (for these topics, the student is counted within group PT in the statistical evaluation).

2.3. Survey

A questionnaire with 24 items was developed to evaluate students' perception of relevance of defined social medical issues and the impact of the teaching format (PBL or PT) on problem awareness, knowledge increase and practical reference regarding the five

topics. Students were first asked to indicate the seminar topic on which they had worked themselves. The further questionnaire consisted of two parts (Part I and II) which are shown in Table 1. In the last 10 min of the seminars, students were asked to voluntarily and anonymously complete the survey.

Table 1. Questionnaire on previous knowledge and learning effects and perceived relevance of the topics.

Questionnaire
Part I: Previous knowledge of the topics and their perceived theoretical and practical relevance (perspective: retrospectively: before the seminar).
Students answered the following questions in the questionnaire for each of the topics covered in the seminar (check if applicable) [(1)]
I have already heard something about the respective topic during my courses (including clinical traineeships)
I have already heard something about the respective topic outside of my studies
I have already dealt with the respective topic
Even before the seminar, I considered the respective topic to be important for medical practice
Before the seminar, I already thought that the respective topic should be dealt with
Part II: Effects on knowledge, perception of feeling well-prepared for a later practical action, and perceived relevance of the topics (perspective: after the seminar).
Students answered the following questions in the questionnaire for each of the topics covered in the seminar (5-point Likert scale) [(2)]
My knowledge on this subject has increased considerably
I feel well-prepared for a later practical action on this topic
The topic seems to me to be more important for medical practice now than before the seminar

Legend: [(1)] For each item, all topics covered in the seminar could be marked with yes. [(2)] Positively directed 5-point Likert scale from 1 = completely untrue to 5 = completely true.

2.4. Statistics

Descriptive data evaluation of all topics included percentage, median, mean, and standard deviation (SD) to describe differences regarding all topics between:

- students who worked on the topic themselves (group PBL),
- those who only listened to the fellow students' presentation (group PT).

Topic-specific mean scores of the respective items were formed to represent previous knowledge and assessments of relevance (survey part I) and the effects of the teaching format (socio-medical topics combined with PBL or PT; survey part II).

Part I was analyzed descriptively. Additionally, topic-specific box plots of the single items and statistical values of group differences in Part II can be found in Appendix A. As the requirements for ANOVA were not met, since there was no standard normal distribution, the non-parametric Mann–Whitney U test was used in Part II (differences between group PBL and group PT) to determine differences in mean scores and items. A possible normal distribution was rejected using the Shapiro–Wilk test. Three of the distributions were left-skewed (topics 1 to 3), two were right-skewed (topics 4 and 5). The respective effect sizes (ES) (formula: test size 'z'/root(n), expressed as Cohen's r) were categorized as small (<0.3), moderate (0.3–0.5), and high (>0.5). Cohen's r was used despite its non-parametric

distribution because the interpretation of effect sizes to describe group differences can be done independently of the distribution of the raw data, as it represents a standardized mean difference (Bühner & Ziegler, 2017). In addition, multinomial logistic regressions using odds ratio (OR) as effect size were calculated for the three items of part II of the questionnaire. It was investigated whether the probability of evaluating a topic as more relevant after the seminar increased following direct sensitization through personal examination of the topic in terms of content. Here, the likelihood quotient was used as the method of variable inclusion. In all analyses, p-values < 0.05 (two-tailed) were considered as statistically significant differences ($\alpha = 0.05$). Students' questionnaires with missing values were excluded from each calculation (individual items and scores). All statistical analyses were conducted using IBM SPSS Statistics (version 24), while the figures were created in MS Excel 2019.

3. Results

3.1. Response Rate and Description of Seminar Participants

Of 597 participating students in four semesters, 550 completed the questionnaire (97.0%). 19 data sets did not contain information about which topic was actively worked on by the students themselves and were therefore excluded from the data analysis. Subsequently, 531 data sets were analyzed. Seminars were conducted five times per semester: four times with five topics in larger groups and once with three topics in a smaller group of students. Across all four semesters, the mean size of the larger groups was 34 students (range of 28 to 37, SD = 3.01; total 538 students and 482 valid data sets) and the mean size of the smaller groups was 15 students (range of 13 to 18, SD = 2.22; total 59 students and 49 valid data sets), respectively. On each topic, 6–7 students worked together in a subgroup. How many students worked on which topics themselves (=PBL) is shown in Table 2.

Table 2. Number of students who worked on the respective topic as PBL.

Topic No.	PBL: *n* (% of Sample)
1. Work incapacity	119 (22.5%)
2. Rehabilitation	113 (21.3%)
3. (Long-term) care level	91 (17.1%)
4. Graded return to work	117 (22.1%)
5. Assistive technology for activities of daily living	91 (17.1%)

3.2. Part I: Previous Knowledge and Perceived Relevance of the Topics

Table 3 shows the mean scores of the self-rating of previous knowledge regarding the topics and their perceived theoretical and practical relevance from a retrospective point of view: students were asked to answer according to their situation before the seminar. Higher mean score values were found for topics 1 through 3 compared to topics 4 and 5. Detailed descriptive answers to the five items are presented in Figure 1.

Among all aspects evaluated, only a low proportion of the students had already dealt with the respective topics (approval ratings: 19.8% to 6.0%), whereas a high percentage had already "heard something" during or outside of their studies (topic-specific approval ratings 77.9% to 39.9%). In addition, a high percentage of students considered the topics to be "important for medical practice" or worth "being dealt with" during their studies (topic-specific approval ratings 85.6% to 38.6%).

Table 3. Previous knowledge about the topics and their perceived theoretical and practical relevance (perspective: before the seminar) (mean score values); $n = 531$.

Topic No.	Mean Score (SD); Median
1. Work incapacity	0.62 (0.48); 1
2. Rehabilitation	0.58 (0.49); 1
3. (Long-term) care level	0.51 (0.50); 1
4. Graded return to work	0.37 (0.48); 0
5. Assistive technology for activities of daily living	0.40 (0.49); 0

Legend: Mean score (1 = yes, 0 = no) of five items (part I of survey) (min 0, max 1). *Abbreviation*: SD = standard deviation; *Note*: Topics 3 and 5 were not presented in the smaller seminar group. There was no statistically significant difference between the larger seminar groups (five topics) and the smaller seminar group (three topics) with regard to response behavior ($p = 0.173$).

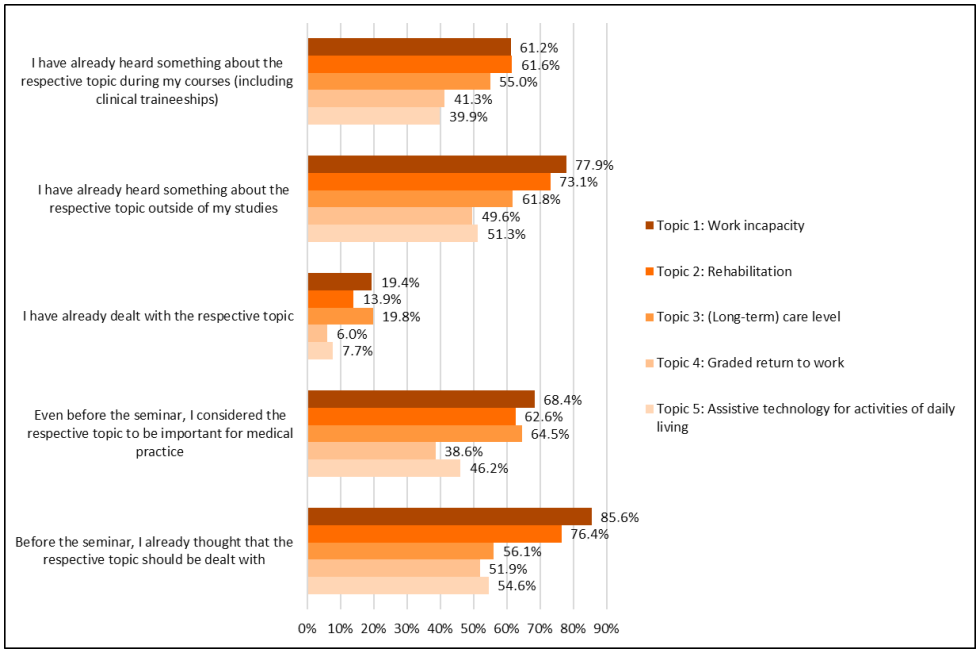

Figure 1. Previous knowledge regarding the topics and their perceived theoretical and practical relevance (retrospectively: *before* the seminar); percentages of approval of single items; $n = 530/530/531/530/530$ for topics 1–5.

3.3. Part II: Impact of the Teaching Format

3.3.1. Learning Effects Associated with the PBL Approach Regarding a Specific Topic

The learning effect mean scores of the three items assessing the five topics are presented in Table 4.

Table 4. Evaluation of the seminar content with regard to the five topics (perspective: at the end of the seminar) (mean score values).

	Means (Standard Deviations)			*n* Valid	*p* Value	Effect Size [1]
Topic	*Group PBL*	*Group PT*	*Total*			
1. Work incapacity	3.32 (1.09)	3.13 (1.07)	3.17 (1.08)	517	0.037 *	0.18
2. Rehabilitation	3.46 (1.08)	3.10 (1.00)	3.18 (1.02)	516	<0.001 *	0.35
3. (Long-term) care level	3.43 (1.25)	3.11 (1.01)	3.17 (1.07)	469	0.030 *	0.28

Table 4. *Cont.*

	Means (Standard Deviations)			*n* Valid	*p* Value	Effect Size [1]
Topic	***Group PBL***	***Group PT***	***Total***			
4. Graded return to work	3.62 (1.13)	3.09 (1.01)	3.21 (1.06)	509	<0.001 *	0.49
5. Assistive technology for activities of daily living	3.45 (1.13)	3.04 (1.02)	3.13 (1.05)	469	<0.001 *	0.36

Legend: Mean score values based on three items per topic: knowledge increase, perception of feeling well-prepared for a later practical action, and perceived relevance of the topic) (min = 0, max = 5) (1 = completely untrue; 2 = almost not true; 3 = a little true; 4 = generally true; 5 = completely true); * statistically significant at $p < 0.05$. Group PBL = students who worked on the specific topic personally and actively in a problem-based approach. Group PT = students were presented the results by their fellow students (peer teaching). [1] Mann–Whitney U test.

As Figure 2 shows, all five topic-related effect mean scores showed significant differences ($p < 0.05$) in favor of group PBL (direct personal engagement with the topic; see Figure 2), with moderate effect sizes in topic 2, topic 4, and topic 5, and small effect sizes in topic 1 and topic 3, as shown in Table 4.

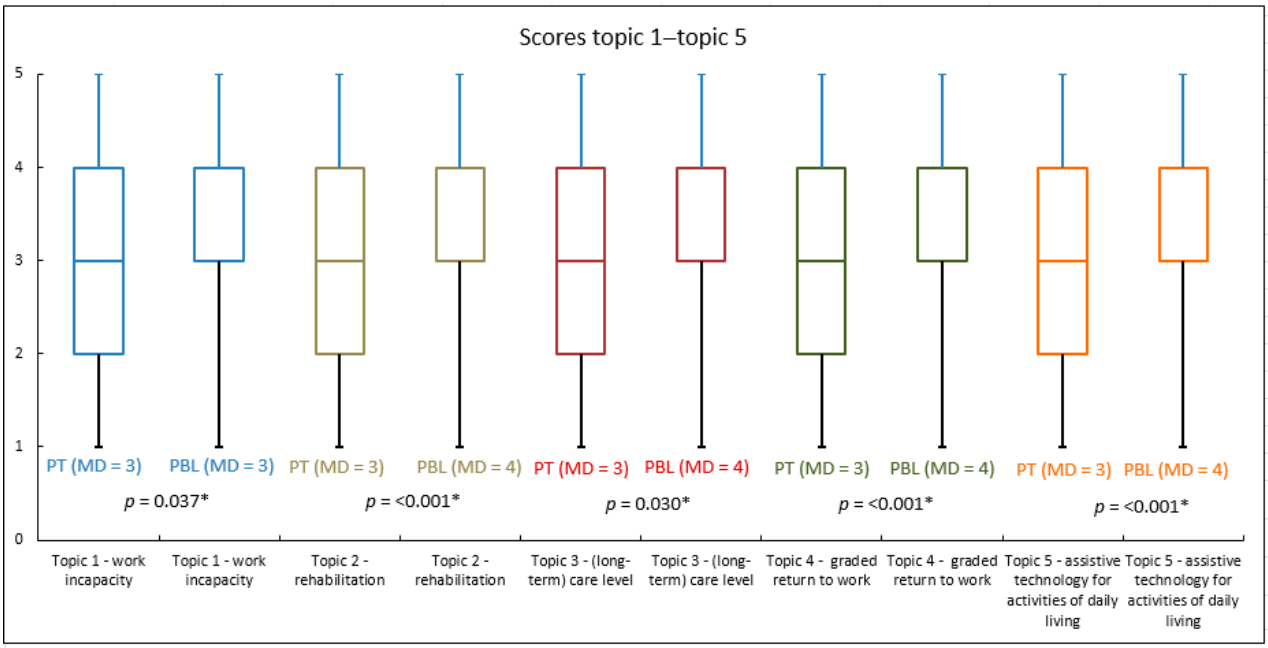

Figure 2. Boxplots and medians of mean scores measuring the effects of the teaching format (items: knowledge increase, perception of feeling well-prepared for a later practical action, and perceived relevance of the topic) by group (PT and PBL) and topic. In the figure, the results of group PT were placed first, as the lower results were expected here (students in group PT did not actively work on the respective topic). *Legend*: Abbreviations: MD = Median; * statistically significant at $p < 0.05$ (Mann–Whitney U test); inscription *y*-axis: 1 = completely untrue; 2 = almost not true; 3 = a little true; 4 = generally true; 5 = completely true; PBL = group PBL (students who worked on the topic themselves), PT = group PT (students who worked on one of the other topics, but were sensitized to the topic by the students in group PBL).

At the item level (see Appendix A Figures A1–A5), the median for all topics in all groups was in the middle or upper-middle for all three items assessing learning format effects. Especially the format with the problem-based approach showed good effects in the results of group difference analysis:

- Direct engagement with the topic (group PBL) led to significantly higher ratings of knowledge increase compared to students in group PT, who received information

on the respective topic from the presentations by participants in group PBL. The comparison of the effect of both teaching approaches resulted in a small ES in topic 1 (0.25), moderate in topic 2 (0.49) and topic 3 (0.38), and high in topic 4 (0.66) and topic 5 (0.55).

- In addition, the feeling of being well-prepared for a later practical action was significantly higher in group PBL than group PT for topics 2, 3, 4, and 5, with moderate (topic 2 = 0.33; topic 4 = 0.42; topic 5 = 0.42) or high (topics 3 = 0.54) effects.
- Significantly higher perceptions of relevance in group PBL ("the topic seems to me to be more important for the medical activity after the seminar than before") were noted for topics 2, 4, and 5, with a small ES for topic 2 (0.18) and topic 5 (0.26) and a moderate ES for topic 4 (0.40).

3.3.2. Perception of Knowledge Gain, Fitness for Medical Practice and Relevance of the Issue Depending on the Extent of Engagement with the Topic During the Seminar

For all five topics, personal, active engagement with the topic according to the PBL approach resulted on average in a higher chance (OR) of giving the highest possible ratings regarding the increase in knowledge, the subjective impression of being well-prepared for medical practice later on, and the general relevance of the topic after completion of the seminar (Table 5). This effect was not found for the items "preparation for later practical action" for topic 1 and "perceived relevance" for topics 1 and 3.

Table 5. Odds ratio for the highest rating of the items knowledge increase, preparation for medical practice, and general relevance of topics 1–5 depending on extent of engagement with the topic (reference: group PT).

Items	1. Work Incapacity			2. Rehabilitation			3. (Long-Term) Care Level			4. Graded Return to Work			5. Assistive Technology (for ADLs)		
	n	*OR*	*95%-CI*	*n*	*OR*	*95%-CI*	*n*	*OR*	*95%-CI*	*n*	*OR*	*95%-CI*	*n*	*OR*	*95%-CI*
My knowledge on this subject has increased considerably	520	1.30	[1.07; 1.58] *	520	1.76	[1.41; 2.20] *	470	1.56	[1.25; 1.94] *	510	1.95	[1.57; 2.42] *	469	1.83	[1.45; 2.31] *
I feel well-prepared for a later practical action on this topic	520	1.20	[0,98; 1.46]	519	1.48	[1.19; 1.83] *	471	1.82	[1.45; 2.30] *	511	1.55	[1.26; 1.91] *	470	1.61	[1.28; 2.01] *
The topic seems to me to be more important for medical practice now than before the seminar	517	1.12	[0.94; 1.33]	516	1.27	[1.05; 1.53] *	469	1.06	[0.88; 1.29]	509	1.40	[1.15; 1.71] *	469	1.28	[1.05; 1.56] *

* Statistically significant OR at $p < 0.05$; Abbreviations: ADL = Activities of Daily Living; OR = Odds Ratio; CI = confidence interval.

4. Discussion

4.1. Main Results

Basically, the study confirmed the two initial research assumptions: The results indicate that active engagement with specific socio-medical topics increases the perception of relevance from the students' point of view. In particular, they benefit from working on the topics themselves more than by obtaining their knowledge from oral presentations by fellow students: as small, statistically significant higher ratings were found in this respect for all social medical topics.

The developed teaching format is student-centered and thus complies with the recommendations of the German Science Council for the further development of medical studies (German Science Council, 2014). This implicitly points to the necessity of implementing seminars with self-learning phases for relevant competencies: a lecture alone may not

be sufficient to convey the learning content. This coincides with other medical studies reporting good experiences made with PBL in small groups (Drexel et al., 2015; De Jong et al., 2010; Ma & Lu, 2019). In their review, Benè and Bergus (2014) summarize that peer teaching in medical student education has a positive impact on the peer teacher and on the learners, as well. In addition, the test results concerning knowledge or skills in the setting of problem-based learning courses or clinical skills instruction were similar, regardless of whether they had been trained by expert teachers or peer teachers. The presented peer teaching approach was developed based on good experiences with a similar PT format within a seminar on the topic of occupational diseases developed by our institute (Hildenbrand & Rieger, 2011). There, for all students, PBL was combined with PT.

In this study, it could be shown statistically that the probability of an increase in knowledge, of feeling well-prepared for a topic, and of judging the topic as relevant for medical work increased significantly when students worked on the specific topic themselves (PBL approach). The subjective learning benefit was lowest for the topic of work incapacity. This is associated with the high mean value score of 0.62 regarding the previous knowledge and the perceived theoretical and practical relevance already before the seminar (see Table 1). This high value may be a result of the students having completed a two-week internship with general practitioners shortly before the seminar so that they already had contact with the topic of work incapacity or sick leave of patients in this context. Work incapacity is one of the most common social medical activities of general practitioners, which is certified daily by all doctors. In 2023, almost 900 million days of work incapacity were certified in Germany (Bundesanstalt für Arbeitschutz und Arbeitsmedizin, 2023). However, graded return to work is very rarely recommended by doctors, which is why we assume that during their internship, students acquired all the skills necessary to certify work incapacity, but not for graded return to work, which explains the large differences in skill acquisition between the two topics. Unfortunately, there are currently no statistics from health insurance companies in Germany regarding the frequency of graded return to work. In 2023, the German pension insurance system (which is primarily responsible for financing rehabilitation and reintegration in the German social system in cases where there has been no accident at work) financed just 41,000 procedures (German Pension Insurance, 2024).

It is also possible that students had previous knowledge about work incapacity through personal experience (e.g., during part-time student jobs). There were also no differences between group PBL and group PT in the perceived relevance of this topic after the seminar. The subjective learning benefit was highest for the topic of graded return to work. Here, the values for previous knowledge and perceived theoretical and practical relevance were also the lowest.

The learning effects in our study showed mean score values between 3 and 4. In the study by Pearson et al. (2020), which also used a 5-point Likert scale, the results were in a similar range. Fifty-two students and residents participated in a course on examining the shoulder and knee to diagnose common causes of pain. The mean self-assessment ratings pre-course and post-course improved from 3.3 (0.8) (mean (SD)) to 4.5 (0.5) for shoulder, and from 3.5 (0.7) to 4.6 (0.5) for knee.

In this study, high effect sizes were found in some dimensions (especially in the topic of graded return to work) when comparing PBL and PT. Hattie (2009) dealt with the interpretation of effect sizes in an educational context. He assumes that an effect size > 0.40 improves learning performance to such an extent that differences can also be observed in the real world. For the present study, this means that, at least for graded return to work (the results are less certain for the other topics), it can be assumed that this will be implemented with greater competence in the students' later professional activities. For social medicine teaching, this means that PBL improves the real-world practical competence (in other

words, the development of competence beyond the knowledge required for university) of prospective doctors (Hattie, 2009; Kraft, 2020).

In our study in the post-seminar questionnaire, many students (36–68%) indicated having already considered the five topics to be important for later professional medical practice before the seminar began. 52–86% of the students stated that the five topics should be covered during their studies. These results indicate that many students were interested in acquiring social medicine knowledge and competencies and mirror their awareness of the relevance and usefulness of the topic for future medical practice.

When designing the seminar, the lecturers selected topics and competencies from the field of social medicine, for which a prospective physician may need knowledge and skills directly after graduation. These chosen five topics were also listed 2015 in the German National Competence-Based Catalog of Learning Objectives in Medicine (NKLM) (Medizinischer Fakultätentag der Bundesrepublik Deutschland e. V., 2015) as competence-based learning objectives or examples of application. This underscores their value for the seminars and arguments for the subsequent inclusion in the current study. The updated NKLM 2.0 from 2021 (Medizinischer Fakultätentag der Bundesrepublik Deutschland e. V., 2021) also lists all five topics as competence-based learning objectives, which is additional verification of the importance of these topics for future physicians. The NKLM and NKLM 2.0 were developed under the leadership of the German Medical Faculty Association with the participation of many specialists from medical faculties and other institutions. The competence-based learning objectives listed in the NKLM 2.0 should be taught and be the subject of examinations at all German medical faculties in the long term. The seminar format presented in this study could therefore be used as a handout for other universities to teach social medical skills/competencies.

Behmann et al. (2011), in collaboration with the German Association for Social Medicine and Prevention (DGSMP), surveyed German medical faculties regarding teaching social medicine at universities. The most frequent format was lecture (91%, n = 20), followed by group work and case studies (55%, n = 12). In contrast, only 23% (n = 5) of participants indicated that they taught in the PBL format.

Reflecting the fundamental work on the role concept at CanMeds, the roles of physicians include those of health advocate and communicator (Frank, 2005). Both require systems-based knowledge beyond medical-scientific knowledge, as well as the development of action and consultation skills in social medicine issues. The five topics addressed in the teaching presented here are examples of this.

A study by Schaeffer et al. (2017) found that 54% of the persons included in a survey had only limited health literacy, e.g., in dealing with the various options in the health service system. Rothgang et al. (2011) also showed that patients had deficits in health literacy, which can lead to underuse and misuse of care. For example, only a minority of the insured patients knew which benefits they were entitled to, e.g., from the social long-term care insurance. One focus of teaching must therefore be directed toward ensuring that physicians promote these aspects of health literacy in patients and thus fulfill their role as health advocates and communicators.

If we consider the capabilities of PBL and PT teaching formats in medical education in general, rather than focusing specifically on social medicine, we can refer to the following three reviews. Trullàs et al. (2022) examined 124 studies on PBL used in undergraduate medical education in their review. They concluded that, when implemented correctly, satisfaction levels are high, particularly among students. Compared to traditional learning formats (mostly lectures), PBL is more effective in improving social and communication skills, problem-solving skills, and self-learning skills. Concerning academic performance, PBL has no worse results (and in many studies better results). However, the use of

PBL is not widespread. This may be because PBL requires greater human resources and ongoing training. In their review, Xiong et al. (2025) included 15 studies on orthopedic education. These studies demonstrated that the PBL and case-based learning teaching methods offer significant advantages over lecture-based learning in enhancing students' theoretical knowledge, clinical skills, and comprehensive abilities.

In their review, Zhang et al. (2022) examined 44 randomized controlled trials to assess the effectiveness of PT in health professions education. They confirmed the significant effect on procedural skill improvement of PT when compared to conventional teaching methods. But PT did not show its advantage over expert teaching on knowledge acquisition.

There are currently only few studies addressing the evaluation of students' learning outcomes in social medical skills, which makes it difficult to interpret the results of this study in a broader perspective. This calls for further studies to allow comparative considerations. Two studies outlined how students can be sensitized to provide care to patients with disabilities in the context of their socio-legal needs and rights (Dharamsi et al., 2011; Doobay-Persaud et al., 2019). Goyal et al. (2021) found that socio-medical skills can be increased especially when taught longitudinally. They also applied aspects of PBL, as students were asked to teach themselves current socio-medical issues on a weekly basis. Studies dealing with teaching formats and their results concerning social medical skills are still very rare. There are, however, some studies that address the contents, e.g., the necessity of implementing "social determinants of health" as an important subject in medical school (Davari et al., 2021; Dharamsi et al., 2011; Doobay-Persaud et al., 2019; Hoffman et al., 2016; Westerhaus et al., 2015): In this regard, Dharamsi et al. (2011) found that the particular way in which social responsibility is interpreted can enhance the appearance of social responsibility in the continuum of medical education and practice. The authors reason that the physician's role in society is closely linked to a sense of moral responsibility (Dharamsi et al., 2011). In their review, Doobay-Persaud et al. (2019) identified $n = 22$ studies which address teaching social determinants of health in under-graduate medical education. Experiential learning was a common instructional strategy here and typically relied on community or clinic-based learning. Nearly half of all integrated manuscripts described school-wide curricula, of which only three spanned a full year. The majority of assessments was self-reported and often related to affective change (Doobay-Persaud et al., 2019). Other studies pointed to the special importance of physicians' advocacy role and the insufficient consideration of this role in medical education (Dharamsi et al., 2011; Hoffman et al., 2016; Westerhaus et al., 2015), while further studies aim to derive specific measures of how social determinants might best be taught in medical education (Martinez et al., 2015). The present study's unique feature is the detailed evaluation of specific teaching formats' value related to defined curricular topics, allowing operationalization in the further development of concepts for teaching social medicine.

4.2. Limitations

As a key limitation, it should be noted that students were allowed to choose their own topics, which could lead to bias (e.g., motivated students choosing certain topics). Another limiting factor was that the questionnaire used was self-generated and had not been validated in terms of its reliability (Cronbach's alpha) and construct validity. The lack of an a priori defined control group design and the inclusion of only one questioning time point had further limiting effects on this trend study. Both were due to the real-world setting, which could not be changed but ensures external validity. In further studies, the same items should be evaluated at several time points, especially before and after attending the seminar. Further studies should also include teachers' perspective and turn to the problem how sustainable the increase in knowledge will be. The association with test

results could not be investigated, because anonymous data analysis was chosen to achieve a high response rate in the survey. Future longitudinal studies should focus on whether the differences in knowledge gain and changes in attitudes are reflected, for example, in examination results, and whether differences in clinical performance can be demonstrated later on.

5. Conclusions

In conclusion, students can be sensitized to social medical issues, especially if they are taught the practical implications of defined social medical topics (for example, via case vignettes). Higher learning benefits can be expected when problem-based learning formats are used, fostering personal engagement. The results call for changes where teaching is predominantly based on lectures or pure transfer of knowledge. They argue for the preference of PBL formats in teaching strategies that aim to increase awareness of social medical issues. Against the background of growing inequality, especially regarding the provision and utilization of medical services, there is a need for greater awareness of socio-medical issues (Westerhaus et al., 2015; Wilhite et al., 2020; Andermann & CLEAR Collaboration, 2016). This must also be true for medical education, especially since there are knowledge gaps among physicians in the area of social medicine skills (Davari et al., 2021; Dharamsi et al., 2011; Doobay-Persaud et al., 2019; Hoffman et al., 2016; Westerhaus et al., 2015; Martinez et al., 2015; Wilhite et al., 2020; Andermann & CLEAR Collaboration, 2016). PBL can be used to achieve a high level of competence in socio-medical skills, which are rarely encountered in practice and are therefore insufficiently covered in practical training, such that a benefit can also be expected in later professional life as a physician. Whether this assumption also applies to other clinical and non-clinical subjects in human medicine courses must be investigated in other research. However, the results presented here do indicate the potential of PBL for the entire course.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee at the University Hospital and Medical Faculty of Tübingen (protocol code 697/2014VF and date of approval: 31 May 2015).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study as follows: students were informed at the beginning of each seminar about the survey so that they had enough time to decide whether to participate in study or not. They were told that the study was voluntary and that they could withdraw at any time.

Data Availability Statement: All datasets are available from the corresponding author upon reasonable request.

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Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

ADL	Assistive technology to support activities of daily living
CI	Confidence interval
DGSMP	Deutsche Gesellschaft für Sozialmedizin und Prävention) (=German Association for Social Medicine and Prevention)
ES	Effect sizes
G-BA	Gemeinsamer Bundesausschuss (=Federal Joint Committee)
LTC	Long-term care
MD	Median
NKLM	Nationaler Kompetenzbasierter Lernzielkatalog Medizin (=German National Competence-Based Catalogues of Learning Objectives in Medicine
OR	Odds Ratio
PBL	Problem-based learning
PT	Peer Teaching
SD	Standard deviation
WHO	Word Health Organization

Appendix A

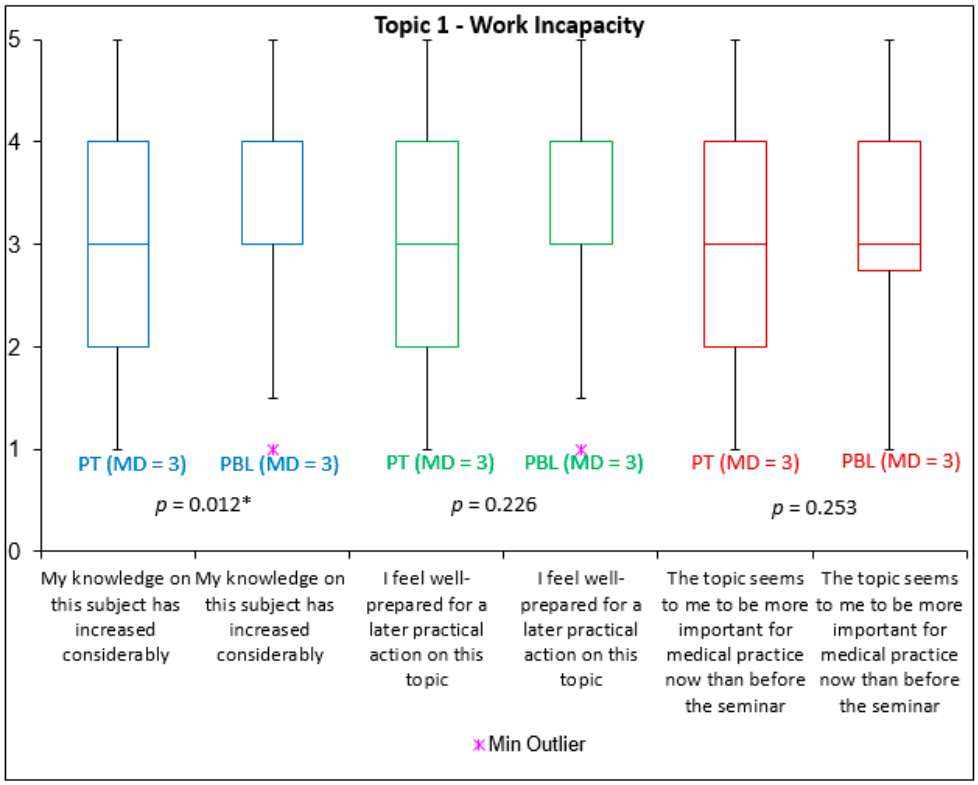

Figure A1. Topic 1 (work incapacity)—three single items (knowledge increase, perception of feeling well-prepared for a later practical action, and perceived relevance of the topic) assessing the effects of the teaching format by students who worked on the topic themselves (group PBL) and students who worked on one of the other topics, but were sensitized to the topic by the students of the other group (group PT); in total n = 520/520/517 for items 1–3; effect sizes ES = 0.25/0.15/0.14 for items 1–3. *Legend*: Abbreviations: MD = Median; * statistically significant at $p < 0.05$; y-axis inscription: 1 = completely untrue; 2 = almost not true; 3 = a little true; 4 = generally true; 5 = completely true; Mann–Whitney U test; PBL = Problem-based learning (students who worked on the topic themselves), PT = Peer teaching (students who worked on one of the other topics, but were sensitized to the topic by the students in the PBL group).

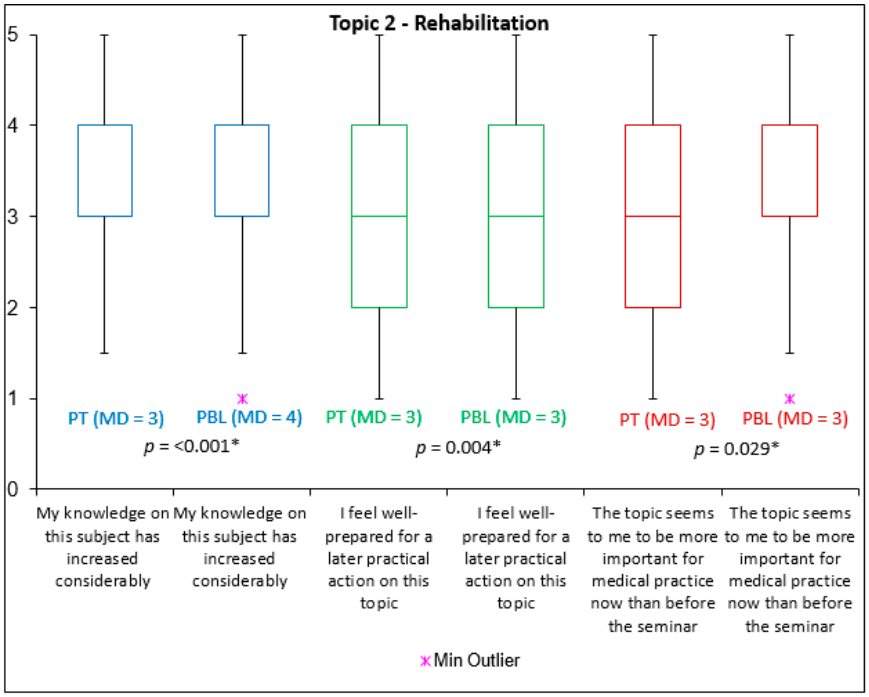

Figure A2. Topic 2 (rehabilitation)—three single items (knowledge increase, perception of feeling well-prepared for a later practical action, and perceived relevance of the topic) assessing the effects of the teaching format by students who worked on the topic themselves (group PBL) and students who worked on one of the other topics, but were sensitized to the topic by the students of the other group (group PT); in total n = 520/519/516 for items 1–3; effect sizes ES = 0.49/0.33/0.18 for items 1–3; for legend, see Figure A1; * statistically significant at $p < 0.05$.

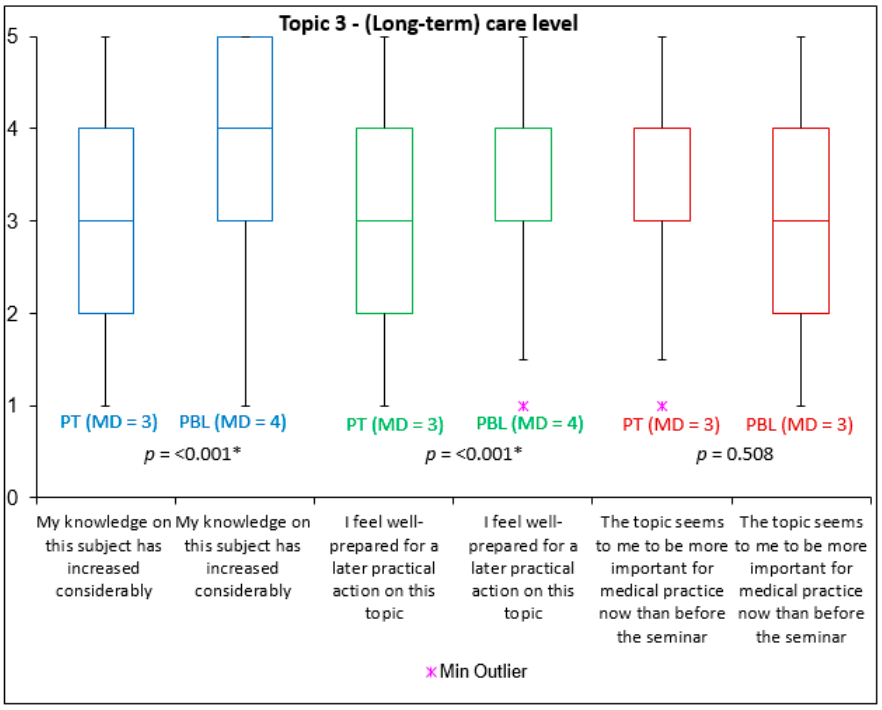

Figure A3. Topic 3 ((long-term) care level)—three single items (knowledge increase, perception of feeling well-prepared for a later practical action, and perceived relevance of the topic) assessing the effects of the teaching format by students who worked on the topic themselves (group PBL) and students who worked on one of the other topics, but were sensitized to the topic by the students of the other group (group PT); in total n = 470/471/469 for items 1–3; effect sizes ES = 0.38/0.54/0.02 for items 1–3; for legend, see Figure A1; * statistically significant at $p < 0.05$.

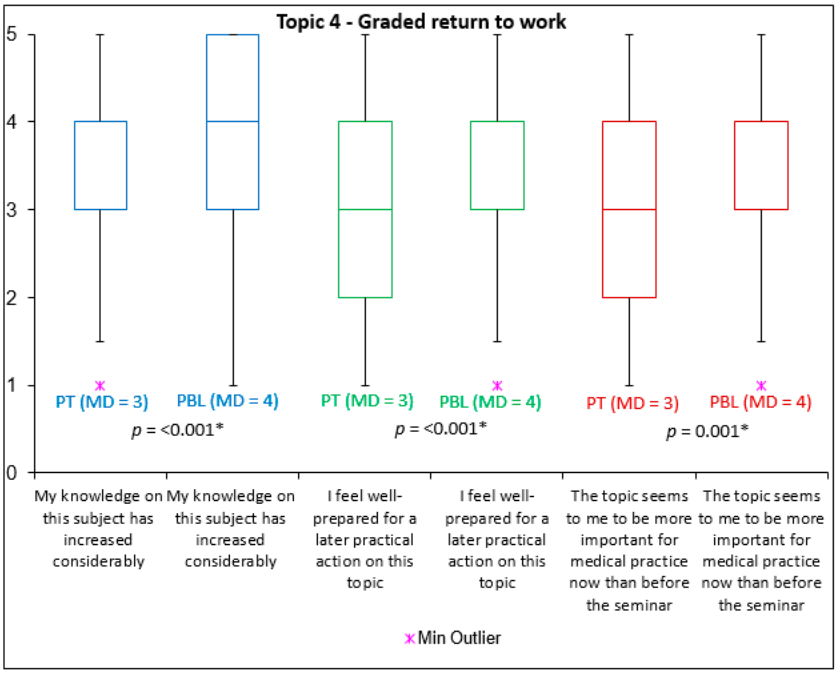

Figure A4. Topic 4 (graded return to work)—three single items (knowledge increase, perception of feeling well-prepared for a later practical action, and perceived relevance of the topic) assessing the effects of the teaching format by students who worked on the topic themselves (group PBL) and students who worked on one of the other topics, but were sensitized to the topic by the students of the other group (group PT); in total n = 510/511/509 for items 1–3; effect sizes ES = 0.66/0.42/0.40 for items 1–3; for legend, see Figure A1; * statistically significant at $p < 0.05$.

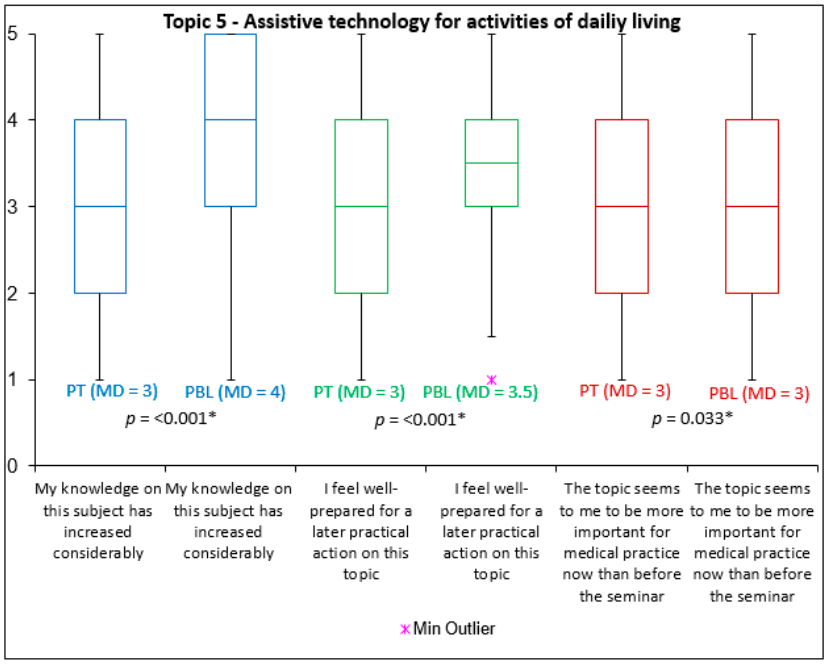

Figure A5. Topic 5 (assistive technology for activities of daily living)—three single items (knowledge increase, perception of feeling well-prepared for a later practical action, and perceived relevance of the topic) assessing the effects of the teaching format by students who worked on the topic themselves (group PBL) and students who worked on one of the other topics, but were sensitized to the topic by the students of the other group (group PT); in total n = 469/470/469 for items 1–3; effect sizes ES = 0.55/ 0.42/0.26 for items 1–3; for legend, see Figure A1; * statistically significant at $p < 0.05$.

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