



Self-Directed Learning

Problem-based learning to foster self-directed learning in geography education

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With all the special guests here tonight, I'll try to



Introduction

“To teach I would build a trap such as that, to escape, my students must learn”

(Robert M. Chute, 1971).

- In my doctoral study with the topic:

“Criteria and strategies for the optimising of contact time in achieving the learning outcomes in the geography training of student teachers”

- I really experienced the value of actively involve geography student teachers in the learning process.
- After I have finished my doctoral study and publishing a few articles on various topics, our then dean (Prof. Petra Engelbrecht), suggested that I must focus on self-directed learning (SDL).

- It is necessary to point out that **teachers** play a pivotal role in providing a **learning environment** conducive to the development of **responsible and self-directed behaviors** in students and learners (Golightly & Guglielmino, 2013).
- Against this background my research interest became more focused on the development of **geography student teachers' SDL skills** using **problem-based learning**.

In my discussion I'll refer to the following:

- ✓ **Self-directed learning**
- ✓ **Problem-based learning**
- ✓ **The influence of PBL on students' SDL**
- ✓ **Providing an example of how to implement PBL in B.Ed. Geography modules**
- ✓ **Future research**

Self-directed learning

- The most common definition - Knowles (1975), who defines **self-directed learning** as:

“a process in which individuals take the initiative, with or without the help of others, to diagnose their learning needs, formulate learning goals, identify human and material resources for learning, choose and implement appropriate learning strategies, and evaluate learning outcomes.”

- A student can become a self-directed learner without explicit instruction and development of these traits, but it is **more likely to occur when lecturers/ teachers foster SDL in educational settings** (Levett-Jones, 2005).

- To promote SDL is to **create learning environments and spaces** in which it can be developed (Levett-Jones, 2005).
- Using **active learning strategies** allows the **practice of SDL** by combining subject content with the application thereof in learning activities (Francom, 2010).
- In the literature it is stated that **PBL**, as a teaching and learning strategy, has all the attributes to assist in fostering students' SDL skills (Golightly & Guglielmino, 2015; Bao et al., 2010; De Simone, 2014; Pepper, 2009; Spronken-Smith, 2005)

Students have different levels of SDL readiness

- Kwan (2003) pointed out that **readiness for SDL** exists along a continuum and is, to some extent, present in all individuals.
- The **instruments** most widely used in educational research to measure SDL readiness, are:
 - **Guglielmino's (1978)** - Self-Directed Learning Readiness Scale.
 - **Fisher et al., (2001)** - Self-directed learning readiness scale for Nursing Education.
 - **Williamson's (2007)** - The self-rating scale of SDL.
 - **Cheng's (2010)** - Self-directed learning instrument.

Problem-based learning

- It is defined by its founders as:

“the learning that results from the process of working toward the understanding or resolution of a problem.”

(Barrows & Tamblyn, 1980:18).

- PBL has had **little impact on teacher education and school education** and relatively little research has been published on PBL in teacher education settings (Hmelo-Silver, 2004; Kwan, 2008).
- However, this has changed over the last decade!

Why PBL?

“We only think when we
are confronted by a
problem”

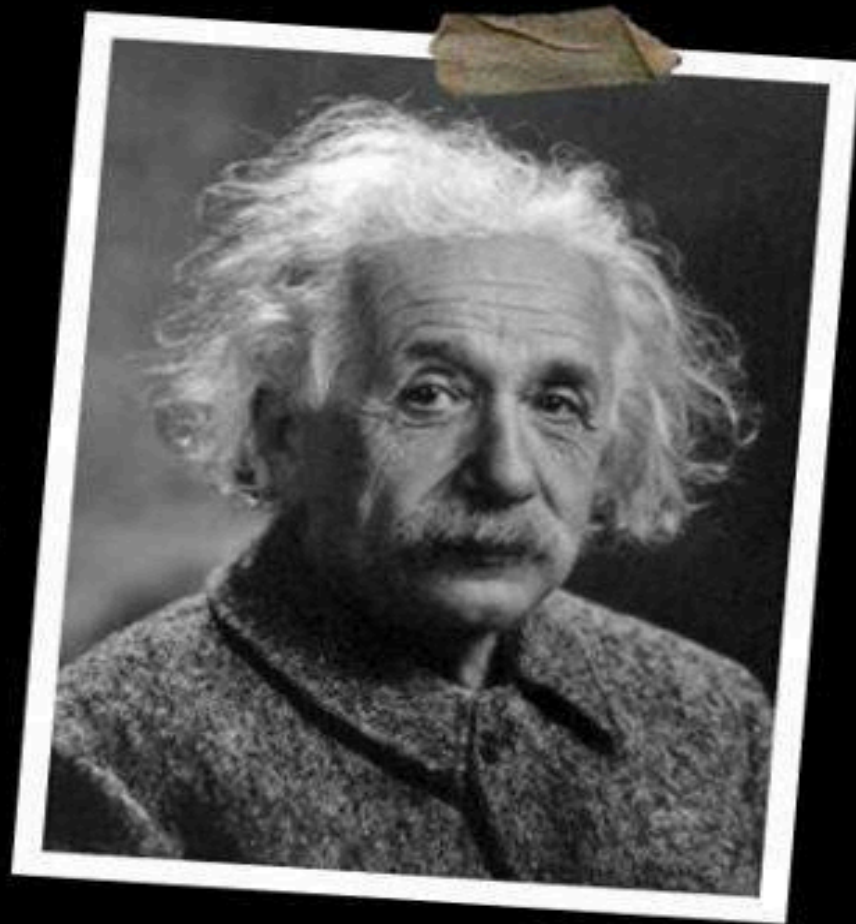
(John Dewey)







**"Education is not
the learning of
facts, but the
training of the mind
to think."
-Albert Einstein**



PBL and 21st century skills



- **PBL** can foster and develop the abovementioned **21st century skills** (Hussin, Harun & Shukor, 2019: 20; Kek & Huijser, 2017: 31), as **learning is structured in real-world contexts** (Kelley, Fowlin, Tawfik & Anderson, 2019)

As a geographer I believe we urgently need more good problem-solvers in our world!!



Active learning and PBL

- Teaching and learning strategies with roots in **constructivism** (Scheer, Noweski & Meinel, 2012: 8)



Main features of PBL:

- A **real world ill-structured problem** stimulates learning
- **Student-centred learning**
- Learning is done in **small student groups** (4-6 students)
- Facilitators **guide** the students rather than teach
- New knowledge is obtained through **self-directed learning**.

PBL process (Schmidt & Moust)

- Present the students with a **real world ill-structured problem**;
- Students learn **collaboratively** (4 to 5 group members);
- Students **discuss the problem** with their fellow students - proposing possible explanations or solutions during tutorial meetings.
- Discussions lead students to **formulate learning issues** for further SDL.
- Students spend time **researching, selecting and studying literature**;
- After this period of self-study, students **share and critically evaluate their findings, elaborate on knowledge** acquired and have opportunity to correct misconceptions.
- Provide **solutions** to the stated real-world problem

Tutorial sessions in PBL



Role of the lecturer in PBL environments

The self-directed approach of PBL suggests changes on the part of the lecturer. The role of the lecturer is to:

- Act as the **facilitator and guide** of students' self-directed learning and collaboration with group members (Van der Vleuten & Schuwirth, 2019: 903).
- **stimulate the discussion,**
- provide students with **relevant content information** if needed,
- be responsible for **continuously giving formative feedback** to the PBL groups (Koh et al., 2019).
- **evaluate the progress** (Koh et al. 2019)
- engage actively in **didactic conversations** with the learners,
- provide **appropriate scaffolds** (Schmidt et al., 2009).
- **create problem scenarios** and **design various types of problems** for PBL activities (Jonassen 2011: 96).

The facilitator supports and guides group members in PBL tutorials



Role of the student in PBL

Students also fulfil new roles, such as:

- **functioning** as members of a team;
- **formulating** learning issues;
- **learning collaboratively** by sharing their newly acquired knowledge;
- **contributing** to the discussions during the tutorials;
- **researching** the formulated learning issues;
- **sharing** information with each other;
- **listening** to each other's contribution and **asking** open questions;
- **applying their knowledge** to solve the problem by presenting multiple solutions; and
- **assessing** their own as well as the group members' contributions

Independent learning in PBL



PBL MODELS/ FORMATS

- **Pure PBL** - when the entire curriculum content is delivered and learnt through real-world problems (McMaster University – Canada).
- **Hybrid PBL** - the facilitator can provide students with the necessary guidance and support during the PBL process through direct instruction such as mini-lectures and demonstrations.
- **Integrated PBL** – PBL is *integrated* in the traditional curriculum (in modules) for a few hours or weeks

Scaffolds in PBL activities



Hard scaffolds in PBL activities

- The **training video of PBL** - uploaded to the university's LMS (Efundu)
- The **short workshop on PBL** presented by the geography lecturer
- The use of the **reflective hints template** during the PBL process
- The use of **assessment rubrics** on how the PBL report will be assessed
- The provision of **pre-reading materials on PBL** as a teaching and learning strategy
- **Written guidelines** on the role of the facilitator, group leader and group members in the completion of the PBL activities
- **Prescribed articles and textbooks** in solving the stated geography real-life ill-structured problems
- **Groups consulting their own resources** (articles, textbooks, videos, internet resources, etc.)
- The **completion of the self- and peer-assessment rubric** regarding group members participation in solving the stated geography problem

Soft scaffolds in PBL activities

- The facilitator provides **support and guidance** at the appropriate time and level in PBL tutorial sessions
- The **facilitator's responses to group members' efforts** when a group member indicates a specific need
- Group members receive **support and help from fellow group members** during the PBL process
- The **facilitator provides hints and cues** to the different groups
- **Guided questions** by the facilitator to groups during the PBL process
- **Group presentations** of the possible solutions to the stated geography problem at the end of the PBL activity
- **Class discussions** generated by questions raised after the group presentations

Why PBL?

Lectures



PBL



Assessment in PBL

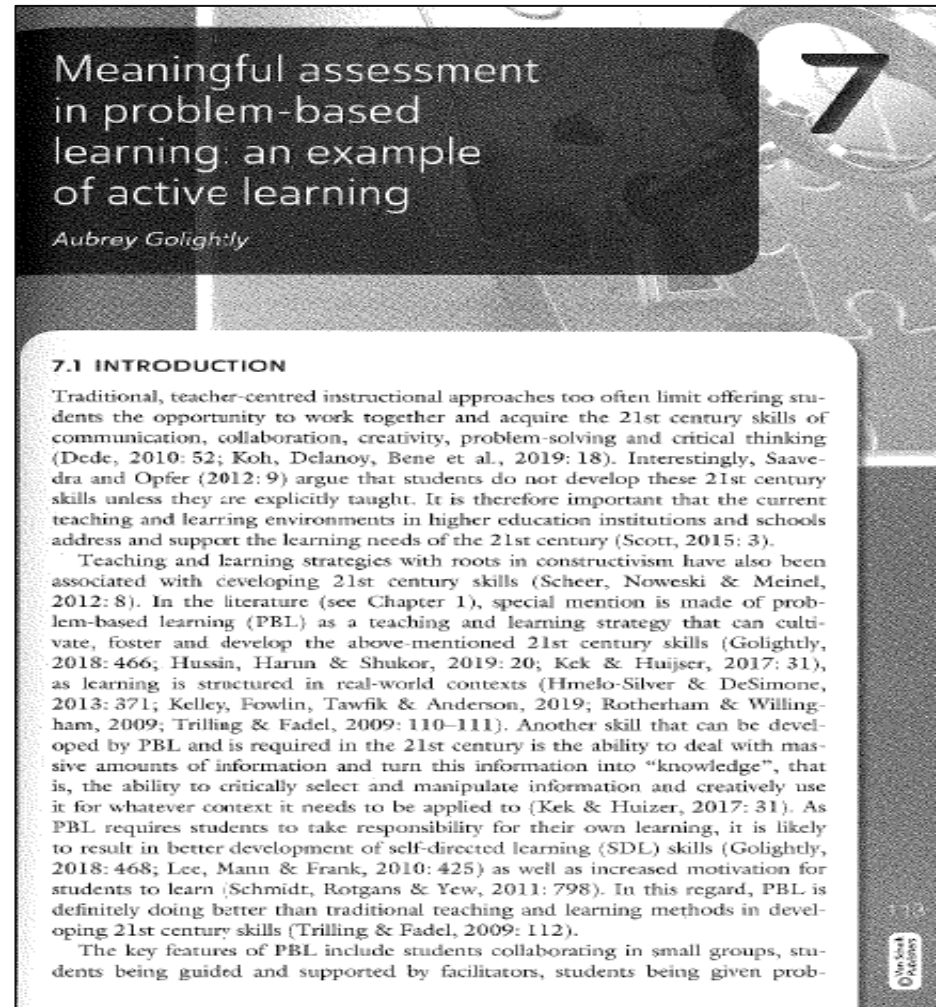
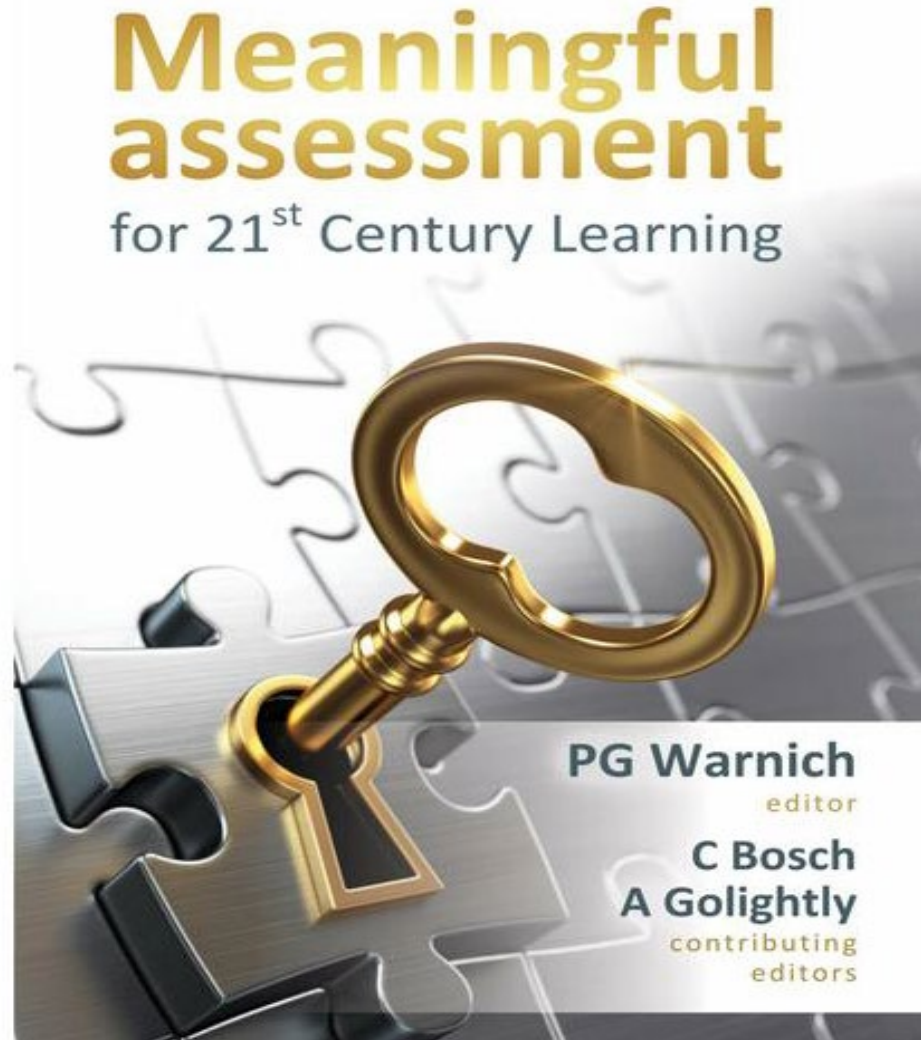
A repertoire of appropriate **assessment of, for and as learning tasks** and methods are essential in assessing students' deep learning of knowledge and skills (Lu et al., 2014: 299).

- ✓ **Assessment of learning** = referred to as “summative assessment” and involves reporting on learning at the end of the PBL activity. (Lecturer assesses the groups' PBL reports)
- ✓ **Assessment for learning** = referred to as “formative assessment” in the form of continuous feedback on a regular basis during the learning process is essential (Albanese & Hinman, 2019: 392). (The lecturer giving feedback to the groups in order to improve their PBL report)
- ✓ **Assessment as learning** reinforces and extends the role of assessment *for* learning as group members are involved in **assessing their own and their fellow group members' contributions and progress in the PBL activity** (Siarova et al., 2017: 40).

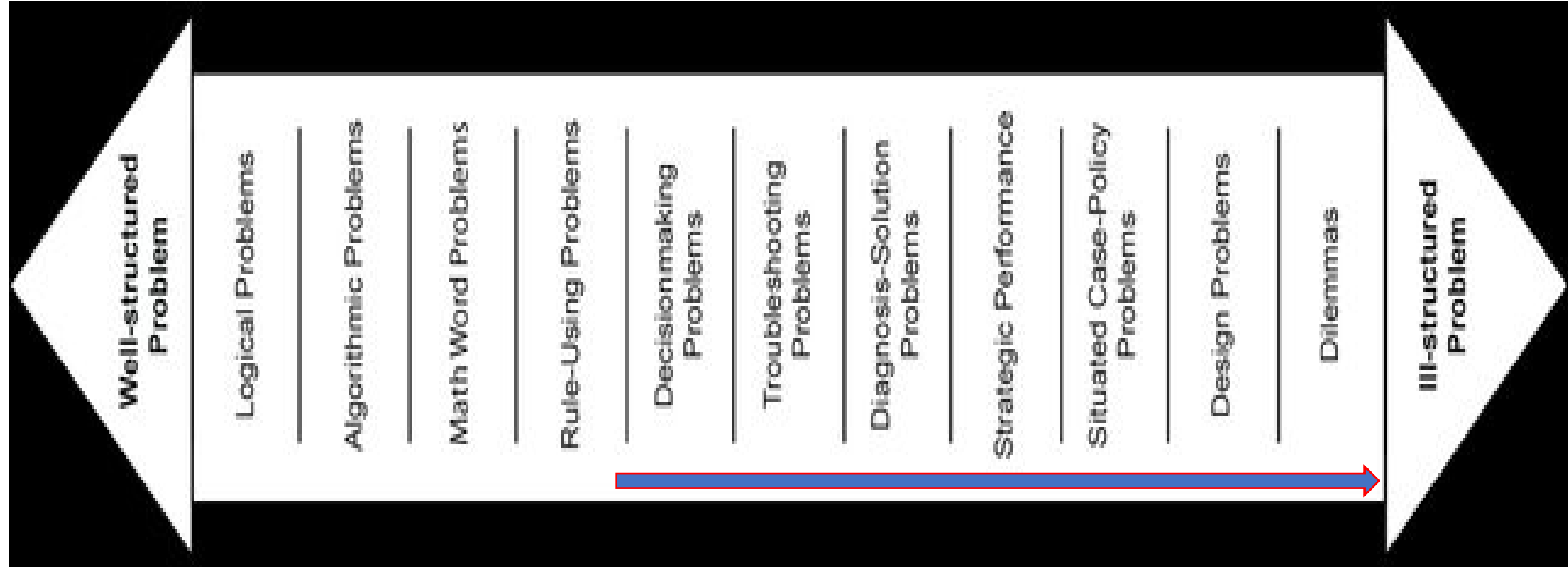
Table 7.1 Assessment rubric for the PBL report

Criteria	Marks	Excellent	Good	Efficient	Inefficient
Demarcation of the problem	___ /4	The demarcation of the problem has been done very well and is complete. (4)	The demarcation of the problem has been satisfactory. (3)	The demarcation of the problem shows gaps and needs further attention. (2)	The demarcation of the problem is poor and vague, and needs to be redone. (1)
Formulation of the learning objectives	___ /8	The learning objectives are well defined and formulated completely. (7–8)	The learning objectives are defined satisfactorily. (5–6)	The learning objectives are incomplete and not well defined. (3–4)	The learning objectives are poorly defined and incomplete. The learning objectives need to be reformulated. (1–2)
The scope and quality of the provisional research	___ /20	An exceptionally well- developed description has been given of the health issues that are found in low-income areas. It shows a good understanding of the problem. (16–20)	A satisfactorily developed description has been given of the health issues that are found in low-income areas, which shows a good understanding of the problem. (11–15)	The description of the health problems in low- income areas should be further developed, since there are gaps in the understanding of the problem. (6–10)	There is a poorly developed description of the health problems in low-income areas, which leads to a poor understanding of the problem. It needs to be redone. (1–5)
The use of recent literature, resources and data	___ /8	The use of recent scientific resources and data is excellent. (7–8)	The use of resources and data is good. (5–6)	Recent resources and data have not been used and need further attention. (3–4)	Not enough resources and recent data have been used, and it needs to be redone. (1–2)
Identification and recommendation of possible solutions to the problem	___ /12	Complete and exceptionally well- formulated solutions to and recommendations for the problem are provided. (10–12)	Complete and well-formulated solutions to and recommendations for the problem are provided. (7–9)	Only some solutions and recommendations are applicable to the problem. (4–6)	Very poorly formulated solutions and recommendations are provided. (1–3)
Writing skills	___ /4	The report is impartial and written in a highly professional style. (4)	The report is impartial and professionally written. (3)	Parts of the report do not testify to impartiality and professionalism. Spelling mistakes are common. (2)	The report does not testify to impartiality and professionalism. There are too many spelling mistakes. The report needs to be rewritten. (1)
Referencing	___ /4	Referencing in the discussion is professional, effective and correctly quoted. The bibliography is complete and correct. (4)	Referencing in the discussion is quoted well. Resources are quoted correctly in the bibliography. (3)	Some of the resources were not referenced or quoted correctly. Not all the resources have been provided in the bibliography. (2)	No reference has been made to resources. Resources have not been quoted correctly. The resources were not provided in the bibliography. (1)
Total	___ /60				

Assessment handbook – Chapter 7



Different types of problems (Jonassen, 2000)



Self-directed learning in problem-based learning

- In PBL, **self-direction** is seen as a critical component (De Graaff & Kolmos, 2003).
- Specific **PBL features** support the development of students' SDL skills (Hmelo & Lin, (2000).
 - ✓ The **student-centred** nature of PBL,
 - ✓ Students start working on a **problem** before they have received **other curriculum inputs**,
 - ✓ PBL students **collaborate with group members** to help solve the problem,
 - ✓ The identification of their **knowledge deficits**,
 - ✓ The generation of their own **learning issues**,
 - ✓ Students' **self-directed research** and **individual study**,
 - ✓ The **critical evaluation** of the literature resources,
 - ✓ The application of the **new knowledge** to solve the problem, and
 - ✓ The **critical and collaborative reflection** on their SDL skills.

Problem-based learning to foster self-directed learning

- PBL develops students' **SDL skills** (Savery, 2016:8; Bao et al., 2010; Koh, Khoo, Wong, & Koh, 2008).
- Most of the evidence supporting PBL in fostering SDL has been reported by higher institutions with **pure PBL curricula** (Bao et al., 2010; Koh, Khoo, Wong, & Koh, 2008; Litzinger, Wise, Lee, & Bjorklund, 2005).
- In contrast, the evidence from the **integrated PBL model on SDL** is rather inconsistent.
 - Walker and Lofton (2003) reported a **decrease** in SDLR scores of PBL students in the first 16 weeks of their pharmacy studies.
 - Aziz, Zain, Samsudin and Saleh (2014) reported **an improvement** in students' perceived readiness in SDL after the implementation of an integrated PBL experience.
- More evidence is required to understand whether the implementation of an integrated PBL model **over a longer period of time** actually leads to students becoming better self-directed learners.

The implementation of PBL in B.Ed. geography modules to foster SDL: An example

Year Level	Semester 1 (10 weeks)	Semester 2 (10 weeks)
Fourth-year geography modules (GEOD411/ LASD421)	Fourth-year students act as tutors	Fourth-year students act as tutors
Third-year geography modules (GEOE311 & GEOE321)	----- (M5) PBL**	PBL** (M6) -----
Second-year geography modules (GEOE211 & GEOE221)	----- (M3) PBL*	PBL* (M4) -----
First-year geography modules (GEOE111 & GEOE121)	----- (M1) PBL*	PBL* (M2) -----

* – Implementation of face-to-face integrated PBL activities (3 weeks per semester/6 weeks per year) (M1-M2; M3-M4)

** – Implementation of the integrated online PBL activities (3 weeks per semester/6 weeks per year) (M5-M6)

----- – Normal classes

M1-M6 – Measuring students' perceptions of their readiness in SDL before and after each PBL intervention



Table-1. PBL activities integrated in the different geography modules in the B.Ed. programme¶

Year¶	First-semester¶	Second-semester¶
First-year¶	GEOE111 Introduction to Africa and South Africa¶ Theme: Water usage in urban areas¶ Municipalities in South Africa have been hit by service-delivery protest over water shortages. A few people were killed allegedly at the hands of police (News24). Water supply by municipalities in South Africa is a basic service that must be provided to urban residents. Municipalities country-wide experience problems to properly render this basic service. Provide possible strategies and guidelines to municipalities and households in using water more wisely.¶	GEOE121 Planetary Geography and Climatology¶ Theme: Learner-centred instruction of Planetary Geography themes¶ The social constructivist approach to learning has implications for teaching geography topics, such as insolation differences on earth, origin of seasons, time differences and calculations of time on earth to first-year students. Assist the geography lecturer in planning learner-centred activities for the abovementioned topics.¶
Second-year¶	GEOE211 Settlement and Economic Geography¶ Theme: Rural settlements: Land reform in South Africa¶ Land reform: Two and a half centuries of conquest and settlement by European colonialists in South Africa deprived Africans of most of their land. Since the election of a new government for South Africa in 1994, there has been no real progress with land reform. Assist the South African government in developing a plan and strategies to secure more agricultural land for black farmers. ¶	GEOE221 Environmental Geography¶ Theme: Water quality¶ South Africa is a water-scarce country and we need to manage water properly. To encourage the different municipalities to improve the quality of drinking water and water sources, the Department of Water Affairs annually awards Blue and Green Drop status to municipalities for the effective treatment and monitoring of drinking water, as well as the management of responsible water consumption and maintenance of services. The Tlokwa municipality (Potchefstroom) has for the past few years received the Blue as well as the Green Drop award. However, the question still remains as to the quality of the water in the Mooi River in Potchefstroom. The local newspaper asks you, as geography students, to determine the water quality of the river by using miniSasa and, if necessary, to make recommendations to the local government on how to improve the river's water quality.¶
Third-year¶	GEOE311 Population Geography and Urban Geography¶ Theme: Poor health in low-income urban areas¶ As beginner geography teachers in a school situated in a low-income informal settlement in Ucagong Potchefstroom, you become aware that the geography learners in your class are absent on a regular basis. In discussions with the principal, teachers, as well as the clinic sisters at the nearby medical clinic, the poor health conditions in the low-income dwelling areas are highlighted as the main reason. The government body of the school ask you to provide possible solutions to the poor health problems of learners and residents in the area. ¶	GEOE321 Climatology and Geomorphology¶ Theme: Climate change in South Africa¶ Global warming and modern climate change are considered a serious problem world-wide and, according to scientists, this threatens the future existence of man on earth. In South Africa there is great concern about the impact that climate change (global warming) will have on our country's people and environment. ¶ The Department of Agriculture Conservation and Environmental Affairs requests a report from the geography students with reference to the presence of climate change in South Africa, as well as possible measures which the SA government could implement to, firstly, help manage this problem and, secondly, to combat it drastically. The Department also wishes to know what can be done by individuals and households to make a meaningful contribution.¶

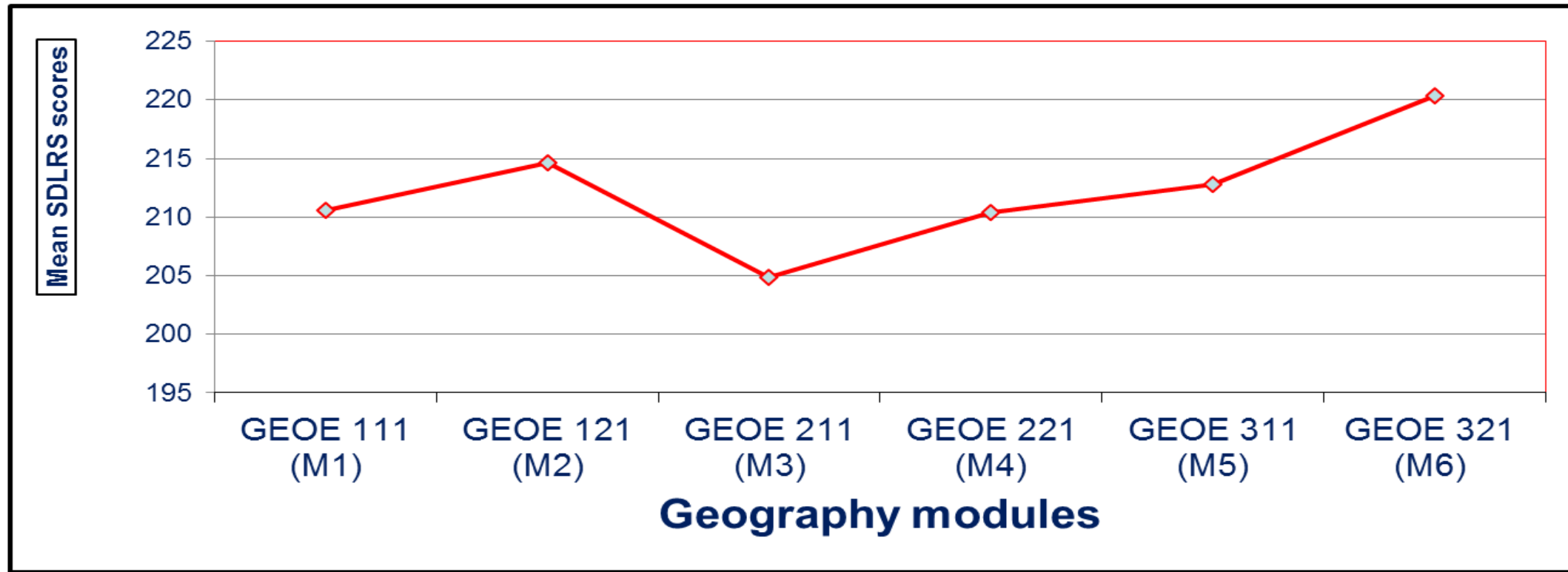
→ (Golightly, 2018)¶

Research method

- A **case study approach** was used for this research (Creswell, 2009).
- In this case study, the **longitudinal equivalent time samples design** (Leedy & Ormrod, 2001) consisted of making a series of observations over a three-year period in measuring the influence of the implementation of PBL in the different geography modules on B.Ed. students' perceptions of their SDL.
- Data collection
 - **Quantitative data**
 - **Self-Directed Learning Readiness Scale** (Guglielmino, 1978)
 - 58 items
 - Students were asked to rate each item on a five-item scale (**1 = almost never true of me; 2 = not often true of me; 3 = sometimes true of me; 4 = usually true of me; 5 = almost always true of me**).
 - A **high score** implies that a student requires **less guidance in learning** than a student with a lower score.
 - The range of the instrument is between **58 and 290**, with the mean score for adults at **214.00 + 25.59**.
 - The levels of readiness for SDL are as follows:
 - **< 176 – low;**
 - **177 to 201 – below average;**
 - **202 to 226 – average;**
 - **227 to 251 – above average;**
 - **252 to 290 – high** (Guglielmino, 1978).
 - **Qualitative data**
 - **Semi-structured individual interviews**

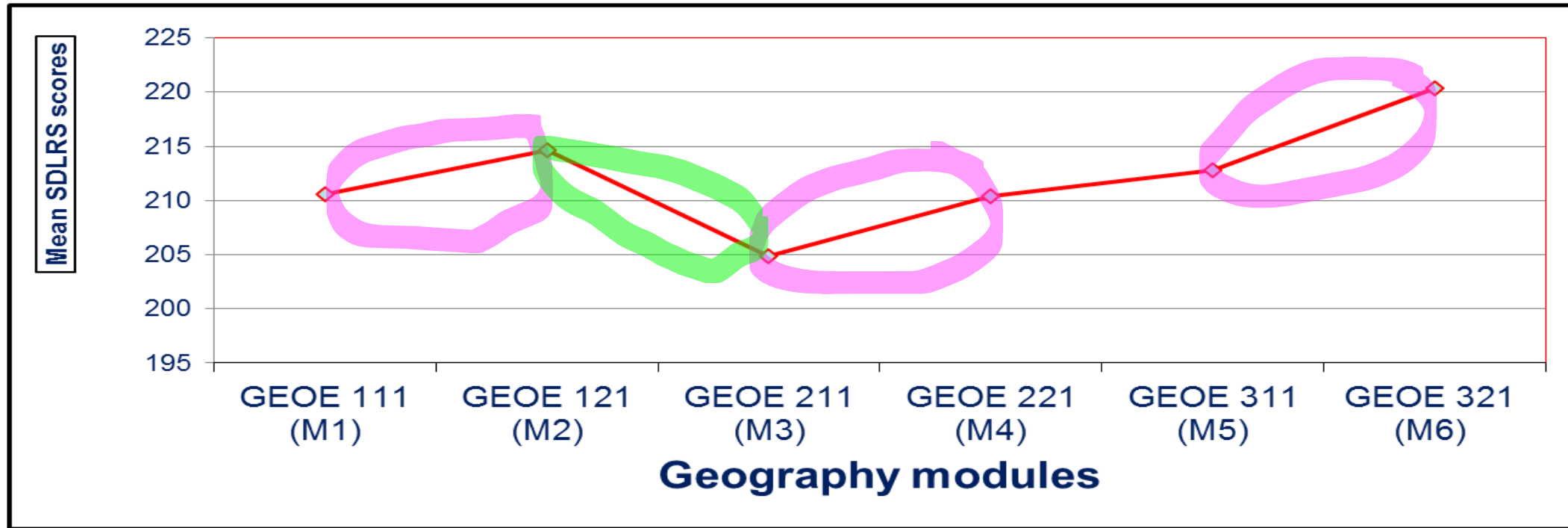
Results

Figure 2 Geography student teachers' perceptions of their readiness in SDL with the implementation of the integrated PBL model in the Geography curriculum



Results

Figure 2 Geography student teachers' perceptions of their readiness of SDL with the implementation of the integrated PBL model in the Geography curriculum



SDLRS scores of Geography education students over the 3 years

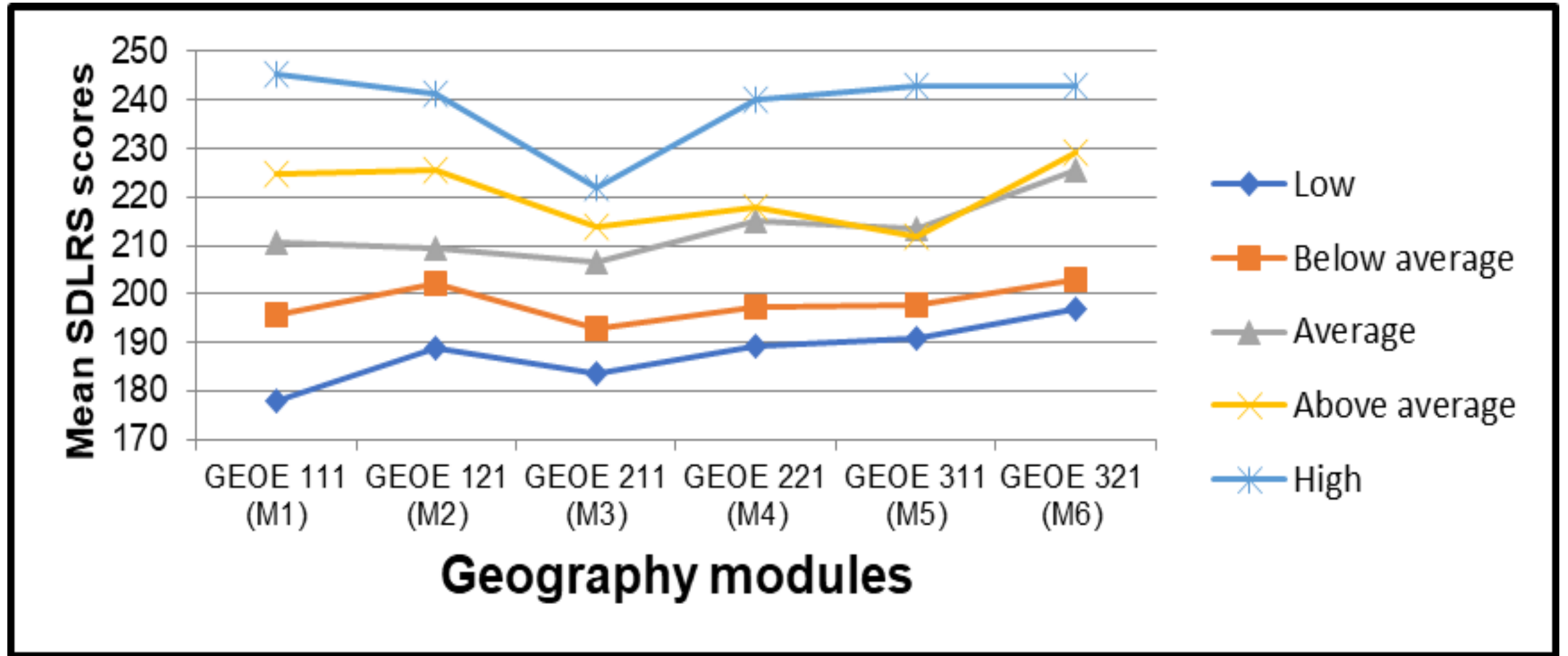
- Geography student teachers' mean SDL scores **increases occurred after each PBL intervention** in the Geography modules (Figure 2).
- These mean SDL scores have **small to medium practical significant increases ($d = 0.27, 0.37$ and 0.52)** with the three PBL interventions (See M1 to M2; M3 to M4 and M5 to M6).
- Interestingly, the **highest increase in students' mean SDL scores**, from 212.8 to 220.4, occurred in the **third year's online PBL intervention** (M5 to M6), with a practical significant increase ($d = .52$) in this period.
- However, a **high decrease** in Geography student teachers' perceptions of their mean SDL scores occurred in the period between the first year's PBL intervention and the second year's PBL intervention (M2 to M3), with a medium practical significance decrease ($d = .66$).

- The average level of readiness for SDL among first-year geography students at the **beginning of the study was lower when compared to other studies in other disciplines** using the same SDLRS questionnaire (Premkumbar et al., 2014; Walker & Lofton, 2003).
- A possible reason for the lower readiness in SDL of geography students in a South African context = most of the students had been exposed to **teacher-centred instruction as learners** in most South African classrooms (Warnich & Meyer, 2013).
- The integrated PBL model in the geography curriculum had **positive influences on students' perceptions of their readiness in SDL over time**. This study concurs with other longitudinal studies from other disciplines **where PBL was implemented over longer periods of time and where students' SDL scores increased** (Bao et al., 2010; Rezaee & Mosalanejad, 2015).
- **Possible reasons for the increase in students' perceptions of their SDL** with the implementation of integrated PBL experiences in this study can be ascribed to:
 - **student tutors and group members supporting geography students in the PBL environment**
 - **solving real-world geography problems.**

- These findings support Williams, Alwis and Rotgans (2011), who stated that students benefit from being facilitated by **student tutors because of cognitive and social congruence**.
- The important role **of group members** in fostering fellow group member's SDL skills during PBL activities was highlighted by the respondents.
- Respondents highlighted the importance of **using real-world geography problems in motivating them to do research**. These findings concur with Lambe's (2007) view that when students address **real-life problems** in teacher education, they **are increasingly motivated to investigate such issues** further.
- The geography students' involvement in the **online PBL activities** in the third-year geography modules encourages them to take responsibility for their own learning.
- This finding supports Sua and Beaumont's (2010) view that solving problems in **wikis/ google docs online promotes interaction, discussion, collaboration, reflection, co-creation, and the sharing of information and ideas among group members**.

- Possible reasons for the geography students' **drastic drop** in average SDL scores at the beginning of the second year PBL experience.
- This contrasts with other studies where the **decrease in students' SDL scores occurred at the end of the first PBL experience** (Litzinger et al., 2003; Reio & Davis, 2005).
- In this study respondents mentioned that most of them had been challenged by their involvement in a PBL environment in the first year, and therefore they **were uncertain and nervous to be involved in PBL activities in the second year**, after a few months of traditional instruction.
- The **steep decrease in students' SDL scores** in this study can possibly be ascribed to the fact that students who entered university had a **greater anticipation and expectation of a new learning environment**, such as PBL (Maung et al., 2007).
- After adaptation to the learning environment, the students faced a **“honeymoon effect”**, meaning the self-directed behaviour would **fade after a period of time**.
- After passing the phase, students would enter **an acceptance phase**, in which they would reflect on their learning process and get a **deeper appreciation of SDL**.

The influence of an integrated PBL model on geography student teachers' perceptions with different levels of SDL scores



- Student teachers who held the perception of **high levels of readiness in SDL**, showed a **steep decrease in SDL scores** with the implementation of the PBL in their first year, after which there was an **increase in the second and third year** in their perception of their readiness in SDL.
- A possible reason could be that **high academic performances in geography at school level** can cause students to have **misconceptions of their SDL abilities**.
- Walker and Lofton (2003) believed the **inflated perceptions of students' regarding their self-directedness in learning** could be tamed over time with the implementation of PBL.

- Students who held the perceptions that they had an **above average level of readiness in SDL** at the beginning of the PBL interventions **initially decreased**, after which there was a **steady increase in their mean SDL scores**.
- The geography student who had measured **very low, low, and average SDL levels at the beginning of the study**, showed **an increase in SDL scores** with the implementation of PBL over the three years.
- In this regard Biggs and Tang (2011) stated students with **low self-directedness in learning** were challenged in the PBL environment to, with time, take responsibility to learn on their own.

Summary

- The effective implementation of PBL in geography education can **influence** geography students' perceptions of **their self-directedness in learning**.
- For the best results to help foster geography students' self-directedness in learning, it is necessary to implement PBL experiences at **regular intervals** in the geography modules in the different academic years.
- The **involvement of students in face-to-face PBL experiences** makes it easier for them to be involved in on-line PBL experiences.
- The **geography student tutors, who act as facilitators** in the PBL process, plays an important role in guiding the students in solving real-world geography problems.
- The **training of geography student tutors and students** to fulfil their new roles in face-to-face and online PBL environments is of the utmost importance.
- **Real-world geography problems** motivate students to learn.
- The provision of **hard and soft scaffolds** is important to assist students to take responsibility for their own learning.

Future research

- I am currently involved in a Geography education project, where I want to explore the **relationship between geography teachers' level of SDL, their involvement in self-directed professional development activities and the implementation of active teaching-learning strategies in the geography school curriculum.**

With reference to my future research, I want to focus on the following:

- **The implementation of PBL activities in the school geography curriculum**
- **The planning of meaningful geography problems**

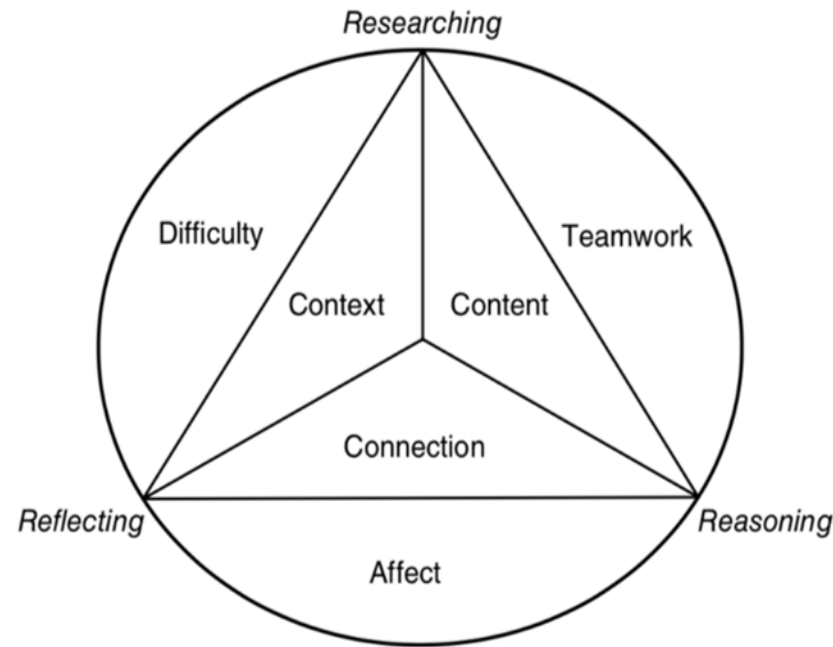
Planning, designing and implementation of PBL

- In this research I plan to involve **my preservice geography teachers** and **geography teachers** in the **designing, planning and implementation of PBL activities** in the geography school curriculum **during the WIL period.**

Design of geography problems

- Distinct feature of PBL - its **problem-driven instruction** (Barrows, 1996)
- **Problem** itself is a vital cause of the success of PBL (Duch, 2001).
- The design of the problem could influence **students' overall learning experience and outcomes** – because the entire PBL process is built upon the problem.
- Against this background Hung (2006) proposed the **3C3R problem design model**, and then later developed the **2nd generation 3C3R model** (Hung, 2019).

2nd generation 3C3R PBL problem design model (Hung, 2019)



- I would like to use this **framework** to assist my geography students (and geography teachers) in **planning and designing geography problems** to help foster SDL.
- I want use my NRF funds to visit Prof. Woei Hung at the University of Missouri-Columbia in North Dokota to collaborate with him in **designing a guiding template that student teachers/ school teachers** can use to plan good PBL problems.

Wow, PBL is definitely the way to go!



