Author's response to reviews

Title: Differences in the Self-Assessment of Clinical and General Competencies Between Problem-based Learning and Conventional Curricula Among German Medical Graduates

Authors:

Christopher L Schlett (christopher.schlett@gmail.com)
Hinnerk Doll (dollhin@googlemail.com)
Janosch Dahmen (janosch.dahmen@googlemail.com)
Ole Polacsek (olepolacsek@googlemail.com)
Martin R Fischer (Martin.Fischer@uni-wh.de)
Gero Federkeil (Gero.Federkeil@che.de)
Fabian Bamberg (fbamberg@post.harvard.edu)
Martin Butzlaff (butzlaff@uni-wh.de)

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Author's response to reviews: see over
Dear Dr. Norton,

Thank you very much for your interest in our manuscript entitled “Differences in the Self-Assessment of Clinical and General Competencies Between Problem-based Learning and Conventional Curricula Among German Medical Graduates” for publication in the prestigious Journal BMC Medical Education.

We thank the reviewers and editors for their helpful comments and have revised the manuscript accordingly. A detailed response with the changes we made is provided with this submission.

Authors Schlett, Doll, Dahmen, Polaese, Federkeil, and Butzlaff all contributed to the design of the study, data analysis, and drafting of the manuscript. Authors Bamberg and Fischer contributed to data analysis and interpretation, and critical revision of the manuscript. All authors have read and provided approval to the manuscript as submitted.

This manuscript is not under consideration elsewhere, none of it has previously been published, and there are no financial conflicts of interest to disclose.

Thank you for considering our manuscript,

Dr. Martin Butzlaff, MD MPH
Director Academic Affairs
Response to Reviewer Comments for Manuscript: 1288858861266700

We thank the editor and the reviewers for their constructive and insightful comments. In response, we have extensively revised the manuscript according to the reviewer’s suggestions. Please find below a point by point response to each reviewer’s comment.

Editor’s Comments:

1. Document, within the methods section of your manuscript, the name of the ethics committee which approved your study.

Response: According to an official request to the institutional ethics committee of the University Witten/Herdecke, there was no approval necessary for conducting this study (as there was no intervention). However, all participants provided informed consent and participated voluntarily in the study.

Methods, page 6, 1st paragraph: “All participants in the study participated voluntarily and provided informed consent.”

2. Include a 'Competing interests' section.

Response: We disclosed the competing interests of the authors.

Competing interests, page 18: “The authors CLS, HD JD and OP are medical students at the University Witten/Herdecke. The authors MB and MRF are employees of the University Witten/Herdecke.”
3. Include an Authors' contributions section before the Acknowledgements and Reference list.

Response: We included in the manuscript a description of the contribution of all authors.

*Authors' contributions, page 18:* “Authors CLS, HD, JD, OP, GF, and MB, all contributed to the design of the study, data analysis, and drafting of the manuscript. Authors FB and MRF contributed to data analysis and interpretation, and critical revision of the manuscript. All authors have read and provided approval to the manuscript as submitted.”

**Comments of Reviewer 1:**

1. The abstract is not fully clear. In the methods section it is not fully clear that students rated the importance and the extent to which they have acquired the competencies. The conclusion in the abstract does not logically follow from the results section in the abstract. The importance was rated equally with the exception of two competencies. PBL students were more positive about the acquisition of medical practical skills, psycho-social competencies, teamwork and problem-solving skills than graduates from conventional curricula and no differences were found with regard to medical knowledge. Furthermore, both conventional and PBL students were of the opinion that they did not acquire business competencies. These findings are fully in line with earlier reported findings (eg Schmidt and van der Molen, 2001). In other words, reword the results and conclusion section such that they are more in line with each other.

Response: We appreciate the comments of the reviewer and have re-worded the entire abstract.
Abstract, page 2: “Graduates from all German medical schools who graduated between 1996 and 2002 where eligible for the study. Graduates evaluated nine self-perceived competencies with respect to the importance in their daily job and how well these were acquired in their curriculum using a 6-point-Likert-scale.”

Abstract, page 2: “The importance of all competencies was evaluated equally except for two. Most relevant were “self-directed learning/work competence” (1.81±0.9) and “medical practical skill” (1.83±1.2). The PBL-based medical school curriculum was associated with benefits for the daily job in “interdisciplinary thinking” (Δ+0.88), “self-directed learning/working” (Δ+0.57), “psycho-social competence” (Δ+0.56), “teamwork” (Δ+0.39) and “problem-solving skills” (Δ+0.36, all p<0.05), whereas “research competence” was identified as a weakness of the PBL-based curriculum (Δ-1.23). Moreover, both conventional and PBL graduates identified “business competencies” as a general weakness of their curriculum.”

2. The introduction section is very short and very context-specific. Mainly the German situation is described here. The German situation should however only be described in the methods section, because readers might think that this study is only relevant for German readers, whereas this is not true. What should be emphasized more in the introduction section is: Which studies have already been conducted dealing with differences in perceptions about acquired competencies between students from conventional and PBL curricula all over the world and what did these studies demonstrate. Make also more clear what the study reported here could add to the existing literature. Skip all the information about the German situation in the introduction section.
Response: We thank you the reviewer for the comments and deleted the description of the German system from the introduction and instead emphasized more on the previously published literature regarding acquired competencies between students from conventional and PBL curricula. Further, we rephrased the research question (please compare Reviewer 1, Question 3). Also, we added a brief description of the German medical school system in the method section to enable the reader to understand characteristics of the German medical educational system, in which the study was conducted.

Introduction, page 4, 2nd paragraph: "There are several single studies indicating that PBL is associated with a higher gain in medical competencies, in particular in interpersonal and cognitive domains [4-11]. Especially, Prince et al. report in their study of 1159 Dutch graduates from 5 medical schools with an average follow-up of 18 months after graduation that 83% of PBL-graduates are satisfied regarding their training in communication skills compared to 41% of non-PBL graduates [8]. In contrast, there is also data showing that PBL may be associated with a deficiency in profession-relevant knowledge [2]. The subject of PBL in medical education remains controversial, while a recent systematic review by Colliver et al. conclude that there is no convincing evidence that PBL improves knowledge base and clinical performance, at least not of the magnitude that would be expected given the resources required for a PBL-based curriculum [12]. Similarly, Cohen-Schotanus et al. evaluate differences in clinical and general competencies and career development between PBL-based and conventional curricula in the Netherlands. In their cohort of 294 subjects, they assess for the appreciation of the curriculum, for self-assessed medical competencies, time gap until residency placement, and research output within a follow-up of three to six years after graduation. In a multivariate analysis, no differences for objective measures are found [13].
However, there are a number of studies and long-term reports demonstrating a significant benefit of a PBL-based curriculum. These findings are summarized in a systematic review from Koh et al. in 2008 [14]. Initially 102 articles were identified, but only 13 met the inclusion criteria of controlled trials, which evaluated the benefit of PBL as a teaching method in medical school, and where the study population was assessed after graduation from medical school. In this systematic review, the investigators conclude that PBL has a positive effect on physician competencies after graduation, mainly with respect to social and cognitive dimensions.”

_**Introduction, page 5, 4th paragraph:**_”Given the current controversy regarding PBL, we sought to assess PBL-related differences in perceived competencies as required for the daily clinical job in a large cohort of over 4000 young medical doctors with two to eight years of work experience. Thus, we compared self-perceived differences and required and acquired competencies among medical graduates who were enrolled in a PBL-based curriculum and medical graduates who were enrolled in conventional medical curricula.”

_**Method, page 6, 1st paragraph:**_ “All German medical schools were contacted and questionnaires were sent out to all alumni. There was only one medical school between 1996 and 2002 offering a PBL-based curriculum in Germany [15, 16]. This medical school at the private University Witten/Herdecke was founded in 1983 with the major goal to provide an alternative in education with self-guided, patient-oriented medical training beginning in the first year of medical school [16].”

3. **At the end of the introduction section, the research questions should be formulated more precisely. So make clear that one question deals with differences in**
perceived importance and that the other question deals with differences in competencies acquired in the students’ perceptions.

**Response:** We have revised the research questions accordingly.

*Introduction, page 5, 4th paragraph:* ”The primary research question of our study was to assess and compare the self-perceived importance of nine key professional competencies in the two groups of graduates. Secondly, we wanted to assess and compare the self-perceived acquisition during medical school of the same nine competencies in the two groups.”

**4. In the methods section it should be specified which actually questions addressed to the students, one dealing with importance and the other dealing with acquired competencies. How were they worded?**

**Response:** We included the wording of the actual questions to the graduates and the competencies within the method section.

*Methods, page 6, 2nd paragraph:* “Furthermore, the questionnaire contained the assessment of eight competencies as demanded by the current employment and whether these were adequately represented in the respective curriculum (“Please evaluate in which extent the following competencies were (A) required during your daily job and (B) taught during medical school”). The textual question design was based on reports describing the general skills necessary for professional practice in medicine [18-20]. We asked the graduates to evaluated these following competencies: “Self-directed learning/working”, “Medical practical skills”, “Psychosocial competence”, “Team work”, “Problem-solving skills”, “Medical knowledge”, “Interdisciplinary thinking”, “Business competence”, and “Research competence”.”
5. Do not make a distinction between clinical and general competencies, since this distinction is not used in the Tables and is also not fully clear.

Response: We eliminated this distinction from the entire manuscript.

6. It is unclear what is meant with the sentence of measurement precision on page 7. An alpha means that the scale is internally consistent, but how many items were included and was this calculated for the importance or perceived competence? So reformulate the sentence and mention that the items were internally consistent with each other.

Response: We reformulate this sentence.

Methods, page 7, 3rd paragraph: “Using self-assessment to evaluate medical education outcomes was internally consistent with each other (alpha reliability: 0.82) [2].”

7. On page 7 it is said that subgroups could contain less than then 10 subjects, whereas it is reported earlier that only schools with 50 or more subjects were included. Explain this to the reader.

Response: We have re-worded this paragraph to clarify that only universities with a minimum of 50 valid responses were included within this analysis.

Results, page 7, 3rd paragraph: “To ensure generalizability, universities were excluded if less than 50 of their graduates responded.“

8. The subheadings on page 10 should be changed towards 1) importance of competencies and 2) acquisition of competences.
Response: We changed the subheadings accordingly to the reviewer.

9. It is unclear whether the same results are reported in Figure 1 and on page 11. Are these data the same as presented in Table 3 or not? The text under Fig 1 and on page 11 under the subheading should either be presented under the subheading on page 10, or it should be made better clear what the differences are.

Response: We thank the reviewer for this important comment. We have clarified this issue by linking the text closer to figure 1 and rephrasing the legend of figure 1.

Results, page 11, 4th paragraph: “Differences between competencies subjectively required at the daily job and acquired during medical school were illustrated for both groups in figure 1.”

Figure Legend, page 21: “Differences in competencies as demanded by the daily job and acquired during medical school according to medical curriculum. Negative values indicate a deficit in the teaching of competencies as compared to job requirements; positive values indicate a surplus. NS denotes a not significant difference, * difference with a p-values <0.05 and ** difference with a p-values <0.001.”

10. The discussion is too long. A lot of literature is cited here that should have been introduced in the introduction section of the paper. It is not necessary to repeat the results section in the discussion section. Skip all the details about the results. Major conclusions should be drawn here and it should become clear whether the findings in general fit with findings from previous studies described in the introduction section and what this study adds to the literature. The argument that these studies were not yet conducted in Germany is not convincing. So skip also a lot of information about
Germany in this section. The reader might think that this paper is only of relevance for a German audience, whereas this is not true. Do not repeat all the details about differences in characteristics between PBL and other graduates, since this is not a research question to be answered in this study. The main conclusion here should focus on the two research questions specified about. The main conclusion about the demographics is that the differences in demographics were very small, the cohorts were similar. The differences found are only relevant to discuss if the authors are of the opinion that they might have influenced the results/conclusion drawn from the two research questions or if they want to explain to the reader that the difference does probably not influence the results (such as age). But keep it short. Focus on the main conclusion here and that is that PBL graduates and conventional graduates find all competencies of equal importance with the exception of two. Explain these two. Furthermore, it should be concluded that this study demonstrates that PBL students were more positive about the acquisition of medical practical skills, psycho-social competencies, teamwork and problem-solving skills and that no differences were found with regard to medical knowledge. Explain whether these findings fit with earlier studies and what the importance is of these findings from a theoretical and practical perspective. Also explain why PBL graduates may find research of higher importance? Is this a curriculum-effect or not? Do not link it with starting a career at a university hospital if this does not differ between the graduates from a PBL or conventional curriculum. And how is this result related with regard to the opposite finding on acquired competencies in research? Do PBL students rate themselves as less prepared because they learned more about research in a PBL curriculum? Anyway, this is a finding that triggers the reader and needs more explanation. Finally, make better clear what this study adds to the literature and do not mention the argument that this study
was conducted in Germany. Did the other studies also focus on importance and acquired competence or did they only focus on acquired competence? What is the selling-point of this study?

**Response:** We thank you the reviewer for his/her excellent points. We have shortened the discussion and removed a number of details about Germany. We deleted also all paragraphs, where the results were repeated. Further we restructured the discussion using subheadings: “Daily Job Requirements”, “Strengths of a PBL-based Curriculum”, “Weaknesses of a PBL-based Curriculum”, and “Generalizability and Practical Implications”. We also discussed our data with respect to the current publications and elaborated, where our study adds evidence to the literature.

*Discussion, page 12:* “In the present study, we compare self-reported competencies between German medical graduates of a PBL-based curriculum and of conventional curricula. Both groups of graduates rate similarly that the competencies “self-directed learning/working”, “medical practical skills”, and “psycho-social competence” are most important for their daily job. In a direct comparison of job requirements and medical school education, the PBL-based curriculum demonstrates benefits in key competencies such as “self-directed learning/working” and “interdisciplinary thinking”. In contrast, the conventional curriculum has its benefit in “research competence”. Both curricula are lacking regarding “business competence”.

*Discussion, page 12, sub-header ‘Daily Job Requirements’:* “Overall, both groups of graduates assess the value of core competencies as demanded by their daily job equally. Competencies such as “medical practical skills” and “psychosocial competence” are related to a high clinical value and mirror classic PBL strengths [2]. Interestingly, young medical
doctors rate overall “self-directed learning/working” as a non-medical competence more important than other medical competencies. One could argue that these findings are in line with the theory introduced by Sir Osler in 1899 emphasizing the need to prepare for lifelong learning [1, 22]. Although the job requirements are similar between both groups, graduates from the PBL-based curriculum evaluate “medical knowledge” less important. This finding may be explained by the differences in the competency of self-directed learning. In fact, while PBL graduates maybe more used to compensate medical knowledge gaps by acquiring self-directed new information, this ability maybe less developed/trained in graduated from a conventional curriculum. This hypothesis is in line with a recent study by Prince et al., which indicate that a less important rating of “possession of profession-relevant knowledge” is associated with PBL-based curricula [8].

Importantly, PBL graduate perceive “research competence” as more important. This can either be attributed to their training in which they became more interested in research or to the likelihood of pursuing a career in academic medicine. Given that we did not detect a difference between the groups in starting a career at a university hospital, it is more likely that over the time of their medical school PBL students realized the critical importance of research for medical practice. This effect maybe further increased by the fact that early clinical rotations – as part of the PBL-curriculum – enable the student to interact with medical professionals. These doctors might emphasize and convey the relevance of research to the students in a different, more practical way as archived in large-scale seminars and classes. This may be well in line with the opposite finding that ‘research competencies’ are insufficiently imparted by the PBL-based curriculum given the known emphasis on clinical relevant cases rather than basic science methodology [12]. Thus, while confirmation of this finding by further research is necessary, it may be advantageous to consider implementing
research courses that methodologically match the research interests in PBL-based curricula.”

Discussion, page 13, sub-header ‘Strengths of a PBL-based Curriculum’: “Efficiency and significance of PBL-based curricula in medical education is still subject to discussion. Whereas a similar study by Cohen-Schotanus et al. report no objective benefits for a PBL-based curriculum [13], a systematic review of Koh et al. demonstrate strong evidence that graduates from a PBL-based curriculum benefit especially in social and cognitive competencies [14]. We confirm these findings, whereas PBL-based curriculum was rated superior in seven of nine competencies as compared to conventional curricula. More important, we demonstrate that the PBL-based curriculum fulfilled all job requirements except for two competencies (see below). In addition to previously published literature, we identified a significant benefit of a PBL-based curriculum in comparison to conventional curricula in “medical practical skills”. These findings may support the hypothesis that PBL methods improve indirectly medical skills by improving self-directed learning and communication skills [2, 8, 23]. This is substantiated by a prior study from the U.S demonstrated that students of PBL-based und conventional curricula had similar USMLE Step 1 and 2 mean scores and pass rates [5]. In Germany, students from the PBL-based curriculum had on average a better grade point at the final medical examination between 1996 and 2002 [21]. One possible explanation could be the surplus of “self-directed learning competence” which might balance the possible deficit in “medical knowledge”.

Our results indicate the strength of PBL-based curriculum predominantly in social and cognitive competencies. Further, our results may show that the reform curriculum based on
PBL not only affects the typical PBL-related competencies, but also the more general work-related skills which are important for success in medical professions [2].”

Discussion, page 14, sub-header ‘Weaknesses of a PBL-based Curriculum’: “In contrast to the benefits of the PBL-based curriculum, the conventional curricula are superior in “medical knowledge” and “research competence”. Case-studies, as used in PBL-based curricula, are time consuming [4]. Further, systematic lectures are (partly) replaced by individual seminars, where students can raise their own questions. Both effects may lead to less impartment of medical knowledge in a PBL-based as compared to conventional curricula [2]. However, “medical knowledge” is sufficient taught regarding job requirements from the perspective of PBL graduates.

Research competence may be second weakness of PBL-based curriculum. In fact, this finding was prior shown in a review by Colliver et al. [12]. Our data pooled with the review lead to the explanation that PBL-based curricula have a distinct disadvantage in losing the ties between educational theory and research [12]. Additional effort and further research is needed to implement special research programs for students in PBL-based curricula. This is underline by the fact that the acquired “research competence” during medical school was not fulfilling the job requirements for PBL graduates.

Importantly, our results demonstrate that also “business competence” is insufficiently imparted by both curriculum types, the PBL-based and the conventional. Thus, it is of great interest to incorporate aspects of business administration and management which apparently are demanded by the clinical job to enhance both curricula. In fact, in a study by Larson et al., the investigators demonstrate that implementation of jointed MD/MBA programs at U.S.
universities has increased considerably from six programs in 1993 to 33 programs in 2002 [24].”

**Discussion, page 15, sub-header ‘Generalizability and Practical Implications’:** “Our study cohort is comparable regarding demographics to them from other European [2] and Non-European countries [25, 26]. Further, graduates from PBL-based curriculum and conventional curricula showed no major differences except for age. Whereas one study showed a limited impact of age on the medical school experience [27], our observed differences in the rating of competencies between graduates from a PBL-based curriculum and from conventional curricula remain even after adjustment for age (data not shown).

We included over 4800 graduates from nearby all medical schools within one country and assured so that medical doctors from all social and economic area within a developed country like Germany were covered. This is a major prerequisite to derive un-biased description of current job requirements. Further strength of this study is the direct comparison of medical school education with respect to job requirements. Further research is necessary to capture in more detail job requirements and how medical school education can be better adjusted to the current requirements of daily medical work. The practical implication of our data are that a PBL-based curriculum provides benefits in job relevant competencies, although “research competence” need a special attention in planning and developing of PBL-based curriculum. Further, “business competence” must be emphasized throughout all medical school curricula.”

11. **Skip the text on page 17 about MBA. This is far beyond the scope of this paper.**
Response: We skipped the major section about MBA programs.

12. Reformulate the limitations. What are the major limitations? In my opinion, the low response rate and the difference in response rate between PBL and conventional. Do not only mention this issue, but explain how it might have influenced the findings. Whether these results can be generalized or not and what the influence might be of the specific German context (a private school versus non-private schools, selection versus no selection) Also mention that this study is about self-perceptions, which might have limited value.

Response: We reformulated the limitation section and focused on the low response rate, and the differences between both groups regarding response rate, the differences between graduates from the University Witten/Herdecke and other German medical graduates and that the judgments were not verified by objective measurements.

Discussion, page 16, sub-header ‘Limitations’: “Our results need to be evaluated in the context of our study limitations. Most importantly, our findings may be limited by selection bias as our overall response rate was low, even so we included national-wide over 4800 graduates. Further, the response rate differed between graduates from the PBL-based curriculum and from conventional curricula. A similar finding has been reported previously by Schmidt et al.. In their study, the investigators concluded that the PBL approach itself may lead to a greater willingness to respond to surveys [2]. While we use the University Witten/Herdecke as surrogate for a PBL-based curriculum in Germany, there may be differences with respect to realization of the PBL framework which may limit external validity of the observed findings. For instance, all medical students at the University Witten/Herdecke underwent a personal assessment in order to be admitted to the medical
school and the average yearly class size is smaller compared to most of the other universities. Thus, practicability of a PBL-based curriculum may not be derived from the University Witten/Herdecke experience in an unbiased way. However, our two groups of medical graduates are similar in most of their baseline characteristics and similar approaches like personal assessment of medical school applicants are performed also in other countries. Therefore the bias may be limited regarding the observed benefits of the PBL-based curriculum.

Ideally such an assessment may pertain to objective measures. Same studies suggest that self-perceptions can differ from objective measures [13]. In this context, an interested aspect may be that the evaluation of job requirements are nearby equal, even so great differences are observed between the evaluation of PBL-based and conventional curricula.”

13. First mention the limitations and thereafter the suggestions for further research. Reformulate the ideas about further research. Should they focus on costs? No, which studies are needed to obtain better insight in differences in competencies? The suggestions for further research should be in alignment with the limitations. Should we ask employees about their opinions? In other word suggest future studies that are more in alignment with the research questions formulated for this study and do not suggest studies in other domains.

Response: We thank you the reviewer for his/her excellent comment to further research topics. We agree that aspects of cost for medical education may not be derived from our data. Instead we rephrase the paragraphs with respect to objective measures and an outcome-based education.
Discussion, page 15: “Given the limitations of the present analysis further research to confirm and extent our findings is warranted. Given the subjective nature of self-perception, it may be less biased to approach and survey employers about their perceived skills of PBL- and conventional medical graduates and the differences with respect to current requirements of daily medical work. Also, by evaluating a third person (ideally overseeing a number of graduates), it may be more likely to collect a representative sample with much higher response rates. Moreover, to address the limitation of low response rates, it may be more feasible to perform personal interviews rather than mailed or online questionnaires.

Discussion, page 16: “But additional research using more objective measures is necessary to confirm the observed benefits and disadvantages of a PBL-based curriculum.”

14. What are practical implications for education based on this study? Add one or two sentences. More emphasis on preparing graduates about business aspects of med?

Response: We restructured the discussion section and added a paragraph regarding “Generalizability and Practical Implications” to address this comment adequately (see Reviewer 1, Comment 10).

Comments of Reviewer 2:

1. While the paper does make a contribution to the debate about the merits of PBL-based curricula as compared to conventional curricula, it is unfortunate that the sample size of PBL programme graduates (n=101) is very small and limited to one medical
school. Furthermore the authors point out that the PBL curriculum student selection process was individualised. The overall generalizability of the findings is thus potentially limited.

Response: We thank you the reviewer for her comments. The relatively small sample size of PBL graduates is based on the effect, that we included graduates, which completed medical school between 1996 and 2002. Overall only 265 medical school graduates educated by a PBL-based curriculum would have been available in Germany for the same graduation years. Further, several studies cohorts for the assessment of PBL were limited to a size between 100 and 200 subjects (Cohen-Schotanus 2008; Tamblyn 2005) and is often below 100 as summarized in the systematic review of Koh et al. in 2008. The reason for this is that the broad implementation of PBL-methods into medical school has started only a couple of years ago. More importantly, we didn’t find major differences regarding demographics between graduates from the PBL-curriculum and conventional curricula, except for age. But even after adjustment for age, the observed and significant differences between these two curriculum types remained. However, we have repeatedly included the limited generalizability of our findings in the new structured discussion section.

Discussion, page 15: “Our study cohort is comparable regarding demographics to them from other European [2] and Non-European countries [25, 26]. Further, graduates from PBL-based curriculum and conventional curricula showed no major differences except for age. Whereas one study showed a limited impact of age on the medical school experience [27], our observed differences in the rating of competencies between graduates from a PBL-based curriculum and from conventional curricula remain even after adjustment for age (data not shown). Nevertheless given the limited generalizability, further research will be necessary to confirm our findings in a larger sample.”
2. Another major limitation of the study is that these findings are based on graduate opinion and the authors do not provide any objective data to substantiate the opinions expressed.

Response: We agree to the reviewer that this is a limitation of our study and we have included this in the limitation section. Furthermore, we discuss this issue in the discussion section and suggest approaching a third person (residency program director) rather than the graduate to more objectively confirm our findings in future studies. However, self-reported judgments have demonstrated sufficient internal and external validity for assessing outcomes in medical education (Schmidt 2006).

3. In addition, as pointed out by the authors the overall response rate of graduates from 34 medical schools was only 14%. There is great potential for bias in this study and the findings need to be seen in light of these significant limitations.

Response: We agree with the reviewer that the low overall response rate is a central limitation of this study. Therefore we have emphasized this issue in more detail in the limitation section and discussed the potential impact on our results. However, one of the initial goals of this study was to draw a representative picture the job-requirements for medical professionals and compare the PBL-based curriculum to a wide range of conventional curricula to minimize the influence of differences between the universities.

Discussion, page 16: "Our results need to be evaluated in the context of our study limitations. Most importantly, our findings may be limited by selection bias as our overall response rate was low, even so we included national-wide over 4800 graduates. Further, the response rate
differed between graduates from the PBL-based curriculum and from conventional curricula.”

4. Line 21 page 2 should read “the training of seven of nine competencies”

Response: While reviewer 1 requested major changes of the abstract, the cited sentence was deleted in the revised manuscript.

5. “Likert” should be in upper case

Response: We apologize for this typo and have changed “Likert” to upper case throughout the whole manuscript.

6. Line 1 page 4 – the opening sentence is incomplete

Response: We apologize for this typo and have completed the sentence.

*Introduction, page 4, 1st paragraph:* “Osler concluded that one way to overcome this issue may be to allow more time for self-directed studying [1]....”

7. Line 18 page 6 – delete the “s” in the text

Response: We deleted the “s”.

8. Line 13 page 10 should read “Assessment of the competencies acquired...”

Response: We changed the text according to the reviewer’s comment.
Results, page 10, 3\textsuperscript{rd} paragraph: “Assessment of the competencies acquired during medical school differed significantly between the two groups (Table 3).”

9. Line 2 page 12 should read “medical graduates of conventional medical curricula.”

Response: We changed accordingly to the reviewer’s comment.

Discussion, page 12, 1\textsuperscript{st} paragraph: “In the present study, we compare self-reported competencies between German medical graduates of a PBL-based curriculum and of conventional medical curricula.”

10. Line 18 page 12 should read “…medical education in Germany is limited …”

Response: This sentence was deleted due to another comment (see Reviewer 1, Comment 10).

11. Line 21 page 12 should read “… graduates of conventional curricula …”

Response: This sentence was deleted in the revised manuscript.

12. Line 7 page 13 should read “Both groups of alumni in our study …”

Response: We changed the text accordingly.

Discussion, page 15, 5\textsuperscript{th} paragraph: “Further, graduates from PBL-based curriculum and conventional curricula showed no major differences except for age.”
13. Line 17 page 13 should read “… some studies showed a limited impact of age…”

Response: We changed the text accordingly.

*Discussion, page 15, 5th paragraph:* “Whereas one study showed a limited impact of age on the medical school experience [27], …”

14. Line 9 page 16 should read “This approach permitted identification of deficits and ….”

Response: This sentence was deleted in the revised manuscript.

15. Line 21 page 16 should read “… It may be of great interest …”

Response: We changed the text according to the reviewer’s comment.

*Discussion, page 14, 4th paragraph:* “Thus, it may be of great interest to incorporate aspects of business administration and…”

16. Line 1 page 17 should read “… implementation of joint MD /MBA … has increased considerably from six programs …”

Response: We appreciate this comment and have revised the paragraph accordingly.

*Discussion, page 15, 4th paragraph:* ”In fact, in a study by Larson et al., the investigators demonstrated that implementation of jointed MD/MBA programs at U.S. universities has increased considerably from six programs in 1993 to 33 programs in 2002 [23].”
17. The meaning of line 8 page 17 is not clear but I think it should read “… which became more dependent upon economic values …”

Response: We appreciate this comment. But while the paragraph about MBA was been shorten according to the reviewer’s comment above (Reviewer 1, Comment 11), unfortunately this change couldn’t be performed.

18. Line 15 page 17 should read “… between PBL-based and conventional …”

Response: We changed the text according to the reviewer’s comment.

19. There are numerous capitalization of journal title errors in the list of references, e.g. Medical Teacher, Medical Education.

Response: We apologize for these typographical errors and have made the requested changes.

20. The journal title of reference 27 is incomplete or incorrect

Response: We have made the requested change. “CMAJ” stands for “Canadian Medical Association Journal” and represents the official abbreviation.

21. Legend for figure 1 states “* difference with a p-value of <0.5”. Is this correct or should it be < 0.05?

Response: We apologize for this typo. The correct value is “0.05” and the figure legend was changed accordingly.
**Figures Legend, page 21:** “NS denotes a not significant difference, * difference with a p-values <0.05 and ** difference with a p-values <0.001.”

22. In the discussion the authors suggest that “… the PBL approach itself may lead to a greater willingness to respond to surveys.” They do not provide any evidence to support this conclusion.

**Response:** We thank you the reviewer for her comment. True, our data are limited in providing evidence that “PBL approach itself may lead to a greater willingness to respond to surveys”, except that we observed higher response rates among PBL graduates. However, this hypothesis was established by Schmidt et al. in their publication about long-term effects of problem-based learning in 2006 and is now cited by us to underpin this statement.