

Problem and project-based learning as an educational philosophy: A novel conceptual model for higher education

Güneş Korkmaz^{1*} and Nurdan Kalaycı²

¹Özel Ege Lisesi, İzmir, Turkey.

²Department of Curriculum and Instruction, Gazi Faculty of Education, Gazi University, Ankara, Turkey.

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ABSTRACT

Educational transformation at universities driven by the radical changes in society, culture, politics, economy, technology and industry has changed the knowledge, skills and competences demanded from individuals in professional life. This has also led to the problem and project-based learning (PBL) to gain importance once again. PBL is a learning model that all curriculum components are oriented at problems. This study aims to analyze the evolution of PBL from a teaching method to educational philosophy and to propose a novel conceptual model for an institution-level PBL design. This paper is based on a narrative approach to analyze the literature, proposes new relationships among constructs and creates links between existing theories to give a novel and broader insight to the theories using a combination of theory synthesis, adaptation, typology, and model. We think that problem and project-based learning should be considered together to create a framework to design a curriculum in higher education to bridge the gap between theory and practice. Also, we believe that the PBL model we proposed in our study can shed light on the practice of the universities in performing their educational and societal roles.

Keywords: Problem-based learning, project-based learning, PBL curriculum, curriculum development, higher education curriculum.

*Corresponding author. E-mail: gunes.korkmaz.gk@gmail.com.

INTRODUCTION

Problem-based learning and project-based learning (PBL) have been the subject of discussion for many years and have been applied at all educational levels across the world. These discussions are mostly about whether PBL works or not, and which educational level is more appropriate to use, or the advantages and disadvantages of PBL in practice. However, as PBL implementations across the world vary a lot, this issue needs to be discussed more broadly including how to apply it in different countries and different levels and requires a philosophical discussion in a broader sense. The purpose of this paper is to analyze the evolution of PBL from a teaching method to an educational

philosophy through the change in higher education in the 21st century and to propose a conceptual model for an institution-level PBL design.

PBL can be defined in several ways; however, in this study, we consider PBL as a combination of problem and project-based learning because the concepts of “problem-based learning” and “project-based learning,” in our view, do not only stand for a teaching approach or method but also an educational philosophy and a core to curriculum design (Korkmaz, 2019). In this design, all curriculum components (objectives, content, learning experiences, measurement and assessment) are based on real-life problems (Kooli, 2019; Kooli, 2020). Although

the term PBL has been used since the beginning 20th century, it has undergone great changes throughout the years, which created a different concept of PBL. We consider the reason for this change in PBL is mainly because higher education throughout the world has profoundly been affected by many factors such as globalization, industry, technology, etc. We investigated several sources on the historical development of universities through centuries and Table 1 summarizes the transformation phases of universities in terms of several parameters.

Table 1 demonstrates how universities have transformed in terms of several parameters such as period, drivers for change, goal, role, method, creating, orientation, cooperation, research, organizational culture and organizational identity. In the first phase, medieval universities whose only goal was to educate professionals adopted a more research-based role in the second phase. In the third phase, universities took up new roles by focusing more on knowledge production and cooperation. In the fourth phase, adding up new roles and characteristics such as innovation, sustainability, transdisciplinary approach, the type of individual to be educated, cooperation, universities started to aim for educating individuals who are able to solve real-life problems. The reason for this change may be because of the changing professional life and societal needs (Korkmaz and Kalayci, 2019). Although many universities such as Aalborg University (Denmark), Roskilde University (Denmark), McMaster University (Canada), Maastricht University (Netherlands), Olin College (USA), Worcester Polytechnic Institute (USA) have already designed their curricula to meet the needs of 21st century, there are still many other universities that have the characteristics of National/Humboldt university (Bleiklie and Kogan, 2007; Lozano and Lozano, 2014; Scott, 2006). However, to fulfill the new roles and to equip the students with certain knowledge and skills required for the 21st century, universities should keep their curricula responsive to the changing demands (Goodyear et al., 2017; Lozano and Lozano, 2014; Roffe, 2010; Sterling, 2010; Van den Akker, 2004).

This study aims to (1) analyze the existing literature concerning the evolution of PBL from a teaching method to an educational philosophy through the change in higher education and (2) to propose a novel conceptual model for an institution-level PBL design including a curriculum development model.

METHOD

This paper is based on a narrative approach to analyze the literature, proposes new relationships among constructs and creates links between existing theories to

give a novel and broader insight to the theories using a combination of theory synthesis, adaptation, typology, and model. Conceptual papers typically focus on proposing new relationships among constructs; the purpose is thus to develop logical and complete arguments about these associations rather than testing them empirically (Gilson and Goldberg, 2015). In addition, conceptual papers explain how and why the theories and concepts on which it is grounded were selected (Jaakkola, 2020). According to Jaakkola (2020), conceptual papers have four types in research design: (1) *theory synthesis*, (2) *theory adaptation*, (3) *typology*, and (4) *model*. Each type has different goals and applications:

- *Theory synthesis* seeks to achieve conceptual integration across multiple theories or literature streams. Such papers offer a new or enhanced view of a concept or phenomenon by linking previously unconnected or incompatible pieces in a novel way.
- *Theory adaptation* seeks to amend an existing theory by using other theories, and it aims to revise the current understanding of the concepts.
- *Typology* classifies conceptual variants as distinct types. The aim is to develop a categorization that explains the fuzzy nature of many subjects by logically and causally combining different concepts into a coherent and explanatory set of types.
- *Model* is to build a theoretical framework that predicts relationships between concepts. It aims to explain and predict the relationships between concepts, to identify novel connections between constructs.

In our study, we used a combination of these types. First, we conducted a literature review in analyzing multiple concepts in PBL and higher education, and we linked the conceptual change of PBL (from a teaching method to an educational philosophy) with the change in higher education in the 21st century. Then, we created a conceptual model for an institution-level PBL design. A conceptual model may be defined as a result of bringing together a number of related concepts to explain a given phenomenon with a broader understanding (Dzimińska et al., 2018). While developing our model, which we called “SEIDS” based on the initial letters of the components in the curriculum development process (Structure-Implement-Evaluate-Decide-Sustain, see Figure 1 and Figure 2), we constructed the philosophical components based on a synthesis of the theories “andragogy”, “humanism” and “professionalism”. And, to describe how to manage the change in PBL, we used the change framework suggested by Thousand and Villa (1995) and combined this framework with the management of change strategies (top-down and bottom-up) suggested by de Graaff and Kolmos (2007). Then, we determined the roles of stakeholders and the units in the institution.

Table 1. Historical development of universities through centuries*

Parameters	Transformation Phases			
	1st Phase (University 1.0)	2nd Phase (University 2.0)	3rd Phase (University 3.0)	4th Phase (University 4.0)
Period	12 th -16 th Century	14 th -19 th Century	20 th Century	21 st Century
Drivers for change	-	Renaissance (The rise of the terms freedom, questioning the authority, nation-state, secularism, etc. and the concept of Bildung)	Industrial Revolution & Globalization (Entrepreneurial and technology-based commercial activities by strengthening the link with the industry)	Changing Professional Life & Societal Needs (Knowledge, skills and competencies demanded from the individuals and society)
Goal	Education	Education and Research	Education, Research, Knowledge Production and Collaboration	Education, Research, Knowledge Production, Innovation, Demand (Society & Economy), Collaboration
Role	Defending the truth	Discovering the nature	Creating value	Innovation and Sustainability
Method	Scholastic	Modern Science	Modern Science	Modern Science
Creating	Professionals	Professionals and Scientists	Professionals, Scientists and Entrepreneurs	Professionals, Scientists, Entrepreneurs and Societally Engaged Individuals
Orientation	-	National, Regional, Local	International, Competitive	Global, Transnational, Competitive
Cooperation	-	With other universities (Limited)	With Industry and Government	With Industry, Government and Society
Research	-	Disciplinary	Interdisciplinary	Transdisciplinary
Organizational Culture	-	-	Multicultural	Multicultural
Organizational Identity	Medieval University	National University/Humboldt University	Cosmopolitan University	Open University

* Source: Authors based on Kyrö and Mattila (2012), Wissema (2009), Korkmaz and Kalaycı (2019), Zuti and Lukovics (2017) and Pawlowski (2009).

Later, we described the curriculum development process which describes how institutions can design their curricula using the principles of PBL philosophy. Finally, through combining the curriculum strategies used in PBL (Moesby, 2004), we prepared a sample table to describe how to implement these strategies in a four-year undergraduate program.

RESULTS

Evolution of PBL from a teaching method to an educational philosophy

Project-based learning (PBL) is not a new term. It dates back to Confucius (B.C.551-B.C.479), Socrates (B.C.470-

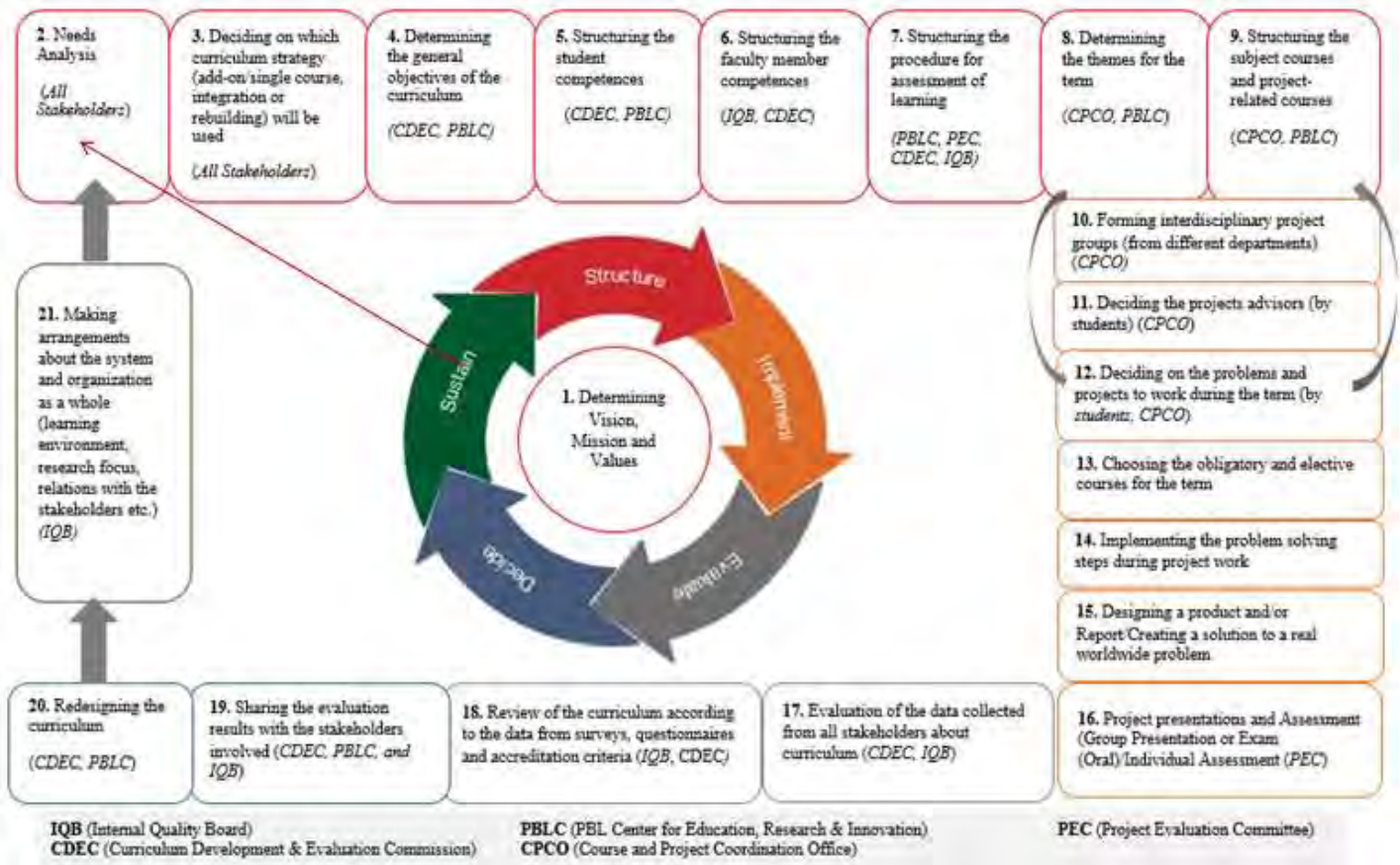


Figure 1. Curriculum development steps in SIEDS.

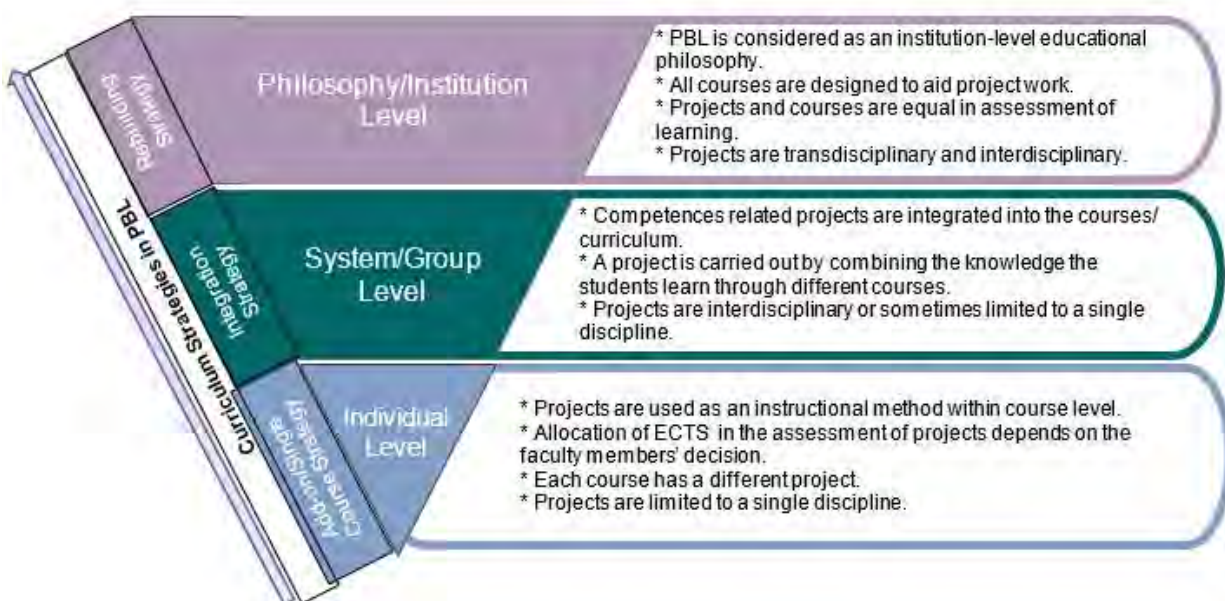


Figure 2. Curriculum strategies used in PBL and their implementation at different levels. Source: Moesby (2004).

B.C.399), Plato (B.C.428-B.C.347), Aristotle (B.C.384-B.C.322) and John Dewey's views on education (Clark, 2006; Díaz Oviedo, 2013; Knoll, 1992; Krajcik et al., 1994; Ulrich, 2016). Although the term "project" was not explicitly mentioned in their works, their views are closely related to the concepts in PBL philosophy.

As a world-recognized philosopher and an educator, Confucius had a great influence on education with his views such as self-cultivation, social development and change, and problem-solving (Kooli, 2019; Sun, 2008), learning by doing (Yeo, 2005), learning from culture, history, and social-political participation and beyond (Helyer et al., 2015; Kooli et al., 2019), student-directed learning, learner-centeredness and critical reflection (Tan, 2018). In addition, as we can understand from the famous dictum of Confucius "I will forget; show me, and I will remember; involve me, and I will understand", students learn best when they are actively involved in the learning process (Christie and Lucke, 2015; O'Grady et al., 2004). This indicates that Confucius believed in learning through experience or learning by doing. Similarly, a Greek philosopher, Plato, as well as Socrates and Aristotle, focused on the concepts of critical inquiry or Socratic inquiry, problem-solving and reasoning (Allen, 1997, p.226; Kamin et al., 2001; Partenie, 2009, p.2). Andriessen et al. (2003) stated that Plato's *Dialogues*, discussion and argument have been seen as the main ways in which knowledge is created and expanded. Similarly, Socrates presented students with problems through questioning, which enabled him to help them explore their assumptions, their values and the inadequacies of their proffered solutions (Savin-Baden, 2000, p.3).

John Dewey's conclusions about education are also very important in explaining the concepts in PBL philosophy. Dewey (1897) claims that education must be conceived as a continuing reconstruction of experience that the process and the goal of education are considered the same thing. Thus, an ideally perfect knowledge would represent such a network of interconnections that any past experience would offer a point of advantage from which to get at the problem presented in a new experience (Dewey, 2001, p.348). In addition, Dewey (1997) states that "development of experience comes about through interaction", which makes education is a social process (p.58). Dewey (1910) claims that students need to transform the natural capacities of inference into habits of critical examination and inquiry (p.29). He suggests that the children should have a reflective examination to solve a problem (Dewey, 1910, p.109). He explains this process in steps. The first step is the occurrence of a problem or a puzzling phenomenon; then observation, an inspection of facts, to locate and clear up the problem; then the formation of a hypothesis or the suggestion of a possible solution together with its

elaboration by reasoning; then the testing of the elaborated idea by using it as a guide to new observations and experimentations. In each account, there is the sequence of specific facts and events, ideas and reasonings, and application of their result to specific facts (p. 203).

The above-mentioned concepts such as "problem-solving, student-directed learning, learner-centeredness, critical inquiry, reasoning, critical reflection, learning by doing or learning through experience, social interaction" are very relevant in PBL philosophy. Because learning through PBL promotes critical thinking, self-directed learning, lifelong learning, self-achievement, self-regulation, self-efficacy, communication and interpersonal skills for students (Guerra and Kolmos, 2011). However, the term "project" as a teaching method was first used by Kilpatrick who was once Dewey's student (Beyer, 1997; Heitmann, 1996). Kilpatrick (1918), who argued that individuals should take an active role in interpreting what is happening around the world they live in, stated that the project is a method that can be used in vocational education and secondary education. Similarly, he stated that a project should be considered as a "wholehearted purposeful activity proceeding in a social environment" (p.320). Kilpatrick's "project" and "project method" concepts changed and turned into an approach aimed at searching for solutions to real-life problems rather than a method to teach (Fogarty, 1997; Lai and Tang, 2000; Markham et al., 2003; Tang et al., 1997). Through the end of the 20th century, the concept of PBL in higher education was included in educational research with the term "problem-based learning" and was first implemented in the medical schools of McMaster and Maastricht University (de Graaff and Kolmos, 2007).

Today, universities such as Aalborg (Denmark), Roskilde (Denmark), Worcester Polytechnic Institute (USA), Olin College (USA) have their own PBL models that are implemented as an institution-wide educational philosophy by designing all curriculum components according to PBL principles (Kolmos et al., 2009; Kolmos and Fink, 2004; Knudstrup, 2004; McNeill et al., 2019; Vaz and Quinn, 2015). Through this conceptual change in PBL, project-based learning has been used as an educational philosophy and an approach to design curriculum according to certain principles, especially at the universities in Europe and the USA. The term "project" has been integrated with the curriculum development efforts in higher education and has become a design approach that considers "problems and project" as a core of the curriculum rather than just a teaching method (Andersen and Heilesen, 2015; Hernandez et al., 2016; Kolmos, Du, Holgaard and Jensen, 2008; Kolmos et al., 2013; Savery, 2019; Simonovich, 2012; Wiek et al., 2014).

At PBL universities, students form small groups,

identify some problems according to the theme determined for that term, and work on projects collaboratively during a whole term or year (these projects have to benefit society). And these projects, which are based on unstructured, complex and real-life problems, exist in the formal curriculum and it allocates a similar amount of ECTS for courses and projects (Andersen and Heilesen, 2015, Edström and Kolmos, 2012; Somerville et al., 2005. For example, in the Aalborg PBL model, every term has 3 courses that each is credited with 5 ECTS according to European Credit Transfer and Accumulation System (ECTS), and a project with 15 ECTS. In other words, 15 ECTS is allocated within the courses and 15 ECTS for a project during the term (Hernandez et al., 2016; Kolmos et al., 2013). In addition, as the students work in groups, the university has designed a learning environment where the students can have their own space to work collaboratively during projects (Korkmaz, 2019).

Although PBL is used as an abbreviation for both “problem-based learning” and “project-based learning” (Kolmos et al., 2009), we consider that “problem” is the starting point in “project-based learning”. In other words, since a project begins with a problem, learning starts with

a problem as well. In this regard, problems are related to the content and context, and projects are related to the form you apply. As problem-based learning and project-based learning have a lot of things in common (student/learner-centeredness, problem-solving process, collaborative learning, experiential learning, inquiry-based learning, self-directed learning, etc.) (de Graaff and Kolmos, 2007), it is better to consider these concepts together.

Figure 3 shows the way we consider what PBL stands for in the 21st century. First, students start with a problem or a problematic case, then they may have many other problems to deal with during the project. Furthermore, project-based learning focuses on real-life problems and the solution of these problems resulting from the social, political, and economic issues, and it supports the development of the 21st-century skills demanded in professional life. Therefore, in our view, more than a teaching method, PBL is a fusion approach or an educational philosophy that integrates problem-based learning and project-based learning in curriculum design. This perspective, we believe, may also help researchers to eliminate the controversy that arises from the question of whether PBL stands for problem-based learning or project-based learning.

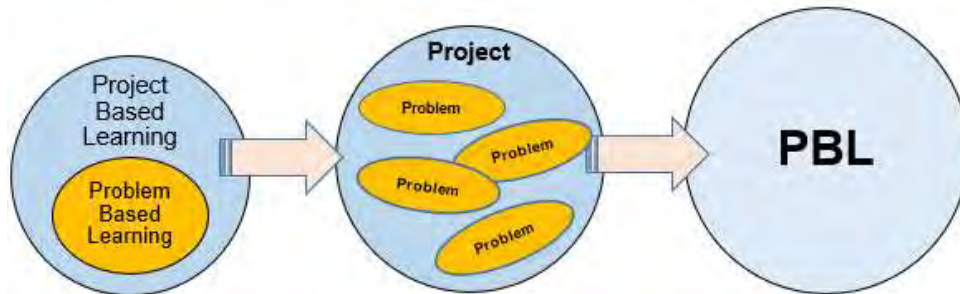


Figure 3. The concept of PBL in the 21st century.

A novel conceptual model for institution-level PBL design: SIEDS (structure-implement-evaluate-decide-sustain)

After analyzing the historical development of universities and the characteristics of PBL in the 21st century, especially focusing on the characteristics of University 4.0 demonstrated in Table 1, and the evolution of PBL in higher education, we proposed a conceptual model for an institution-level PBL design including a curriculum development model. We believe that the PBL philosophy has the potential to promote the necessary knowledge and skills required by university students. We think that our model will serve as a guideline for the universities which aim to design a PBL based curriculum. SIEDS is

discussed under the headings of the philosophical components, how to manage the educational change, the role of internal and external stakeholders, and the curriculum development process in the model.

Philosophical components of SIEDS

Our model, which we called “SIEDS”, is based on three main concepts: andragogy, humanism and professionalism. The philosophical components and the sub-components of the model are shown in Figure 4.

Andragogical context: The term “andragogy” is the equivalent term for “pedagogy” at the higher education

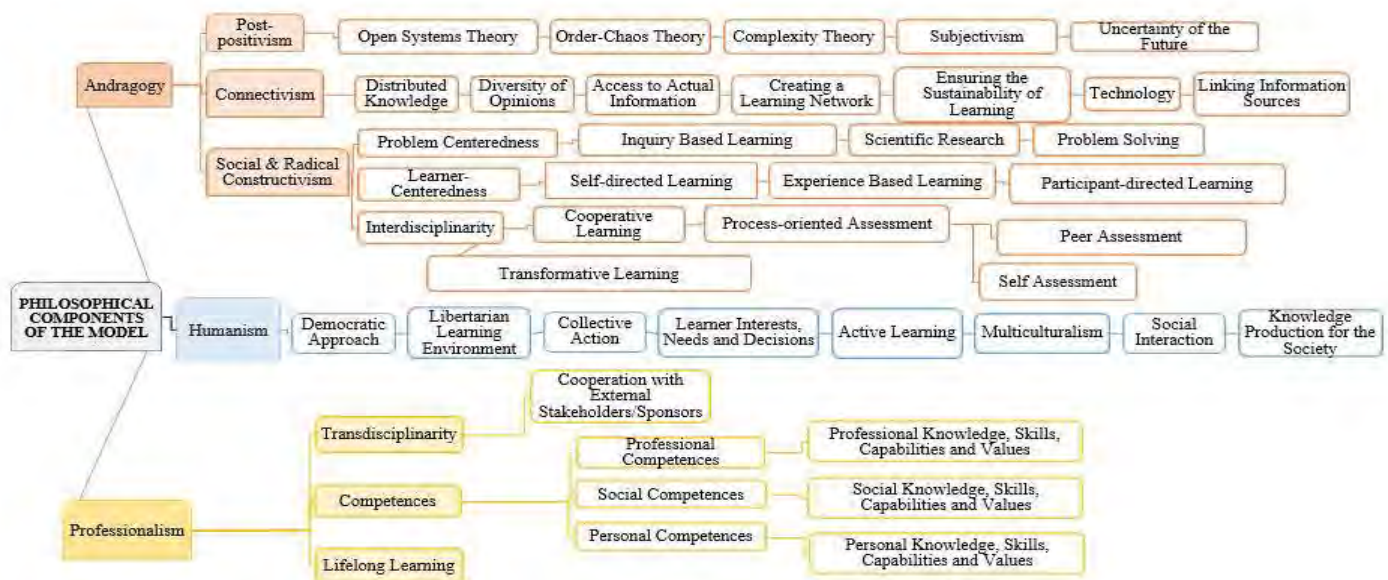


Figure 4. Philosophical components of SIEDS.

level. Knowles (1973) states that the word “pedagogy” derives from the combination of the words “paid” and “agogus” in Greek, and it means “the science and the art of teaching and guiding children”. It is a teaching-centered approach, and mostly the teacher decides on what, when and how is to be learned (p. 42). However, andragogy derives from the combination of “aner (adult/adult)” and “agogus (guidance)”, and this term is defined as “the science and art of helping adults to learn” (Knowles, 1973, p. 43). This concept, in contrast to pedagogy, adopts a learner-centered approach in which individuals take responsibility and determine their own learning needs (Conner, 1997; Nielsen, 1989). Since the proposed model in this study is about higher education, we preferred to use the term “andragogy”.

SIEDS is organized according to the principles of open systems, complexity and chaos-order (Doll, 1989) theories of the postpositivist approach. Roth (2013) states that in post-positivism, there is nothing like an event, subject, object, cause or effect as a “thing” or “phenomenon” in itself. This perspective leads us to the pure mobility of life generally and the unfinalized and living curriculum (Ornstein and Hunkins, 2018, p. 201). Doll (2012) argues that mobility, ambiguity, uncertainty, chaos, complexity are the aspects of the postmodern perspective. Although we can plan certain contents and experiences to be presented to students, it is not certain that the outcomes will be the same as they are stated in a curriculum or lesson plan. And learning does not stop at the end of the lesson or school day. Learning through creativity and imagination flourish in myriad ways, some

anticipated, mostly unforeseen (Ornstein and Hunkins, 2018, p. 201).

The term “project” used in SIEDS does not imply a task that can be carried out by individuals but a process in which students from different disciplines work together during a term or a year in small groups. For this reason, we adopted social constructivism and radical constructivism. Social constructivism argues that the acquisition of knowledge and skills occur through learners’ interaction in the learning environment (Kooli, 2019). In this context, according to social constructivists, learning is an active process involving others around the individual (Schunk, 2012, p. 230). Radical constructivism is based on socially shared experiences, language and the meanings agreed upon. Therefore, knowledge is formed by social negotiation, social interaction, reflective abstraction and self-regulation. This knowledge created by the individual cannot be expected to correspond with “external reality” as each individual’s experiences are different; therefore, there is no single right view of truth or reality (Arslan, 2007).

Our model suggests the use of cooperative learning, self-directed learning, participant-directed learning, learning by doing, inquiry-based learning as they are the ones that support social constructivism. Adult learning theories, which are based on andragogy, aims for learners to gain skills such as self-directed learning, inquiry, and problem-solving (Knowles et al., 2012; Knowles, 1980, p. 56; McGrath, 2009; Merriam, 2001). Therefore, we can say that the adult learning theories prove to be a good fit for the project-based learning

model in higher education. Based on the ideas of Freire (2005) about critical theory, our model also features the transformational/transformatory learning introduced by Jack Mezirow in the 1970s. Mezirow (2000) states that critical reflection skills are transformed appropriately according to the conditions of the day, and this transformation is also a problem-solving process (p. 20).

Another learning theory in the andragogical context of SIEDS aligns well with the connectivist learning theory suggested by Siemens (2004) and Downes (2008). The theory states that (1) learning is based on diversity of ideas; (2) there is a connection between various information resources; (3) learning can also take place in digital environments where the human factor is absent; (4) learning capacity is more important than acquired knowledge, (5) networks should continuously be supported to ensure the sustainability of learning; (6) linking between disciplines, ideas and concepts is a basic skill; (7) learning activities' primary objective is to access correct and up-to-date information; (8) decision-making is also a learning process (Siemens, 2004). However, according to connectivism, deciding what to learn and the meaning of new knowledge may change permanently. That is to say, the information that is true today may be wrong tomorrow (Downes, 2008; Siemens, 2004). Therefore, the sustainability of learning depends on the learner.

Humanistic context: Humanism is another key concept of our model. The humanistic approach to learning involves a certain amount of warmth, genuineness, maturity, and concern for people, in educational case children and youth; therefore, the focus is not only on academic achievement, but also on his or her social, psychological, physical, and cognitive needs (Ornstein and Hunkins, 2018, p. 143). In other words, when humanism is associated with learning, cognitive and affective needs of learners should be considered together. SIEDS in terms of humanistic context is based on Dewey's (2001) and Freire's (2005) views about democratic education. Dewey (2001) states that democracy and education are the concepts that always go hand in hand (p. 339), and he claims that the school is a miniature democratic society, a form of social life, a miniature community and one in close interaction with other modes of associated experience beyond school walls (p. 367). Therefore, learning requires a democratic environment. In addition, individual differences and characteristics of the students are always important and the students can realize themselves better in an environment where no pressure exists (Firdaus and Mariyat, 2017; Hedeem, 2005; Kooli et al., 2019; McDonough and Portelli, 2004). Similarly, in a humanistic learning environment, individuals are actively involved in learning activities and decide on their learning materials

and methods by themselves. It is the learners' responsibility to make right or wrong decisions. Therefore, the duty of the educators is to respect student's interests, needs and decisions, and to facilitate students in learning (Ashworth et al., 2004; Cercone, 2008; Connolly, 2016; Ornstein and Hunkins, 2018).

In terms of the humanistic context, social interaction is also another key component that we decided to integrate into our model. Freire (2005) states that the world and human beings do not exist apart from each other, they exist in constant interaction (p. 50). We believe that the same interaction also exists in a learning environment. In addition, Dewey (2001) claims that the principle that development of experience comes about through interaction means that education is essentially a social process (p.58). Similarly, Ornstein and Hunkins (2018) stated that appreciating human connections, and ideas from a multicultural, and diverse perspective makes education more effective (p. 60).

Professional context: The professional context in our model is based on three basic concepts: competences, lifelong learning and transdisciplinarity. The competences are the knowledge, skills and values which learners are expected to have by the time they graduate from university. Competence, in terms of higher education, is about what a person should know, what he or she can do and what he or she will be good at upon completing his study successfully (YÖK, 2010). Similarly, Le Deist and Winterton (2005) defines competence as knowledge, skills and abilities that may be used in the specific occupation as well as transversally, and skills and abilities for mastering tasks and developing appropriate problem-solving strategies.

Another component in our model within the professional context is lifelong learning. Learning is to be a lifelong educational process (Ornstein and Hunkins, 2018, p. 140), and as Fischer (2000) suggests, in today's world, learning can no longer be dichotomized into a place and time to acquire knowledge (school) and a place and time to apply knowledge (the workplace). Lifelong learning needs to promote effective educational opportunities in a variety of learning settings through which people pass, including home, school, work, and the larger political community. Professional work cannot simply proceed from a fixed educational background (Fischer, 2000). The last component in the professional context of our model is transdisciplinarity. This concept refers to the production of knowledge by working collaboratively with non-university or non-academic organizations (municipalities, regional organizations, industrial organizations, etc.) and individuals (employers, graduate students, etc) (Tress et al., 2003; Kooli and Abadli, 2021; Korkmaz, 2019). In our view, transdisciplinarity within this context is very well matched

with the university in terms of project work. For example, Nordahl and Kofoed (2008) states that PBL is a higher degree of learning and PBL projects require a high level of social, communication and cooperative skills among students. These skills are highly demanded in professional work. In this way, project groups interact with others outside the university and the students get the opportunity to learn more about what they need in real life and gain awareness about their future professions (Gatto and McCardle, 2016; Özerol et al., 2018).

How to manage the educational change

The transformation of universities through PBL is not an easy process. Therefore, we integrated the concept —~~management~~ of change” into our model. Kolmos et al. (2008) stated that the difficulty in the management of change is particularly true in the transformation towards PBL because the establishment of a PBL culture demands many interrelated aspects to be carefully considered. These include organizational structure, administrative support, and faculty engagement, student engagement, and other staff members in the change process. Therefore, it is important to promote this change by creating a vision and mission, and by getting support from change agents (Andersen and Heilesen, 2015; Kooli, 2019; Kolmos et al., 2016).

Dahms (2014) stated that the process of change will take time regardless of which curriculum strategies are used. Some researchers claim that the most important factor that makes the change difficult is the lack of preparedness of educators for PBL and their resistance to change (Arsat, 2014; Bouhuijs, 2012; de Graaff and Kolmos, 2007). Another reason related to resistance is that many educators still consider —~~teaching~~” to be more important than —~~learning~~”. They also believe PBL takes a lot of time, and their workload will increase since the PBL requires a lot of cooperation among instructors (Guerra, 2014; Teo, 2004). To be able to manage the change process more systematically, there are some models developed by the researchers. In our model, we decided to use the framework developed by Thousand and Villa (1995). Thousand and Villa (1995) state that there are some basic elements to deal with a change process, and the absence of one of these elements affects the other elements. Therefore, each element is equally important for holistic and systematic change. Similarly, de Graaff and Kolmos (2007) suggests two types of strategies to successfully manage this change process: top-down strategy and bottom-up strategy. The top-down strategy is related to the decision of individuals in the administrative level of the organization on a matter and to apply this decision without asking other stakeholders’ ideas in the organization. The bottom-up strategy, on the other hand, is an effort to make the administrators

approve or accept the decision made by all stakeholders. However, it is not enough to use only one of these strategies to manage the change successfully (de Graaff and Kolmos, 2007). In addition, successful change cannot be achieved through bureaucracy or hierarchy; all units within the organization have a share in the change. So, it is necessary to act with a common vision for the PBL curriculum to be accepted by all stakeholders of the university (de Graaff and Kolmos, 2007; Moesby, 2004). (Figure 5)

The role of internal and external stakeholders in the model

We believe that it is important to determine the roles of internal and external stakeholders involved in the planning, implementation and evaluation of the curriculum for the universities that plan to implement the PBL curriculum. For this purpose, prior to the description of the curriculum development process in our model, we would like to elaborate on the stakeholder roles (Table 2) and an organizational chart (Figure 6). When the roles of internal and external stakeholders are analyzed in Table 2, it is clear that all stakeholders have cooperation in planning, implementation and evaluation of the PBL curriculum, and a collective work discipline has been adopted. In addition, there are different curriculum development and evaluation commissions at each faculty, and each unit in the chart (Figure 6) plays a supportive role in the curriculum development and evaluation process. In this context, policy and decision-making are not carried out by the pressure of —~~management~~” or —~~hierarchy~~”. In addition, there are different curriculum development commissions at faculties, which provide academic programs with autonomy, academic freedom and flexibility. Table 2 shows the roles of internal and external stakeholders we suggest.

Figure 6 shows a sample organizational chart that shows different units within an organization where PBL is implemented at the institutional level. We believe that this chart we prepared can guide the universities that consider implementing PBL. The following paragraphs describe the units and responsibilities that we created within the SIEDS model.

PBL Center for Education, Research and Innovation is designed to research project-based curriculum, plan and prepare courses related to PBL for students, organize seminars and workshops on PBL (for both students and educators). This PBL center also cooperates with other universities about different PBL practices and provides consultancy services to individuals and institutions that are planning to implement PBL for the first time. The center consists of experts who are experienced in PBL.

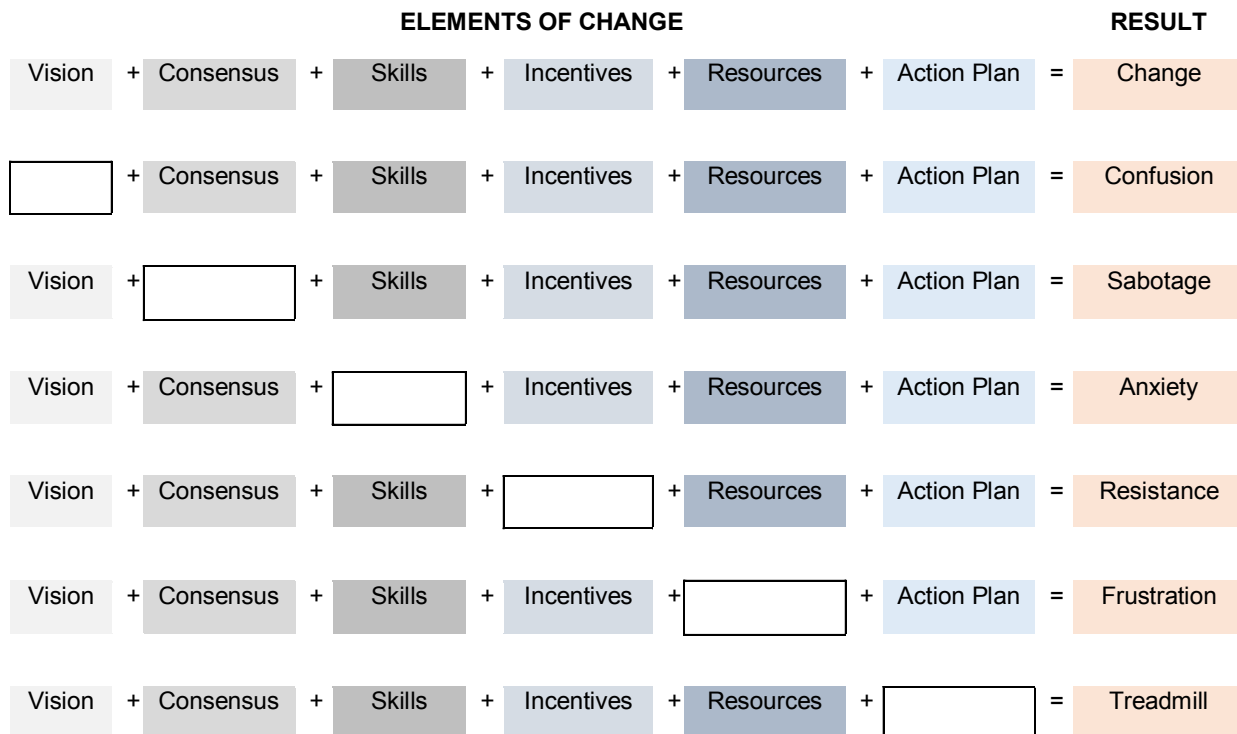


Figure 5. *Elements in the management of change* (Thousand & Villa (1995) Managing complex change towards inclusive schooling. Villa, R. A. and Thousand, J. S., *Creating an inclusive school* (Association for Supervision and Curriculum Development (ASCD)).

Table 2. The roles of internal and external stakeholders in the model.

Internal Stakeholders	External Stakeholders
<p>Management (Rector, Dean, Department Heads, Coordinators)</p> <p>Ensuring organizational change (All units)</p> <p>Creating vision-mission (All units)</p> <p>Encouraging staff for organizational change about PBL (All units)</p> <p>Determining the themes for the term or year</p> <p>Deciding which curriculum strategy to use for PBL</p> <p>Funding the projects</p> <p>Providing the appropriate physical environment and resources for PBL (Rector, Dean)</p> <p>Carrying out implementations on meeting the accreditation criteria (All units)</p>	<p>Employers, Industry Leaders</p> <p>Proposing projects to universities</p> <p>Collaborating with universities to conduct a project</p> <p>Financially supporting projects</p> <p>Participation in the evaluation process of student projects</p> <p>Supporting the relationship between theory and practice in academic programs</p> <p>Providing students with internship and work opportunities upon graduation</p> <p>Giving feedback during curriculum development and evaluation</p> <p>Collaboration with universities in the product development</p>
<p>PBL Center for Education, Research and Innovation</p> <p>Conducting research on PBL</p> <p>Organizing online courses for students about PBL</p> <p>Organizing seminars and training on PBL (Students and Faculty)</p> <p>Cooperation with regional, national and international universities</p> <p>Providing consulting services to individuals and institutions who wish to implement PBL</p>	<p>Spokespersons from the Government</p> <p>Proposing problem situations/themes and projects to universities</p> <p>Financially supporting projects</p> <p>Establishing a national framework for continuous assessment of the quality of university and education</p> <p>Giving feedback during curriculum development and evaluation</p>

Table 2. Continues.

<p>Faculty Members</p> <ul style="list-style-type: none"> Suggesting project ideas to the students (if needed) Ensuring the sustainability of the curriculum implementations Giving feedback to the management about curriculum Collaborating with external stakeholders in identifying themes and problems Facilitating project groups during the academic term 	<p>Non-Governmental Organizations</p> <ul style="list-style-type: none"> Informing universities about regional and global needs Proposing problems and projects to universities Collaborating with universities to conduct a project Continuously questioning and evaluating the quality of university and education Giving feedback during curriculum development and evaluation
<p>Students</p> <ul style="list-style-type: none"> Participating in the curriculum development and evaluation process Making proposals about lectures, problem situations and project themes Giving opinions on academic policies and curriculum 	<p>Municipalities, Regional Organizations</p> <ul style="list-style-type: none"> Inform universities about regional needs Proposing problems and projects to universities Financially supporting projects Giving feedback during curriculum development and evaluation
<p>Curriculum Development and Evaluation Commission</p> <ul style="list-style-type: none"> Planning and executing all work related to the curriculum development and evaluation 	<p>Alumni</p> <ul style="list-style-type: none"> Making suggestions to the university about problem situations and projects in business life Giving feedback during curriculum development and evaluation
<p>Course and Project Coordination Unit</p> <ul style="list-style-type: none"> Coordinating the collaborative activities between department heads, academic staff and students Providing guidance to students on the selection of projects and courses Guiding students and instructors in the formation of project groups 	<p>Accreditation Agencies</p> <ul style="list-style-type: none"> Checking that curriculum complies with the Bologna process or other criteria Checking if there are enough faculty members in a particular department at the university Checking the conformity of the physical conditions of the University Determining the societal contribution level of the projects Determining about to which degree the program responds to the needs Checking the quality of education and research at the university Controlling the degree of university research at the international level Checking students' attendance and drop-out status Checking whether the university implements the internal quality system
<p>Project Evaluation Committee</p> <ul style="list-style-type: none"> Recording the performance of students during project work (internal evaluators) Participating in the process of project evaluation and giving feedback to students during project presentations (internal and external evaluators) <p>Internal Quality Board (Internal Accreditation Board)</p> <ul style="list-style-type: none"> Monitoring the education, research and social contribution activities of the institution Conducting the quality assurance process related to the institution's academic, curricular and administrative services Controlling the compliance of curriculum with accreditation criteria 	

They design some elective courses that students can attend online to assist the projects. These courses are accessible to students throughout the academic year. In this respect, PBL Center for Education, Research and Innovation contributes to the flexibility of the curriculum by providing appropriate resources to both students and educators.

Another unit in the organizational chart is the Course and Project Coordinators. The coordinators provide cooperation between department heads, lecturers and students, and facilitate students in choosing their projects and courses. They are also involved in the formation of project groups if needed. Each faculty has a different unit for course and project coordination. Coordinators at

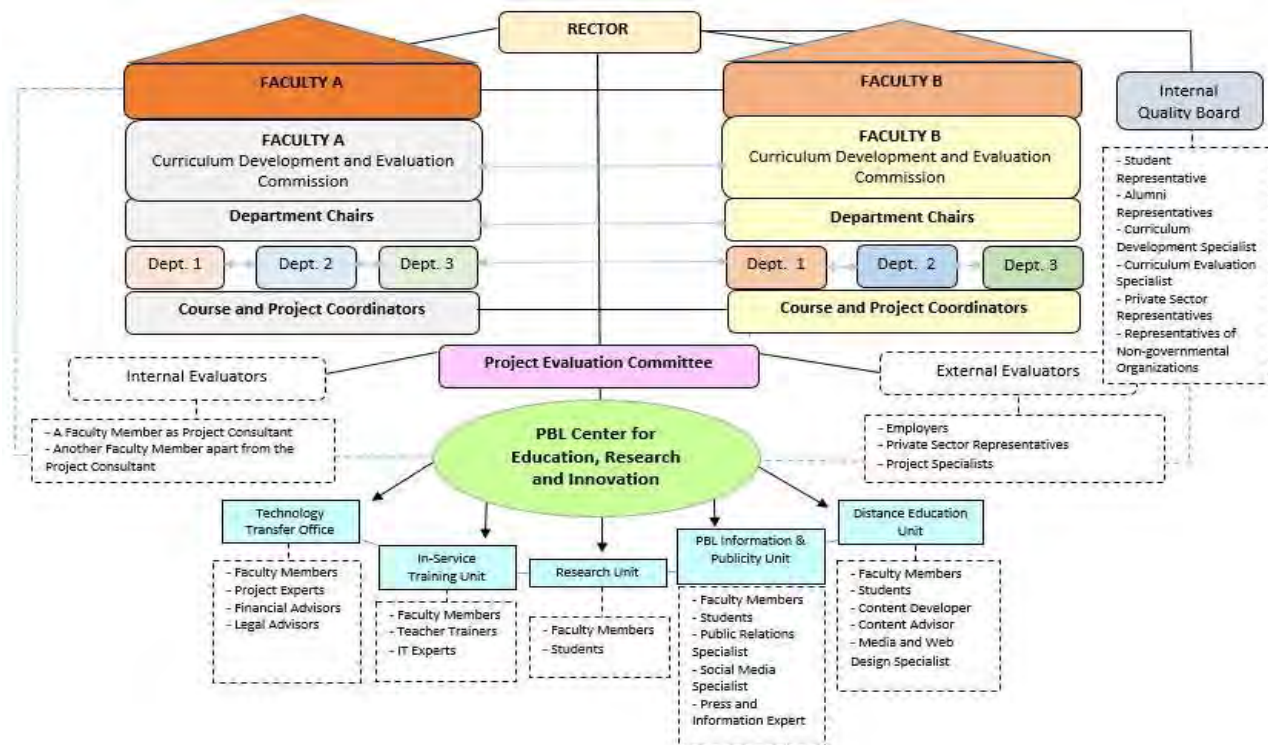


Figure 6. Organizational chart in SIEDS.

different faculties work collaboratively with each other. The primary reason for this is to ensure that project groups are formed in accordance with the principle of interdisciplinary.

The Project Evaluation Committee consists of internal and external evaluators. A faculty member facilitates students as a project advisor and another faculty member as a project consultant. These faculty serve as internal evaluators. Also, there may be some external evaluators who are employers at a company or experts in the field. The internal evaluators in this committee facilitate and evaluate the students throughout the project process. Thus, there is a continuous evaluation. However, external evaluators take part in the evaluation process of project presentations at the end of the semester.

The Internal Quality Board consists of people appointed by the Rector (student representative, alumni representative, curriculum development specialist, curriculum evaluation specialist, sector representatives, and representatives from non-governmental organizations etc.). These individuals control the entire process related to institution and curriculum prior to the evaluation by external accreditation bodies and assess the need to make the necessary arrangements and improvements for the accreditation criteria. This board submits a report to the Rector's Office periodically, and

these reports help to ensure that all internal stakeholders are fully informed about the changes to be made in the institution.

In Curriculum Development and Evaluation Commission, there are internal stakeholders (administrators, faculty and students) and external stakeholders (municipality spokesperson, representatives from non-governmental organizations, employers, industry leaders, government spokespersons, representatives of regional organizations etc) and they all work in cooperation during curriculum development and evaluation process. In addition, each curriculum development and evaluation commission from different faculties works collaboratively.

Curriculum development process in the model

Deciding which model to use in the development of the PBL curriculum is an important issue. It would be wrong to say that only one certain curriculum development model is appropriate for PBL. However, in a few studies related to PBL literature, it is stated that the most appropriate curriculum development model for PBL is Cowan and Harding's (1986) Logical Model of Curriculum Development (Dahms, 2014). This is because the model

Year	Semesters	Distribution of Courses and Projects in an Academic Term				Duration of Projects	Strategy		
4th YEAR	8th	TRANSDISCIPLINARY PROJECT (15 Credits)				One Term	Rebuilding		
		Project Course (5 Credits)	Project Course (5 Credits)	Project Course (5 Credits)					
	7th	TRANSDISCIPLINARY PROJECT (15 Credits)				One Term			
		Project Course (5 Credits)	Project Course (5 Credits)	Project Course (5 Credits)					
3rd YEAR	6th	TRANSDISCIPLINARY PROJECT (15 Credits)				One Term			
		Subject Course Integrated with Project Competences (5 Credits)	Project Course (5 Credits)	Project Course (5 Credits)					
	5th	INTERDISCIPLINARY PROJECT (15 Credits)				One Term			
		Subject Course Integrated with Project Competences (5 Credits)	Subject Course Integrated with Project Competences (5 Credits)	Project Course (5 Credits)					
2nd YEAR	4th	Subject Course (8 Credits)	Project	Subject Course Integrated with Project Competences (8 Credits)	Subject Course Integrated with Project Competences (8 Credits)	PROJECT (12 Credits)	Project within subject courses varies according to the scope of the project/Large-scale projects take one term.	Integration	
	3rd	Subject Course (8 Credits)	Project	Subject Course (8 Credits)	Project	Subject Course Integrated with Project Competences (8 Credits)			PROJECT (10 Credits)
1st YEAR	2nd	Subject Course (10 Credits)	Project	Subject Course (10 Credits)	Project	Subject Course (10 Credits)	Small-scale projects carried out in the course.	3-4 Weeks for Each Project	Add-on/Single Course
	1st	Subject Course (10 Credits)	Project	Subject Course (10 Credits)	Project	Subject Course (10 Credits)			

Figure 7. Use of PBL curriculum strategies at an 8-semester undergraduate program.

emphasizes that learning is more important than teaching, it is based on a competence-based approach, and states that the curriculum development process is often influenced by external factors (external stakeholders, accreditation criteria, etc.) (Arsat, 2014; Dahms, 2014). However, considering these issues, we decided to propose another curriculum development model that fully serves an institution-level PBL design. The initials of the components in the curriculum development process in Figure 2 (Structure-Implement-Evaluate-Decide-Sustain) are the ones that helped us determine the name of our model as SIEDS. Figure 1 shows the curriculum development process we suggest in our model.

We have decided the process shown in Figure 1 based on the PBL principles stated by Barge (2010) and de Graaff and Kolmos's (2007), necessary elements/components in the process of organizational and educational change stated by Dahms (2014) and Thousand and Villa (1995), the logical model of curriculum development by Cowan and Harding (1986) and constructive alignment theory by Biggs (1996). This process is also shown in Figure 2 in detail, and some abbreviations have been used to explain the contribution of the internal and external stakeholders to the curriculum development process. This curriculum development process consists of five major components: structure, implement, evaluate, decide and sustain (Figure 1). In the

process, each step is numbered to follow the process sequence in curriculum development. In addition, the units involved in the curriculum development process are shown in parentheses (Figure 1).

Figure 5 shows the steps the curriculum development process in detail, and we believe that this process will serve as a guide for institutions that are planning to organize their curriculum according to PBL principles at institution level. The strategies mentioned in Step 3 (Figure 1) are briefly described in Figure 2 at individual level, system/group level and philosophy/institution level.

To exemplify how to use these strategies at different levels, we prepared a table (Figure 7). It shows how to implement these strategies in a four-year undergraduate program. Because the decision to implement PBL at the philosophy or institution level requires a radical process, not only a curricular change but also an organizational change will be needed. Therefore, the institutions planning to implement an institution-level PBL curriculum may prefer to use a hybrid model that blends these strategies. For example, using add-on or single course strategies (individual level) in the freshman year and then having integration strategy (system-group level) through rebuilding strategy (philosophy-institution level) can make it easier for the institutions to cope with the problems during curricular and organizational change. In this way, the faculty members and students who do not have enough experience in PBL can gain some experience

through practice. Figure 7 shows a sample structure in which all strategies (different strategies in different semesters) are used to design the curriculum according to PBL in a four-year undergraduate program (8 semesters).

CONCLUSION

Based on the analysis of problem and project-based learning (PBL), its evolution through the change in higher education and what we propose as a model, we believe that in order for universities to perform their roles (education, research, knowledge production and service for the benefit of the universe and society), they need to transform themselves according to the societal needs. We think that our novel conceptual model for an institution-level PBL design that also stands for a curriculum development model can be applied by many universities in various countries. We also believe this model is appropriate in the attainment of the goals and roles of contemporary universities. Our model can also contribute to the practitioners who would like to transform their institutions and design their curriculum according to the principles of problem-based learning. PBL curriculum draws an effective framework for the knowledge, skills and competencies demanded from individuals in the 21st century. As mentioned in the review of various universities above, we believe that our curriculum development model can bridge the gap between theory and practice precisely because it is based on the best PBL principles. Importantly, the implementation of the PBL curriculum can result in the change of vision and culture at the institution level. To do this, it is imperative for the universities to get permanent support from all units within an institution. Finally, our suggestion for the universities that aim to design the curriculum according to PBL principles is to start with the add-on strategy and then use the integration and rebuilding strategies, respectively. Change and transformation take time; however, no matter how long it may take, it is worth venturing on rebuilding the strategies for curriculum design, particularly when the conditions are ripe to do so.

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