

Accountability and Project-based Learning

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Abstract

We offer a review of the publications concerning accountability of instructors and students for project-based learning (PBL) in an educational institution. At first, the PBL approach, its methodological justification, and the characteristics of the PBL environment that promotes taking accountability for learning are examined. Then, the publications are reviewed regarding their potential contribution to determination, creation, and development of accountability for PBL. Determination of accountability demonstrates its constructive role in improvement of teaching and learning. Creation of accountability is considered through collaborative knowledge building and using the comprehensive assessment of students' learning while execution of study projects. Development of accountability for PBL is encouraged by PBL enhancement. It caused analysis of a computer-mediated adaptive support for PBL stimulating and facilitating collaborative knowledge building by students while learning by doing. The adaptive support provides adaptive formation of the collaborative groups, the adaptive assessment of the PBL to correspond with the progress of students' knowledge, and adaptive management of a collaborative learning based on execution of the projects.

Keywords: project-based learning, accountability, adaptive support

1. Introduction

A basic goal of an educational institution is development of high professional intellect in students. Professional intellect comprises knowledge and social intelligence (Quinn, Anderson & Finkelstein, 1998; Tiwana, 1999; Goleman, 2007). Creation and development of accountability of instructors and students for learning promote achievement of the goal.

The most effective way leading to creation and development of the accountability is organization of learning by doing (Blumenfeld et al., 1991; Schank, Berman & Macpherson, 1999). The effective methods of learning by doing are based on problem based learning strategy (Schwartz, Mennin, Webl, 2001; Savery, 2006) and concepts: community of learners (Brown, 1992), community of practice (Lipman, 1991; Wenger, McDermott & Snyder, 2002), community of purpose (Coakes & Clarke, 2006), and community of interest (Henri & Pudelko, 2003).

The Project-Based Learning (PBL) approach can serve as a constructive mean of learning by doing while execution of a study project. The project is set of interrelated learning tasks. It is aimed at solving of a certain problem. PBL promotes building the knowledge represented in different levels, enhancement ability of students to translate cognitive knowledge into real results, and cultivation of self-motivated creativity.

The PBL approach unfolds possibility of collaborative learning founded on constructionism (Papert, 1980; Papert & Harel, 1991; Resnick, 1996; Maureen, 2000; Han & Bhattacharya, 2001) and shared cognition theory (Hergenhahn & Olson, 2004). Consequently, collaborative learning by doing is the most effective way of knowledge building by students.

The PBL approach and the PBL environment that promotes taking accountability by instructors and students for educational process are explored in the section2. In the section3 some publications are reviewed regarding their potential contribution to determination, creation, and development of the accountability caused by formation and reinforcement of the PBL environment.

2. The PBL approach and characteristics of the PBL environment

The PBL approach has been found to improve independent learning, the ability to critical thinking and problem solving. PBL allows students to practice, gain, and improve soft skills (i.e., communications, collaboration, and learning to learn skills).

Thomas (2000) suggested the five criteria of PBL. The criteria are: centrality (the project is the main teaching strategy guiding students to learn the discipline through execution of the project; problem solving (projects are focused on problem solving); constructive research (projects involve students in constructive research); autonomy (projects are student-centered); realism (projects have to be realistic).

Mergendoller, Markham, Ravitz & Larmer (2006) developed a four stage management approach to lead students effectively through the PBL process. The stages are project planning, project start, product creation, and project completion. Management activities of PBL are determined relative to each stage. The PBL spiral created by Krauss & Boss (2013) can serve as the practical tool for teachers in development of critical thinking and learning experience of students.

The PBL model fosters stimulation and facilitation of collective knowledge building (Markham, Larner

&Ravitz, 2003; Solomon, 2003; Scardamalia & Bereiter, 2003; Weinberger et al., 2003; Barkley, Cross & Howell, 2004; Stahl, 2006). Students depend on each other and learn a subject together (Dillenbourg, 1999). Furthermore, the project induces a real need for interactions between students since it requires joint work in order to create their learning product.

The PBL model can be significantly enhanced by the Collaborative Learning model (Felder & Brent, 2001; Barkley, Cross & Howell, 2004). It requires integration of these models (Roberts, 2005; Ornstein & Lasley, 2003; Bransford, Brown & Cocking, 2000). Collaborative learning encourages critical thinking, actively involves students in learning, and improves learning results (Panitz, 2001).

Consequently, the project-based collaborative learning model (Thomas, 2000; Solomon, 2003; Barkley, Cross & Howell, 2004) is the most suitable model of collaborative learning by doing for realizing problem based learning strategy and the above-mentioned concepts. It fosters and supports collaborative work (Felder, Brent, 2001; Barkley, Cross & Howell, 2004; Savery, 2006).

A specific PBL environment promotes taking the accountability for learning results. The environment is characterized as student-centered, knowledge and skill-centered, community-centered, and assessment-centered (Garrison, 1992; Felder & Brent, 2001; Reeves, 2004; Anderson, 2008; Doyle & Tagg, 2008).

The student-centered environment encourages student interest in problem solving and independent learning by doing, combines individual and collaborative learning, provides the acquisition of learning skills and thinking skills, promotes development of critical thinking and problem solving abilities (Thomas, 2000; Felder & Brent, 2001; Solomon, 2003; Barkley, Cross & Howell, 2004; Savery, 2006; Ravitz, 2009; Bender, 2012). Students are prepared for taking accountability for learning results (Garrison, 1992; Reeves, 2004; Doyle & Tagg, 2008).

The knowledge and skill-centered environment promotes concentration of the instructor on enhancing and monitoring knowledge and soft skills of students and ensures adaptability to each student.

The community-centered environment conduces to acquisition of knowledge and skills collaboratively. Students drive their own learning through collaborative work to perform projects. Collaborative learning by doing occurs during joint realization of project tasks. The students are responsible for one another's learning as well as their own. It assumes interdependence, motivation, compatibility and sociability (Barkley, Cross & Howell, 2004; Weinberger, et al., 2003).

The assessment-centered environment contributes to high quantity and quality of assessments while maintaining the students' motivation and involvement to develop their knowledge and soft skills, and provides adaptability and complexity of an assessment for obtaining desired learning results. The instructor should lead, facilitate, and induce acquisition of knowledge and skills (Stahl, 2006; Scardamalia & Bereiter, 2003; Weinberger et al., 2003).

Consequently, the aforementioned PBL environment is the most suitable environment in order to promote taking accountability by instructors and students for learning results.

3. Determination, creation, and development accountability for PBL

Some explorations are reviewed in terms of their potential contribution to various aspects of determination, creation, and development of accountability for PBL in an academic institution.

3.1 Determination of accountability

Bergsteiner (2012) developed an accountability theory that describes and explains the accountability process, the influence factors, and the elements of accountability that are associated with the process. The author designed a decision tree model for building of goal-oriented accountability.

Shavelson (2009) proposed formative function of accountability changing an educational process and the summative function of accountability connected with determination of the extent of accountability. He asserted enhancement of teaching and learning can be obtained by coordination of an assessment system and an accountability system.

Samuel & Chiche (2004) described a personal accountability model, which enhances aspiration to become accountable. The model is based on determination of accountability as an action that is compatible with the student's desired outcomes.

Schoof (2010) examined relation between student-centered learning and student accountability. The author concluded that student accountability is caused by student-centered learning. Reeves (2004) considered the student-centered accountability systems.

Brundrett & Rhodes (2011) affirmed that creating accountability engenders a culture of quality that ensures an improvement of teaching and learning. Ballard & Bates (2008) demonstrated the need to hold instructors accountable for students' performance through evaluating the quality of instructions which students receive from their instructors.

Abu-Hussain, Essawi & Tilchin (2014) developed an approach to creation of accountability instructors and

students for learning results. The suitable PBL model was built within the framework of the approach. The approach offers forming a two-phase process of creating accountability, building collaborative groups of students by taking into account their personal accountabilities, and creating an adaptive assessment system.

Abu-Hussain, Tilchin & Essawi (2015) proposed the TERA model, which can serve as a constructive tool of creating accountability of instructors for an educational process. The “Accountability” component of the model provides creation of accountability of instructors for results of students’ learning. It is achieved by coordinated self-assessment willingness, possibility, and desire of instructors to take accountability for teaching and learning.

3.2 Creating accountability for PBL

The suitable PBL environment promotes creating accountability of instructors and students for learning. Building the PBL environment is caused by organizing productive collaboration of students and forming constructive assessment of their learning results.

3.2.1 Organizing productive collaboration

Organizing collaboration in the PBL environment is aimed at collaborative knowledge building by students while performance of study projects. Markham (2012) suggested an approach to management of project execution. It oriented to building higher-order knowledge through collaboration. Maltese (2012) affirmed the PBL is a means of student involvement in creative problem solving, and learning to work together. The author revealed skills of a group that works efficiently. Students are induced to collaborate through their reflection and the interdependence of learning. Zimmerman (2002) specified self-directed learning skills enabling autonomous learning. Schmidt & Moust (2000) underlined the particular importance of collaboration due to its influence on motivation of students and their learning results.

Graham and Misanchuk (2003) determined the stages of organization of collaborative learning: forming a structure of learning activities, building groups, and facilitating group interactions. They preferred heterogeneous composition of a collaborative group and emphasized the need for interdependence of group members to facilitate group interactions (Dillenbourg, 1999). According to the work (Chuen-Tsai Sun & Sunny, 2001) choice of homogeneous or heterogeneous composition of a collaborative group is provided as a result of online polling of the students. Debbie (2009) underlined the importance of group composition in the PBL environment.

An approach to integration of collaborative learning into the learning environment is proposed in (Wessner & Pfister, 2001). An instructor builds appropriate collaboration groups for certain parts of a web-based course by use of information about the collaboration. Lawrence-Slater (2006) described an organization of collaborative learning of an online course. The students built online groups and successfully completed a collaborative project. In order to attain this, the students posted their informational profiles.

Krauss & Boss (2009) analyzed a learning environment providing reflection and sharing within the project life cycle. Ellis & Hafner (2007) researched an influence of different types of models of a collaborative group on its functioning. The role of a student in a group is caused by the model type. Orvis & Lassiter (2008) described dynamic management of group organization.

Daradoumis, Xhafa & Marques (2002) proposed an approach to creating the PBL environment facilitating interaction between students. Soller & Lesgold (2003) developed a computational approach to analysis of online knowledge sharing interactions. Daradoumis, Martínez-Monés & Xhafa (2006) used a social network analysis of the group activity and a quantitative analysis of group effectiveness for evaluation of collaborative interactions. Stanton & Fairfax (2007) determined a productive collaborative environment. It should provide interdependence of the students on a project, individual accountability of students for results of project tasks execution, face-to-face interaction.

The analysis of aforementioned publications reveals organization of work of collaborative groups for providing stimulation and facilitation of the knowledge acquisition by students was not examined. Composition of collaborative groups is determined by students. Consequently, the instructor could not influence on the collaborative groups’ composition causing facilitation of interaction among students.

Dynamic organization of the PBL conducting stimulation and facilitation of the knowledge building interactions was not investigated. The authors have not considered adaptation of the collaborative groups’ composition to dynamics of students’ knowledge while collaborative execution of a group project.

However, the PBL environment providing collaborative performance of study projects by students based on reviewed above the publications promotes creation of accountability of the instructors and the students for learning.

Moreover, there is possibility for development of the accountability through stimulation and facilitation of the collaborative acquisition of knowledge by the students. It can be achieved by joint consideration of task-relevant knowledge, temporal and structural parameters of the project tasks, and individual knowledge of students; dynamic change of the role of a student in a group depending on his/her possibility to implement the project tasks; dynamic adjustment between building the sequence of execution of the project tasks and

assignment of collaborative group students for their performance.

3.2.2 Building constructive assessment

Knight (2000) established the need for a comprehensive approach to evaluation of students' learning providing reliability, validity, and usability of the assessment.

Moallem (2007) considered the assessment process relative to the following stages: initial assessment, progress assessment, and product assessment. Ma & Zhou (2000) introduced a fuzzy set approach to assessing the student learning outcomes. The intention of the approach is to induce students to participate in the learning.

McLoughlin & Luca (2002) suggested a student-centered approach to development of team skills through assessment. Swan, Shen & Hiltz (2006) explored the use of assessment as tool for inducing collaboration in online learning environment. Markham (2012) confirmed the need of assessment of creativity. Tillema (2010) declared the formative assessment promotes learning. Macdonald & Savin-Baden (2004) concerned with the lack specific assessment methods for PBL. The authors declared assessment should take into account of the practical orientation of PBL. Lovie-Kitchin (2001) affirmed assessment methods should be conforming the PBL process.

Daradoumis, Xhafa & Marquès (2002) proposed two kinds of project assessment: formative and additive. Assessment of the whole learning process is provided by formative assessment. Additive assessment is created for assessment various learning situations while project performance. Wiliam (2011) defined the ways for formative assessment: clarifying, sharing, and comprehension of learning aims and criteria for success; forming project tasks; providing feedback; and activating individual and collaborative learning. Ellis & Hafner (2007) developed a tool for execution of three kinds of PBL assessment: assessment by an instructor, self-assessment, and peer assessments.

Ellis & Hafner (2008) created the criteria for assessment of PBL. According to these criteria, assessing each student is caused by work his/her team and his/her personal work. Brookhart (2010) affirmed using an assessment mechanism for holding students accountable for higher order thinking improves the student motivation and the learning outcomes.

The exploration of aforementioned publications reveals that the role of assessment in fostering learning is not detailed; the influence of assessment on acquisition of knowledge by students is not demonstrated; assessment of knowledge dynamics for each student and for a collaborative group while project performance is not explored; and applying the different assessments of the students' PBL inducing instructors and students to take accountability for learning isn't provided. Hence, lack of an approach to comprehensive dynamic assessment of PBL constrains development of the accountability for learning.

3.3 Development of accountability for PBL

Development of accountability of instructors and students for PBL is advanced due to enhancement of PBL gave by adaptive support. The adaptive support of the PBL can be ensured by dynamic forming and evaluating of a knowledge management environment. Burgos, Tattersall & Koper (2006) described the various types of the adaptive learning support comprising problem-solving support, information filtering, building collaborative groups of students, adaptive testing, and real-time changes of course by the instructor. Papanastasiou (2014) determined adaptive support as assessment that is set for each student based on an assessment of his (her) prior execution. This adjusts an assessment relative to individual ability.

The adaptive support promotes collaborative learning (Arteaga & Febregat, 2004; Soller, 2007). Brusilovsky & Peylo (2003) proposed adaptive formation of groups using knowledge about collaborating students, and adaptive collaboration support ensuring an interactive support of collaboration helping an individual student in problem solving.

Soller (2007) examined different tools of adaptive support for distributed collaborative learning. The author set the tools facilitated interactions and induced for knowledge sharing. Mennin (2007) investigated a PBL group as a complex adaptive system. In this system interactions of students can change due to their self-organizing. A student group is adaptive as members individually and in a group are changed.

An assessment should be a managed, adaptive, formative, and summative process (Ellis & Hafner, 2007; Shavelson, 2009; William, 2011). Such the process fosters development of accountability of the students for learning results.

Abu-Hussain & Tilchin (2016) proposed the approach to ensuring an adaptive support of the PBL environment directed towards of development of instructors' accountability. The adaptive support was provided by a dynamic assignment of tests for every student and projects for collaborative groups, adaptation of assessment to knowledge progress of individual students and the collaborative groups, and manageable formation of the students' collaborative groups.

Abu-Hussain & Tilchin (2017) created a seven-step method for formation of a PBL environment furthering development of student accountability for course study. Development of student accountability for the project execution is provided by each step of the method. Particularity of forming the PBL environment is constituted by priority of execution of the sample-project and the group projects while course study, self-formation of the

students' collaborative groups for realizing projects of the suitable complexity levels, support of collaborative fulfillment of the project tasks, and use of adaptive assessments. Management of accountability development is provided because of calculated accountability measures of students for implementation of the project tasks.

As appears from the above development of accountability of instructors and students for teaching and learning promotes PBL progress owing to: management of formative assessment of student knowledge regarding different knowledge levels; building of knowledge heterogeneous collaborative groups through adjustment of personal accountabilities furthering knowledge sharing among students; creation of personal accountability of students for learning results through self-assessment of built knowledge; and sharing accountability among students, and between an instructor and students.

Realization of the PBL is a hard work for an instructor to do by hand. It prevents taking accountability by an instructor for the PBL. Consequently, a computer-mediated adaptive support while implementation of the PBL is needed. Such support would conduce development of instructors' accountability for teaching in the PBL environment. However, there isn't means of computer-mediated adaptive support for PBL promoting stimulation and facilitation of collaborative knowledge building by students while doing study projects.

Stimulation and facilitation of collaborative knowledge building can be obtained as a result of formation of determined sequence of project tasks, creation of collaborative groups promoting maximal mutual supplementation of students' knowledge, assignment of the students for performance of the tasks inducing their need in knowledge, and management of formative assessment of student knowledge concerning various knowledge levels.

Thereby, computer mediated adaptive support has to ensure adaptive setting of group projects, adaptive building of students' collaborative groups, and adaptive assessment of knowledge progress of students. A corresponding adaptive support tool would promote students' knowledge building, and facilitate management of PBL process.

4. Conclusion

Exploration of the publications related to determining accountability revealed effectiveness of PBL and constructive role of accountability in improvement of teaching and learning. Relationship of accountability of instructors and students for PBL with the specific PBL environment and is examined in this review.

The PBL environment induces taking accountability for learning. Collaborative knowledge building by students, and evaluation of students' PBL by using the comprehensive assessment promote creation of accountability for learning while performance of study projects. It is affirmed by analysis of the corresponding approaches and methods.

As follows from the review, the computer-mediated adaptive support for PBL stimulates and facilitates knowledge building by students while learning by doing. Because of this, the support provides development of the PBL environment that promotes developing accountability.

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