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BRIEF REPORT

Weak and strong ties and its connection to experts' problem-solving styles in scaffolding students' PBL activities on social media [version 1; peer review: 4 approved with reservations]

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Abstract

Background: Studies have acknowledged that social media enables students to connect with and learn from experts from different ties available in the students' personal learning environment (PLE). The inclusion of experts in formal learning activities through social media such as in scaffolding problem-solving activities helps students see the practicality of experts' thinking in solving real-world problems. However, studies that evaluate experts' problem-solving styles and how these influence the experts' thinking process in delivering the know-how to students on social media based on the ties that the students have with the experts in social media are scarce in the extant literature. The study aimed to explore the problem-solving styles that the experts portrayed on Facebook based on their ties with the students.

Methods: This study employed a simultaneous within-subject experimental design which was conducted in three closed Facebook groups with 12 final year management students, six business experts, and one instructor as the participants. The experts were invited by the students from the weak and strong ties in their PLE. Hinging on the Theory of Fluid and Crystallised intelligence and the Strength of Weak Ties Theory, this study employed thematic analysis using the ATLAS.ti qualitative data analysis software to map the experts' comments on Facebook.

Results: The use of strong ties in combination with weak ties balances out the negative aspects of the business experts' problem-solving styles. All the experts used both fluid and crystallised intelligence in scaffolding the students' learning; however, the degree of its usage correlated with the working experience of the experts.

Conclusion: The use of weak or strong ties benefited the students as it expedited their problem-solving tasks since the experts have unique expertise to offer depending on the degree of their working

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Approval Status

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version 2				
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1. **Els Boshuizen** , Open University, Heerlen, The Netherlands
2. **Fauziah Sulaiman** , Universiti Malaysia Sabah, Kota Kinabalu, Malaysia
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4. **Lillian Buus** , VIA University College, Aarhus, Denmark

Any reports and responses or comments on the article can be found at the end of the article.

experiences and the proximity of the students' relationship with the experts.

Keywords

Problem-based learning, Facebook, business experts, problem-solving styles

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Introduction

Background

Personal learning environment (PLE) is a self-driven learning space that allows individuals to collaborate, connect and participate using one or more technological artifacts, platforms, or online tools available in the personal learning space.¹ Siemen,² the founder of social connectivism theory, asserted that the inclusion of PLE is vital in online learning as students could form connections with external sources of more experienced people from dispersed geographical locations that could contribute knowledge and experiences that essentially aid students' educational experience.³

The use of social media embedded in students' PLE enables students to gain access to experts who could support their formal and informal learning.^{4,5} Social media allows students to tap into the connections of the weak ties from which they might draw resources.⁶ In his famous strength of weak ties' experiment, Granovetter⁷ reported that people secure jobs mostly through weak ties by getting job information from acquaintances rather than close friends or family. Weak ties are defined by relationships that involve infrequent contact such as distant relatives, acquaintances, or people unknown to us. Meanwhile, strong ties refer to relationships of people who are closely in touch such as family members and close friends. Granovetter argued that although weak ties display low intimacy and emotional intensity than strong ties, it offers vital benefits such as providing more social support and networking strength.⁸ It is reasonable to postulate that students could utilise their strong and weak ties by engaging with experts in their PLE on social media to support learning. Unfortunately, existing studies have not ascertained this assumption.

Recently, the use of experts to facilitate students' learning in online settings has gained substantial attention among problem-based learning (PBL) scholars, mainly because expert thinking differs vastly from novice thinking.⁹ Horn and Cattel's¹⁰ Theory of Fluid and Crystallized Intelligence described experts as having more crystallised intelligence embedded than novices when dealing in knowledge-rich problem situations where the goals of a problem are uncertain and the solutions are not straightforward.^{10–12}

Therefore, experts devise solutions faster than novices because they use necessary knowledge based on their life experiences that are stored in long-term memory which makes up their crystallised intelligence. Additionally, experts also demonstrate fluid intelligence, namely the ability to reason and adapt without the need for substantial levels of prior learning when confronted with new problems or situations. This enables business experts, for instance, to accustom themselves to an ever-changing contemporary business environment characterised by volatility, uncertainty, fuzziness, and complexity.¹³

In contrast, novices tend to lose direction when dealing with complex problem-solving, especially when confronting information that is presented simultaneously in an online context. Consequently, when placed in online platforms to solve complex problems, students often need a more experienced individual to guide their thinking to approximate the experts' reasoning¹⁴ and to reconcile the misunderstanding. The use of PBL in technology-rich environments such as social media allows students to receive online scaffolding, a form of assistance from more experienced people who could guide them in performing unfamiliar tasks they are incapable of performing on their own in online mediated platforms.⁴ Students may integrate their PLE with unlimited arrays of scaffolders who are socially connected in social media including instructors, peers and experts to assist in the problem-solving tasks.

Several studies have investigated how experts deal with novices in problem-solving activities.^{15–17} Nevertheless, very few have explored the patterns of experts' problem-solving styles that are drawn via the use of strong and weak ties to support problem-solving activities with students.

Objectives and rationales

This study explored the patterns of experts' problem-solving styles and intelligence characteristics when reasoning with students in problem-solving activities whereby the patterns were mapped against the ties the students established in their PLE. Since experts think differently from novices, understanding these patterns would help novices and educators gain insight into the scaffolding provided by experts.

Methods

The sampling techniques and the instruments used were reported according to STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) reporting guideline,¹⁸ a popular guideline in social science research.

Ethical approval and consent

This study was approved by the Research Ethical Committee of Multimedia University (EA2012021). Initially, all participants were briefed on the assignment deadlines and expected roles in the problem-solving protocols. Subsequently,

written informed consent for participation and publication of the research has been obtained from the participants. All communications on Facebook were transcribed and their identities were concealed for maintaining the participants' anonymity following STROBE guideline and Subirats *et al.*¹⁹

Study design, setting and participants

The researchers made a call for volunteers who were undertaking a global management course at a Malaysian private university to participate in solving a decision-making business problem. The volunteers were required to invite along two business experts from their PLE to scaffolded them for eight weeks. The requirements of the business experts were set as follows: having substantial working experience of 10 years or more, hold a managerial position and the experts must have one of the following ties with the students; both experts are from strong, weak or both ties. Finally, 12 final-year baccalaureate students who met the research criteria volunteered to participate. This study used a simultaneous within-subject experimental design for three groups comprising four students each (two from Cohort 2017 and one from Cohort 2018) were assigned in a closed group Facebook to communicate, clarify issues, and share resources. Furthermore, this group arrangement is common in PBL studies.²⁰ Facebook was selected because of its effectiveness in supporting various degrees of ties and capability to accommodate small PBL groups.²¹ The Facebook communications were transcribed and available in a dataset.²² Students were scaffolded by the experts and instructor following Ge and Land's²³ problem-solving protocol which involved problem identification, developing and evaluating solutions, and assessing alternative solutions.

The students documented their work on Google documents that could be assessed only by the instructor, experts and students for each respective group.

Table 1 depicts the business experts' profiles. Groups 1 and 2 used weak ties. A student in Group 1 invited two experts from her former internship company during her diploma studies. Group 2 invited two experts whom the students searched from an organisation's website; none of the students knew the experts before inviting them to participate in this study. Group 3 used a combination of weak and strong ties. The strong tie was one of the students' close relatives while the weak tie was one of the student's internship acquaintances. The business experts from Groups 1 and 3 have 20 to 30 years of work experience in the shipping and airport management industry, respectively. Meanwhile, the experts in Group 2 have 10-15 years of work experience in the e-commerce industry.

Methods of analysis

Friese *et al.*²⁴ recommended the use of deductive thematic analysis when a pre-existing framework is available. Therefore, the discussions between the business experts and the students were thematically mapped using Selby's²⁵ three problem-solving styles. These included problem-solving preferences (explorer vs. developer) which were coded as M: Explorer and M: Developer; the manner of processing (internal vs. external) coded as MP: Internal and MP: External; and finally, ways of deciding (people vs task preference) coded as WOD: People and WOD: Task. The Theory of Fluid and Crystallised Intelligence¹⁰ was used to map the type of intelligence the experts primarily demonstrated. ATLAS.ti software (Version 8.4.25.0) was used to analyse the identified themes to reflect the business experts' responses. Acknowledging that there is available open-source software as alternatives to ATLAS.ti such as **QualCoder** and **Tagguete**, many qualitative scholarly papers adopted ATLAS.ti for its user-friendliness for coding and displaying network analysis results. Besides that, ATLAS.ti has a variety of tools to analyse unstructured data.²⁶ Moreover, one of the researchers in this study is well-versed in using ATLAS.ti. For those reasons, ATLAS.ti was chosen.

Results

Figure 1 displays the network analysis based on the themes extracted from Facebook discussions. The weak tie experts in Group 1 (**Figure 2**) displayed a more accommodating approach and a sense of belongingness by using phrases such as

Table 1. The business experts' profile.

Group	Ties	The industry that the business experts were engaged in and the assigned case.
1	Weak	Shipping industry https://www.nst.com.my/news/2016/03/132323/revival-hope-floats-shipping-master-plan
2	Weak	E-commerce industry https://www.digitalnewsasia.com/digital-economy/slow-internet-speeds-damping-malaysias-digital-economy-aspirations-mdec-ceo
3	Strong + Weak	Airport management http://www.thenational.ae/business/aviation/mattala-rajapaksa-airport-fails-to-take-off-as-sri-lankas-newest-destination

Figure 1. The Network Analysis from ATLAS.ti.

Excerpt from Group 1 (Weak ties)

[Post 3 initiated by Expert 1]:

Dear team, here are my comments and hints:

1. Problem analysis using 5W1H must be consistent with the problem-solving goal....based on your lecturer's comment dated 17 Jan., your team needs to create a new gap. Subsequently, the problem solving goal needs to be amended.
2. Information for problem analysis must be supported with facts and figures i.e. statistics for performance, comparisons, business model, actual costs, indices, for example LSCI etc. Show graphs or figures.
3. Streamline the discussion in problem analysis. The issues on foreign vessels are redundant.
4. The six thinking hats used in this case study is incomplete. Please do not force thru the possible solutions.

Comments for the post:

Expert 1 : Can I look at your finalised versions of stage 1 and 2 again. Just to make sure I don't miss anything important....but Does google docs being updated with the latest/finalised versions?

Student 3: Yes , they were updated

Expert2: before i put forward my comments, just need a little enlightenment on your problem and whose problem that you are going to solve.....

Expert 1: since there is a lack of clarity on the "problem", the discussion at the analysis stage indicates lack of continuity and focus. Do not just cut and paste from the article....put your analysis and formulate the information to be consistent with the 5Ws 1H questions.

Student 1: Means we should use Student 3's versions of problem-definition and create the questions from that?

Expert 2 : we can look at her version 1 and 2

Expert 2: Hints: LSCI has 5 major components i.e TEU capacity, shipping companies, services, maximum ship sizes and a number of ships.....Student 3's Version 1 and 2 refer to the attainment of global competitiveness....dear team, my recommendation is to look into these areas and support your facts and figures with LSCI ranking.

Hints: Attainment of global competitiveness but LSCI is showing otherwise....

Expert 1: pertinent question: whose problem do you intend to solve. Which players are we referring to? Shipbuilders, MRO? Ports and Logistics? or any specific trade, such as a commodity, passengers etc.

Expert 2: Ask a simple question, who is the customer/s and player/s of this industry?

Figure 2. The weak tie from Group 1.

“dear team” and “keep moving team”. Selby²⁵ described this as the people preference style where this approach is seen as an effort to maintain harmony in the group. The experts respected the students' own pace of processing information as they required time to digest and internalise the meaning of the information presented to them by the students before responding. In contrast, the business experts from Group 2 (weak ties 2) adjusted their reasoning based on the information the students presented to them first. This sort of arrangement falls under the explorer style. The experts preferred the students exploring all possible options and presenting the latest information before guiding the students based on the materials presented (Figure 3).

Lastly, Group 3 which used a combination of both weak and strong ties (Figure 4) showed mixed findings. The strong tie expert (Expert 1 from strong tie) was sensitive to the participants' feelings and ended her comments with remarks such as “Otherwise, good job all”. This style is categorised as the people preference. The strong tie expert also demonstrated more persistence and patience in scaffolding the students by presenting the developer style. She directed the students beginning with a basic idea and gradually developed the ideas as the students were progressing by making statements such as “I think it would be a good idea if ...”. This characteristic is similar to the style of experts in Group 1. In contrast, the weak tie expert (Industry Expert 2) exhibited a task preference style where the tone of the discussion was more of task accomplishment tend to be free from emotion and are focused on the tasks, which sometimes resemble the explorer style²⁵ as the experts were inclined to share only after receiving information from the students.

These sorts of problem-solving styles of the experts correlated with the types of intelligence used and working experiences. Experts from Group 2 (with 10-15 years of work experience) exhibited more fluid intelligence as they were flexible in dealing with new information in thinking and reasoning with the students. In contrast, the business experts in Groups 1 and 3 (with more than 30 years of work experience) demonstrated crystallised intelligence and shared validated business solutions by occasionally sharing how the presented information was linked to their past experiences.

Excerpt from Group 2 (Weak ties)

Student 1: Among all the new ERG (expectation, reality & gap) stated above, I quote from the text , "Given the target for SMEs to contribute to 41 per cent of GDP by 2020" . That 41% is SME contribution as a whole or SOLELY from online platform. That has to be given more consideration. I would like to gain some insights from our experts Expert 2 and Expert 1 on the suggestions given in the text and the comments by my teammates in the comments above. As of my understanding, the gap between expectation and reality is like what Expert 2 post last time (the 3 points in the final part of the text)

Expert 1: 41% is the whole SME contribution to GDP by 2020

Expert 1: Please download and read National eCommerce Strategic Roadmap here <https://mdec.my/about-malaysia/government-policies/national-ecommerce-strategic-roadmap/>

Expert 1: Both roadmaps are aligned.

Expert 1: Use both roadmaps as your main reference

Student 1: So yes. To the team, we are focusing on e-Commerce contribution or what is expected. 41% may not be fit to use in our ERG as that figure is about SME business GDP contribution overall. Our EXPECTATION is already as simple and concise as it has been. Expectation: Malaysia government expect to see SMEs/Retailers to extend their business to digital platform.

Instructor : You may also focus on SWOT ..esp SMEs readiness, the issue is more towards the attitude of the SMEs or the facilities readiness (broadband level etc) --Internet speed in Malaysia is also slow , behind Indonesia. dig out more information <https://www.malaysianwireless.com/.../akamai-malaysia.../>

Expert 1 : Benchmarking with other countries

Student 2: Is it better for us to compare with ASEAN country or globally?

Student 3: We will do the benchmarking on a table and post it here

Expert 1: Compare with developing countries similar to the Malaysian environment eg Taiwan

Figure 3. The weak ties from Group 2.

Excerpt from Group 3 - Strong ties (Expert 1) and Weak ties (Expert 2)

Expert 1 : Good job team. So.. let's look in-depth at the above matter.

1. Try to find out who owns the airport either an independent company @ the government
2. If the government itself, there shall be less bureaucracy in applying the ICAO Regulations & Standards. Follow all annexes of the ICAO
3. HRI should practise one of the annexes, i.e. Annex on Bird Hazard Management, to avoid the accident.
4. Then only we look at commercial/sort of urban development in the airport itself & at the airport border.
5. Sufficient infrastructure & facilities to attract & make ease the people to link to the airport.

Will get back to you once i've found more details about the info that you've given above (smiley icon)

Expert 2:

Ok Student 2... when the above matter could be solved, more aircraft will accommodate & utilize HRI as their connecting link, the passenger movement will be improved, hence HRI's revenue will be proportionately improved too..

Expert 2: Thanks Expert 1 for the input. I can see 2 main problems with MRIA.

1. The bird strikes
2. Low passenger load

Bird strikes are a common problem at airports in America & Europe. There are solutions such as pyrotechnics, lasers & lights, loud speakers, drones etc with varying degrees of success. Look up bird control on Google.

The low passenger traffic is part of a bigger issue. I think the infrastructure is now in place but there is not enough economic activity to justify the airport in the first place. I think the Sri Lankan govt already has a solution & is going ahead with it. It remains to be seen if that is the right solution.

Students may want to look up the article in Forbes. Also look China's Belt and Road Initiative to understand China's interest & the importance of Sri Lanka in its plans. Just a thought..

Figure 4. The strong and weak ties from Group 3.

The explanations given by the experts in Groups 1 and 3 were also seen as more insightful compared to the guidance provided by experts in Group 2.

Discussion and conclusion

According to Bilalic and Gobet,¹⁷ the greater the degree of expertise, the more flexible the experts are in responding to new information. The profile of the business experts from Groups 1 and 3 showed they have vast experiential knowledge, rendering them capable of deciphering information from different perspectives. The experts used more technical terms and jargons which necessitated the students to ask a second party to provide the meaning-making for them. Occasionally, the students were observed needing to rely on the other expert or instructor for the meaning-making process (to put the meaning in a context understandable to the students). This is supported by Ryberg²⁰ who claimed that placing students in different degrees of ties sometimes require different participants like the instructor to provide the interpretation of meaning.

Daniel Kahneman,²⁷ in his book "Thinking Fast and Slow", outlined two thinking systems called System 1 and System 2. System 1 is fast and energy-efficient because it follows the "rule of thumb" and does not involve processing of details; as a result, System 1 thinking is full of shortcomings and biases. In contrast, in System 2, information processing is intricate, time-consuming, and expends more energy, especially when dealing with ill-structured problems. This is where the roles of experts could help in expediting students' effort by simplifying the need to understand. For novice learners, using System 2 may require a longer time for information processing. Nonetheless, the availability of experts with more work experiences could shorten students' thinking process because of the experiential knowledge the experts have that resembles their crystallised intelligence. This is consistent with previous studies that confirmed people tend to use more crystallised intelligence as they increase in age.¹⁰

Additionally, the business experts who used more fluid intelligence had different reasoning styles with the students. Instead of offering the information asked by the students straightaway, the experts from Group 2 often asked the students to search for the materials first, and later worked on the materials together with the students. This was possibly done to avoid offering inaccurate advice as a result of using System 1 thinking. The experts needed to verify the information before formulating relevant strategies to scaffold the students. The experts from Group 2 mostly provided policy papers rather than offering specific real-life business evidence that the students could use as a reference. Possibly, the experts expected the students to put in the effort to search for the information first.

This study also verified that scholars should not equate all weak tie experts as sharing similar problem-solving styles. It is postulated that how the students knew the business experts matters. The business experts from Groups 1 and 3 were from the weak ties; however, the past working relationship that one of the students in each group had with the experts during internship placement led the business experts to display a more empathic attitude towards the students' learning needs. In contrast, the business experts from Group 2 had no prior relationship with the students, thus their preference for using more task-oriented problem-solving styles. Nonetheless, despite their different styles, the inclusion of the experts in the discussion still accelerated the students' learning, in tandem with previous studies that acknowledged business experts' inclusion in PBL enhances students' learning experience.^{28,29}

Conclusion

This study contributes towards our understanding of the roles of problem-solving styles and the strength of ties in problem-solving activities on Facebook. The use of networked learning in PBL depends on individualised networking and social collaboration that encourage content generation in problem-solving.²¹ It can be concluded from the findings that not all experts from the weak ties have similar problem-solving styles. Factors such as the experts' work experience and how the weak ties were developed played a major role in determining the experts' problem-solving styles, which indirectly influenced their thinking and reasoning strategies with the students.

The experts, regardless of whether they were from weak or strong ties, still benefited the students in expediting their problem-solving tasks. Thus, inviting business experts to participate in formal learning on social media by utilising the strong and weak ties the students have should be encouraged as each expert has unique expertise to offer, especially in helping the students see the different sides of complex information that are essential to prepare them for future professional career.

Limitations

The use of non-probability sampling involving two experts in each of the three groups in one degree-level management course limits the generalisability of the findings to other courses. Hence, the study's findings should be evaluated with caution and may only be applied to similar studies, for example, those that examine Facebook use for PBL in management courses.

Data availability

Underlying data

Figshare: Facebook Discussions captured in ATLAS.ti, <https://doi.org/10.6084/m9.figshare.16811542>.

This project contains the following underlying data:

Datafile 1: Transcribed conversation of Group 1

Datafile 2: Transcribed conversation of Group 2

Datafile 3: Transcribed conversation of Group 3

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](#) (CC-BY 4.0).

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Lillian Buus

VIA University College, Aarhus, Denmark

The article works with weak and strong ties in relation to PBL group-work inviting in experts to scaffold students learning.

This is an interesting and relevant research, although I miss a clear theoretical approach, as it seems the theory is not following through the article. The authors present in the introduction 'connectivism' but do not refer to this or their arguments in the introduction or the discussion. I also wish to stress that the first two references are placed wrong and that Siemens is missing an s (just to have some formats in place).

What I would suggest to the authors, is to work a little more with the structure of the article as well. I miss a clear theoretical part, that also can be part of the argumentation in the discussion. So, choose only some of the theoretical approaches brought in, and go more in depth with these arguments.

Another part I would like the authors to consider is the figures. It might be good to structure the 'Excerpt from the groups' after each other, as it becomes confusing to read the analysis 'in between' figures. I also miss the arguments for the statement: "The explanations given by the experts in group 1 and 3 were also seen as more insightful compared to the guidance provided by experts in Group 2" - I miss the "Why" and "How" arguments on this.

I also would like the authors to elaborate more on the analysis and how they have conducted that e.g. with examples of parts that identified the expert's roles. Also, for other being able to in details to replicate the research. Transparency is important, and there is a minor lack in this part.

A part I also think is missing in the methods is the ethical consideration on using SoMe like Facebook for this. Not that it is wrong but I believe that there is some issue combined with this. What if an expert didn't have Facebook or would use this media for professional work issues? What about the right for information on Facebook? Other ethical issues could also be stressed. Just a notion on this could be expected as well when talking ethical issues.

It was positive to read that the authors took into consideration the sampling for the research, which is good. I think the research is interesting and I would like the authors to go more into this to gain more insights for this.

Good work so far and just work on the combination of theoretical arguments and analysis/conclusion will give your article more strength.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Not applicable

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Expertise in Problem-Based learning and education, knowledge about strong and weak ties, from novice to expert (Dreyfuss and Dreyfuss), Teaching with digital technologies and social media use,

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 09 November 2021

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Mohd Nazir Md Zabit

Department of Educational Studies, Universiti Pendidikan Sultan Idris, Tanjong Malim, Malaysia

This paper aims to explore the problem-solving styles that the experts portrayed on Facebook based on their ties with the students.

Overall, the methodology suits the research requirements. It has been clearly explained and easily understood by readers. The only concern is how the authors arrange and monitored the three closed Facebook groups with 12 final year management students, six business experts, and one instructor as the participants. Need a little bit of explanation.

Overall, the manuscript has been written and prepared in a moderate writing style. The work is acceptable based on the suggestions given and should also be based on other assessors' comments.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Not applicable

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Business education; teacher pedagogy; thinking skills

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 08 November 2021

<https://doi.org/10.5256/f1000research.76848.r97807>

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Fauziah Sulaiman

Faculty of Science and Natural Resources, Universiti Malaysia Sabah, Kota Kinabalu, Malaysia

Overall the article is well written and easy to follow. It is about the use of PBL in the Facebook platform to students' engagement in real-life activities by involving the business expert as the booster for them to really immersed in the issue they are facing. However, the weak and strong ties in this research are lacking with basic info, for example, why does the student need to choose by themselves the business expert? Why not the researcher choose the business expert? Therefore the weak, strong, and weak+strong group setting maybe can be arranged. Having these totally different group settings can lead maybe different impactful outputs. Just a thought anyway.

So these are my comments on the statement that I commented as partly:)

Other than that, all looks adequate.

A few additional comments on the manuscript can be found [here](#).

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.**Reviewer Expertise:** Education: Physics/Science Education, Educational Technology, Higher Education, in-depth in Problem Based Learning Model. Physics: Non-Destructive Testing (Eddy-Current Testing Technique)

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 02 November 2021

<https://doi.org/10.5256/f1000research.76848.r97804>

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Els Boshuizen

Faculty of Educational Sciences, Open University, Heerlen, The Netherlands

This article investigates how external experts (that is, not connected to the university) with weak or strong ties to the students can support them through social media in their problem-based learning activities.

It is investigated in three PBL groups of four students each, who worked on divergent topics, and who invited two domain experts per group. The Facebook platform was used for communication and cooperation as it provides ample opportunities for data collection.

A couple of theoretical foci were applied: strong vs weak ties; PLE as a means to receive on-line scaffolding; expertise seen as fluid vs crystallised intelligence; aspects of expert-novice interaction; Selby's problem solving styles; system1 vs system2 thinking. One could say that this is an innovative combination of theoretical approaches, however - in my view - it blurs the real innovation in this study, that is, the participation of outsider-experts in student support through many different expert actions: providing information and information sources, pointing out gaps, asking questions, etc. combined (or not) with motivating actions. Also the role of the instructor as a go-between students and experts is an interesting addition. And I agree with the authors that the participation of these experts was successful.

Having said that I list a couple of issues that need clarification:

1. The authors should make clear why they introduced the theory of fluid and crystallised intelligence to describe expert reasoning and knowledge use in combination with interaction with novices. Using this theory introduces connotations that might not be intended. Especially in a short article like the present one, it is better to be sparsimonious with concepts used. Very much research has been done on the issue expert-novice communication in PBL including the question whether intermediates might fulfil a better role (for instance by Schmidt and Moust) that does not use these concepts.
2. Furthermore, the authors should better document how the use of fluid vs crystallise intelligence was coded. And in the Results section it is good practice to provide proof using quotes. The excerpts given provide interesting reading material but they do not show how the researchers coded this.
3. The issue of strong vs weak ties is very interesting. I wonder whether the way expert invitation was carried out was sensitive to tie strength. I assume that available expertise was the decisive factor, not kind of tie. It is, of course, interesting whether kind of tie affects communication.
4. The issues raised by Bilalic et al. and by Kahneman resonate in different ways with fluid and crystallised intelligence. They are very interesting but by introducing these authors it is

more difficult to bring the message across.

5. Small issue p7: According to Bilalic, McLeod, and Gobet .. McLeod is missing.

6. As the journal's focus is on fast publication, I would prioritise the comments on Method and Results.

Is the work clearly and accurately presented and does it cite the current literature?

Partly

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

No

If applicable, is the statistical analysis and its interpretation appropriate?

Not applicable

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Expertise development; expert vs novice knowledge and knowledge structure; expert vs novice reasoning.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 02 Nov 2021

Aznur Hajar Abdullah, Multimedia University, Cyberjaya, Malaysia

Dear Prof Els Boshuizen,

We are greatly appreciative of the insightful comments and helpful suggestions that you have provided.

Some of the issues are somewhat similar in term of the responses, so we encapsulated issue 1 and 3, in the last comments (comment no# 5).

The following are our response on the five issues that you have highlighted:

1. Thank you for proposing Schmidt and Moust's paper, we had read the paper with great interest. Schmidt and Moust studied about what makes a tutor effective and we found some similarities in the line of argument, that also emphasizes the personal qualities of the tutor. In essence this study proposed, do not presume experts from similar ties would offer similar degree of scaffolding as their degree of scaffolding corresponds with the level of crystallised intelligence that they have. We have commented more detailed in comment #5 below).

2. * In the revised version later, we will incorporate more clearly on why the theory of fluid and crystallised intelligence was used.

3. In the original submission the codes were attached, but they were coded directly from Facebook communication (all Facebook communications were the snapshots from Facebook and coded in ATLAS.ti). Despite the identities of all participants were cancelled and made anonymous, for copyright purposes, the F1000 reviewer recommended to transcribe the conversations as they cannot be published with any element associated to Facebook.

*In the revised version, we will incorporate again the coding.

4. To some extent we believe the ties matter as strong tie and weak tie with more working experiences who showed differing in levels of intelligence (fluid vs strong intelligence) - they were more accommodative to students' learning needs. Explaining about the tie per se seems incomplete to explain why not all weak tie experts behave in similar manner when scaffolding the students. Experts from Group 2 showed different scaffolding approach from experts from Group 1 and Group 3. We have commented more detailed in comment #5 below).

5. Rather than looking at Bilalic and Gobet resonate differently from Kahneman's, we opine that the arguments from these authors complement the findings of this study. Bilalic and Gobet resonate the flexibility of the experts is in accordance with the degree of fluid and crystallised intelligence that the experts have. This study showed that, experts with lesser working experiences tended to seek "help" or to rely on information provided by the students before they could fully utilise System 2 thinking to scaffold the students to deal with ill-structured problems. Although novices have to go through certain stages before they could pick up and put pieces of information into a meaningful context, your comments made us realise, the experts with less crystallised intelligence need to put pieces of information too. Interestingly, we view this as a pre-scaffolding preparation that experts from Group 2 in this study exhibited before they could devise an appropriate assistance to students. Your comment has enlightened us to propose future research to investigate the reciprocal role that students could play in scaffolding the experts' thinking.

In the revised version we will improve the clarity of the sentence to capture the above comments in the revised version. If you agree with the above comments, please let us know.

Thank you again for your time in reviewing this manuscript.

Competing Interests: No competing interests were disclosed.

Comments on this article

Version 1

Author Response 21 Nov 2021

Aznur Hajar Abdullah, Multimedia University, Cyberjaya, Malaysia

Dear respected reviewers,

Thank you for your time in reviewing the manuscript and providing insightful comments.

We just would like to let you know that we are in the midst of incorporating all the changes that you had proposed.

Regards,
Aznur, Neo (Ken), Low (Jimmy)

Competing Interests: No competing interests were disclosed.

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